Gallinazo Phase Migration in the Moche Valley, Peru

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ABSTRACT

BARKER FARISS: Gallinazo Phase Migration in the Moche Valley, Peru
(Under the direction of Brian R. Billman)

This dissertation project is focused on settlement patterns in the Moche Valley, on the North Coast of Peru, during the Gallinazo Phase of Early Intermediate Period (ca. 0-200 CE). Geographic Information Systems (GIS) technology, generalized logistic models (GLM) and Principal Components Analysis (PCA) are used to define architecture and spatial organization unique to nonlocal settlement. This research addresses broad theoretical concepts in anthropology like ethnicity and power, and examines methodological issues of investigating prehistoric culture contact and interaction. The concept of an ethnotone is reintroduced to replace the core/periphery model in a pluralistic society where there is no central place. Nonlocal architecture at a sample of sites is specifically described and settlement patterns are differentiated. The results provide further evidence that nonlocal Gallinazo Phase settlements in the Moche Valley are ethnic-highland. Contrary to conflict-centered theories about culture contact in the Andes, interaction between migrants and locals on the North Coast at this time was probably less violent than previously thought. Among other variables, this research establishes that building on hillsides was common, and communities tended to aggregate into clusters around elite compounds; yet, this pattern is not overtly defensive. Technological advancement in the form of expanding irrigation regimes lessened competition for resources, resulting in social complementarity rather than conflict.

For Lou Nell Falls

ACKNOWLEDGEMENTS

There are so many people I must recognize as instrumental in completion of my project. Without a doubt, I would not be here if it were not for the encouragement of Brian Billman, my dissertation advisor, colleague and friend. I would also like to thank everyone in my dissertation committee individually. Carole Crumley has been a mentor to me since my years as an undergraduate student at UNC in the 1990's. I always sought her approval and she helped me achieve a confidence in my ability that I will carry forward into my professional career. Scott Madry's assistance with GIS has been invaluable; and, his behind-the-scenes supervision of my project helped me find a path to completion. Steve Davis and Patricia McAnany provided me with some of the most thorough and insightful comments regarding the presentation of my research. My dissertation in its current form is in large part a result of the time and effort they put into thoughtfully reading multiple drafts of the manuscript. Thank you all very much.

There are no words to express my appreciation for the enduring encouragement and loving support I have received throughout this process from my wife of 15 years, Brandie. We met in high school and began building a life together more than two decades ago. We travelled the world and landed in Chapel Hill; now, we have returned to Oklahoma with our two beautiful boys. Things weren't always easy for us, but we persevered. To quote someone important to us, "What a long, strange trip it's been." Thanks for being my travel companion.

While I know you are too young to realize it now, Keller and Crosby, your presence in my life has inspired me to fight through disappointment and misfortune, and to continue working on this project even when it seemed hopelessly out of reach. To my mom, Dolores, you very much continue to be an inspiration to me; and your words of support have been essential every step of the way. To her husband Cecil, thanks for championing my project all these years as a priority, reminding me of its significance in the face of sobering life events. For over a decade, Brandie's parents Bob and Lisa Sullivan and her sister Jamie have maintained unwavering support; thank you. To my big sister Kristie, thanks for always being there. Dad, thanks for imparting nuggets of practical wisdom that continue to serve me well; such as, "excuses only sound good to those who make them" (so, let that be fair warning to my nascent graduate students). To my entire family, thank you so much for all you have done; and, thank you in advance for your patience, love and support in the years to come.

I have made so many friends and colleagues over the last decade; I should have started a master list. Many thanks to all of the people I have lived among and worked closely with in Peru since 2001. Gracias a Jesus Breceño, mis amigos de Ciudad de Dios y todos los trabajadores. Gracias a Jose y todo mi familia de Huanchaco. To my coworkers Jen, Daniel, Julio, Evan and Sara, among so many others over eight years, I will always appreciate your friendship. To those who paved the way, Chris, Jon, Celeste, Greg and Amber, thanks for your guidance. And Erik, no matter how much time passes, I know that we will always be able to reconnect and have lively discussion over a beer (or two, or three). Thanks comrade. I would also like to thank the Anthropology Department faculty; in particular, Charles Price for his friendship and advice. And lastly, to my life-long friends, Grant, Paul, Ross and Steve, who knew me before graduate school, thanks to you all for sticking around. Cheers.

PREFACE

As I write this preface, I have just returned from monitoring a seismographic survey in Oklahoma. I work for the Osage Nation now, and frequently find myself thinking about the role of archaeologists in today's society. As the wells are drilled and the pipelines are buried, everyone seems concerned about energy independence or environmental degradation; rarely does one hear elected officials or the public discuss protection of cultural resources. But, although few are talking about it, the good thing about the United States is that we have laws to protect cultural resources. What's more, the great thing about having laws in this country is that they are usually enforced. I find myself reading dozens of Section 106 notifications every day, monitoring construction in culturally sensitive areas and performing other duties.

Our office is also involved in community outreach and public education. Preserving cultural resources must go beyond enforcing the laws; it begins and ends with education. We must understand the past, and that is often the strength of research archaeology. We must protect the past, and that is the directive of cultural resource management (CRM). An important place where research archaeology and CRM meet is education. It is imperative that archaeologists work together to understand the past, preserve prehistoric material culture and educate the public. I have noticed in the last decade an increase in dialog about public education between research archaeologists and CRM professionals at conferences and in trade journals. We are moving in the right direction.

I was trained as an Andean archaeologist. This dissertation deals with prehistory on the North Coast of ancient Peru. While Peru has laws regarding the protection of cultural resources, they are almost never enforced. Around the world, in places like the Moche Valley, Peru, it has become the job of research archaeologists (often foreign) to manage the preservation of cultural resources. By saying this, I am not passing judgment; often these countries have far more important social issues to manage with limited financial resources. It seems ironic that many of the most significant prehistoric sites are situated in the poorest regions of the world. It is important for research archaeologists working in these regions to bring with their field school students, grant funding, and professional agendas a plan for preserving the cultural resources in unprotected areas.

For example, in 2007 I assisted Dr. Brian Billman with launching MOCHE, Inc. (Mobilizing Opportunity through Cultural Heritage Empowerment); a 501c3 nonprofit organization that partners with descendent communities in Peru to develop a stronger sense of connection with the past and provide resources for mutually agreed upon community development activities in return for help protecting endangered prehistoric sites. In addition to focusing my efforts on cultural resources of North America, I will continue to contribute to the protection of Peru's threatened cultural heritage and ecological resources. My future research will facilitate the goals of MOCHE by accurately characterizing the region's archaeological landscape and by highlighting the potential areas for community involvement. I will continue working with MOCHE in every way possible to provide opportunities for improved heritage protection and ecological preservation in the context of sustainable rural development.

I first traveled to Peru in 1997 to attend a three-month Spanish immersion course in Cuzco with my wife Brandie, a new graduate student in the Ecology Curriculum at UNC-Chapel Hill. We returned to Peru every summer over the next three years for her pre-dissertation fieldwork, until we moved to Peru in 2001 to conduct her field research. Brandie's dissertation focused on community and conservation dynamics in the Huascaran Biosphere Reserve and World Heritage Site, and for nearly two years we lived in a highland village called *Pashpa* located just over 10,000 feet above sea level [Figure F-1]. I helped conduct social surveys and followed herders around for weeks in participant observation.

Figure P1. Reflection of Huascaran in a tarn near Pashpa (photo credit: Brandie Fariss).

Years before moving to Peru, I worked with a linguistic anthropologist on a project with the Cherokee Nation in Tahlequah, Oklahoma and on multiple projects with human geographers and anthropologists at the Carolina Population Center in Chapel Hill, North Carolina. In the years working my way through college, I had multiple forays in and out the food service industry and almost opened a restaurant with a good friend of mine. At the last minute, I got cold feet and returned to anthropology at the Duke Primate Center in the Fossil Primate division. For two years, while at Duke, my interest in anthropology was solidified.

By the time I reached Peru, I had tried my hand at three of the four sub-disciplines of anthropology: linguistics, physical anthropology and cultural anthropology. I remember vividly the moment I decided to try archaeology. I was sitting on top of the roof at the Refugio, a Swiss chalet-style behemoth constructed at base camp *Ishinca* [Figure 1-2]. It was built by the Italian Catholic church in the 1980's, and is still administered by papal mandate. The Refugio is nestled between six of the most popular climbing peaks in the park, and situated next to a large emerald green glacial lake. It is a very popular destination for adventure tourists from around the world. Climbing was a passion of mine in those days, and still today, an ember burns inside me waiting for the opportunity to reignite.

Figure P2. The Refugio is located in the Ishinca Valley, Huascaran Biosphere Reserve.

Every week, I was charged with the task of hiking up to the Refugio, climbing atop the lodge and downloading weather station data. As I sat there that day waiting for the station to dump a week's worth of wind speed, precipitation and temperature data, I realized that her project would be coming to an end soon. I peered up at the peaks surrounding me and thought about learning to climb. My mind drifted from the Wichita Mountains in Oklahoma to the ranch in Paul's Valley where I spent many of my summers as a child. The ranch belonged to an old friend of the family, Charles Yarnell Pyle. His friends and family called him CY. Father of my dad's best friend, he became my "surrogate" grandfather, since my actual grandfathers passed away when I was very young. CY was a longhorn steer rancher by trade, but always wanted to be an archaeologist. Before the war, he had participated on excavations in Egypt and other parts of the world as a camp cook; and later in life returned to school to get a Master's degree in Anthropology, with a concentration in Archaeology.

We would often ride out on the prairie in his old F-150 to search for wayward young bulls, mend fences, drop feed and fill water tanks. Behind the bench seat, he kept a wooden box of prehistoric tools he'd found on his land. There were dozens of scrapers and a few projectile points. He had a coffee can full of heat-treated pink flakes fashioned from the local Florence-A chert and various other lithic materials. He even had some ceramic sherds, which are a pretty rare find on the ground surface in this part of the country. CY taught me about stratigraphy and seriation, and the law of superposition. He always gave me archaeological or anthropology-related gifts for Christmas and birthdays; such as a book of Catlin's paintings, or the Marshalltown I still use today. More than any other person, I can attribute my interest in prehistoric cultures and my early foundations in archaeological method to him.

While I sat there on the roof of the Refugio watching trekkers and climbers set up tents at the base camp below, I pondered self-imposed suffering and enhanced spirituality, I guess because climbing is that way. I remembered the famous painting of a Mandan Okipa Ceremony illustrated in that collection of paintings by Catlin that CY gave me. As the stream of consciousness guided me, I thought about Moche art and the graphic depictions of violence and sacrifice. I recalled that one semester at Chapel Hill as an undergraduate, a new professor in the Department, Brian Billman, talked in detail with me after class about his archaeological investigations on the North Coast of Peru, the *Moche Origins Project* (MOP). He suggested I come check it out once we moved to Peru. Then, with a beep, the weather station indicated it was finished uploading the data to my computer. I climbed down off the roof and hiked back to Pashpa.

Later that week, between buying provisions for the month ahead and planning the logistics of upcoming research efforts (not to mention showering and sleeping on an actual bed at a guest house in Huaraz) I found time to visit an internet café near the *Plaza de Armas*. I sent Brian an email about coming down to the coast and visiting the MOP study site, and asked about possibly staying for a little while. He responded later that week with an enthusiastic welcome and offered me a volunteer staff position on the field school.

About four weeks later, I found myself at the station in Huaraz about to board an overnight bus to Trujillo. I wasn't sure where the curvy descent from my home in the mountains would take me, both literally and figuratively. I walked across the platform and my gaze diverted through the gate at Mount Huascaran, the tallest mountain in Peru. It towers above Huaraz at more than 20,000 feet. It is only a few miles from Huaraz, and from just about anywhere in town you are provided with a magnificent view of the peak. I paused before stepping on to the bus as my mind's eye captured the image of its massive glacier and the magnificent colors of dusk. Dappled in pastel orange and pink light from the setting sun, it appeared as if the mountain was painted against a vanilla sky, on a canvas created just for me to behold in that instant. As an avid climber, the sight tugged at my heart, in all my years visiting and living there I had not attempted to climb Huascaran; and, while I have returned to Huaraz many times since that day, I still haven't climbed it. Perhaps, I will someday.

Upon arriving in Trujillo at 5 o'clock in the morning, I was weary and disoriented. It was dark and cold; but not a dry cold like the mountains, it was dank. The city seemed dingy. The buildings around the bus station looked the same as any other metropolitan area in Peru, cinderblock constructed flats, sandwiched together and stacked one on top of the other with rebar and cemented glass shards sticking out of the walls of the roof. Although I was new to this place, I was not new to this sort of place. I took a minute to gather myself and waited for the sun to rise before I found my way outside to negotiate an overpriced taxi ride to Huanchaco, the location of the MOP field house.

Huanchaco is only a short taxi ride away from the urban sprawl of Trujillo, but it feels like it is in a different world altogether. It is an ancient fishing village most recognized in tourism photographs by a type of reed boat called *Caballito de Tortora* that has been used by fishermen more or less in its original form for thousands of years [Figure F-3]. As I stood at the door of the field house I could smell the bouquet of brewed coffee and fried bacon, coupled with occasional whiffs of the salty ocean air. The field house is just a few hundred feet away from the beach. Bougainvilleas grow above the door and across the courtyard wall of the field house; which, now in retrospect, they add a floral layer to my olfactic reminiscence. Some say the sense of smell is most associated with memory. I have very pleasant memories of that morning. It was a new beginning for me.

Figure P3. Los c*aballitos* on the beach in Huanchaco.

I recall that a pair of doves cooed from within the dense bush above my head, their song a leggerio against the drone of nearby Pacific waves. Only slightly muffled by the thick wooden door, I could hear Billman's unmistakable laughter. I knew I had found the right house, but what's more, I knew I had found the right place. I knocked. Jennifer Ringberg opened the door and invited me inside. Brian greeted me on the open-air patio and informed me that the crew was leaving for the field in five minutes. He gave me the option to come along directly, or first get settled in and come along the following day. Being used to the impromptu nature of travel in Peru, I opted to tag along. Upon my decision to go with them, I was hurriedly led up three flights of stairs to the 'maid's quarters'. I can't remember now exactly why we call that room the maid’s quarters, I guess because it has a small water basin and brooms stored there. Although just big enough for an old worn out mattress thrown on the floor, it was obvious no one had actually lived in the tiny room for a very long time, if ever. Nevertheless, it was available floor space. I graciously nodded and I threw my duffle on the mattress. It landed with a thud and a cloud of dust floated across the beams of early morning sunlight. I turned to notice the view and took note of the pleasantries my rooftop accommodations afforded me. I returned downstairs and grabbed a cup of coffee to go. Before I knew it, we were speeding down the Pan American highway to the Moche Valley.

On route to the site, I got to know some of the crew. Jen, Jesus Briceño (the MOP co-director) and Brian led our car and the bus full of field school students through the Moche Valley to Cerro León. I was introduced to three graduate students at UNC working on the project that summer, Greg, Jon and Drew. Upon arrival, we filed out of the vehicles and chatted about logistics for a minute. We lathered on sunscreen and portioned out the gear for the short, but steep, hike up Cerro León to MV225. At the top, Jon and Greg began stringing out a new unit. Drew found a student volunteer to jockey the stadia rod while he ran the total station. Multiple groups of students gathered around scattered sorting boards, laughing and whispering and shouting all at the same time. Brian conferred with the site guard and local laborers about various things, including payday on Friday. Jen showed me her excavation unit first and I continued to work there with her for the next few days.

Throughout the week, Jen patiently described the whole process for me, everything from archaeological site designation to archaeological unit description, excavation level identification, to drawing planviews and profiles. She even briefly explained some theoretical perspectives on the bigger picture of what we were attempting to do. As a newbie, I spent much of my time on the sorting board, learning the material culture. Then, there was the paperwork, ah … the paperwork. Of course, Jen helped me with that too. I owe her one for introducing me to the MOP and field archaeology in general. Strike that. I owe her at least a case for everything she's done for me.

After my first week on the project, I knew that archaeology was what I wanted to do professionally. As I mentioned previously, at one time or another, I had worked in every other sub-field of anthropology. I felt like my exposure to so many different perspectives had molded my unique skill set. On my last night in Huanchaco, while on the roof watching the sun sink into the ocean and partaking in an adult beverage, Brian and I discussed graduate school and my future on the project.

Upon returning to Huaraz, I made the obligatory stop at an internet cafe. This time, instead of catching up on dozens of emails, I researched what I needed to do to apply to graduate school. As luck would have it, I managed to get a hold of a dog-eared and somewhat tattered copy of a GRE preparation workbook. I spent many nights in Pashpa that rainy season studying by lantern. Upon return to the States the following year, I began my graduate school career at UNC-Chapel Hill. I continued to work on the North Coast nearly every summer field season from 2003 to 2010. I look forward to returning soon for future projects. Now, more than a decade since I first traveled to Peru, I present this dissertation. I hope that it is interesting and informative.

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INTRODUCTION

> A significant issue for archaeology is the development and refinement of approaches for the study of culture change and persistence using material remains. This issue is especially pertinent to archaeologists undertaking culture contact research in pluralistic settings. How does one evaluate the magnitude, direction, and meaning of change that may result from encounters between diverse people in multi-ethnic communities?
>
> (Lightfoot et al. 1998:200)

In ancient Peru, during the Early Intermediate Period (ca. 300 BCE to 700 CE) a large influx of presumably ethnic-highland migrants moved into the Moche Valley of the Andean North Coast [Figure 1-1] and established multiple colonies among a local population. This dissertation investigates culture contact and interaction between nonlocal migrants and indigenous coastal groups living in the Moche Valley during the Gallinazo Phase of the Early Intermediate Period (EIP), roughly a 200-year interval between 0 and 200 CE. The principal objective of my investigation is to understand the nature of interaction between these distinct populations living in proximity at such a crucial time for socio-political development in the Moche Valley. In this dissertation, I address important questions about the nature of living in an ecologically constrained, pluralistic social environment, and speak to issues of conflict and complementarity among ethnically diverse populations. In order to do this, I have combined traditional archaeological methods of survey and excavation with the converging technologies of *archaeological geomatics* and *predictive modeling*. The former is defined here as tools, methods and theories from spatial sciences used in archaeological settings; the latter is defined here as an inductive process of determining the statistical magnitude of specific variables to calculate the probability of a general outcome.

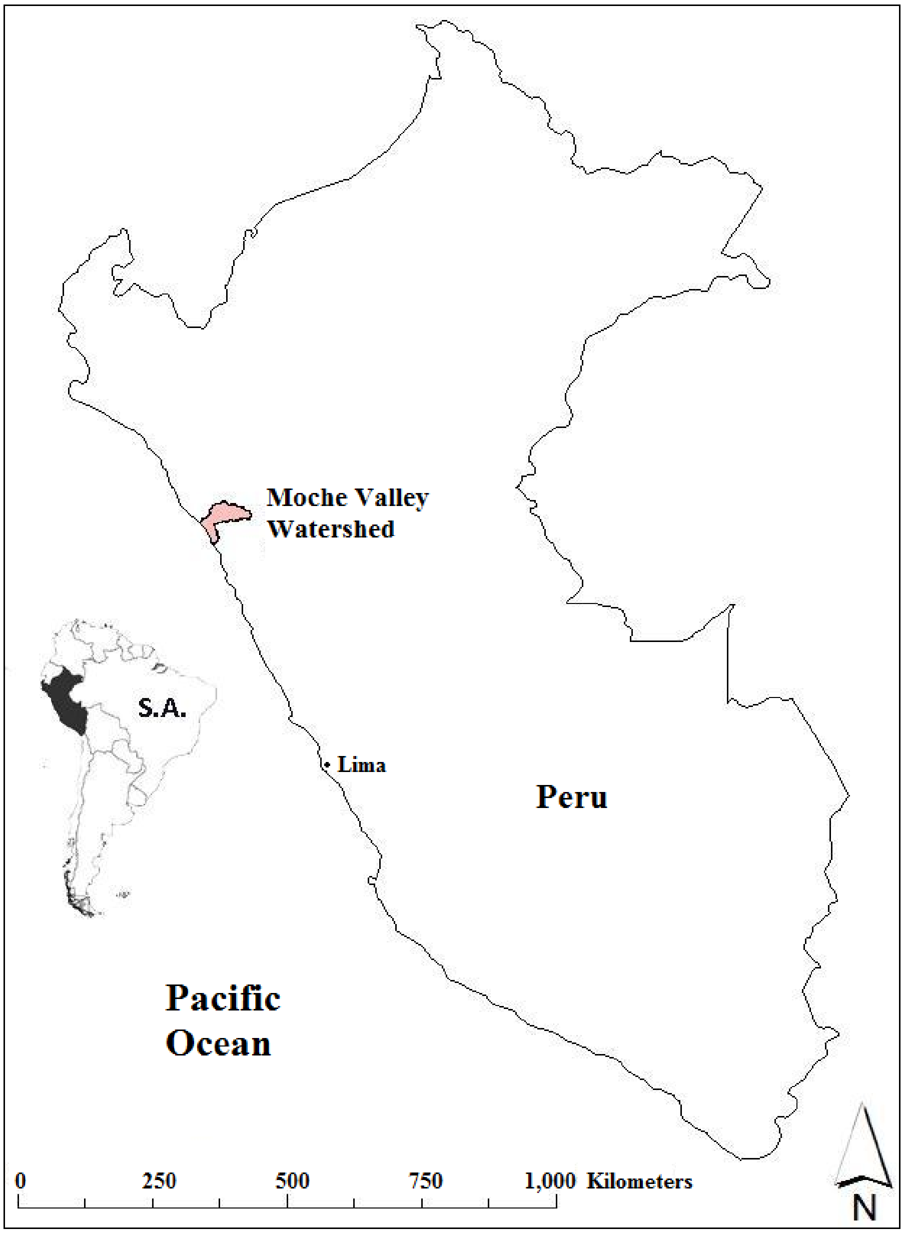


Figure 1-1. Moche River Valley, northern coastal Peru, South America.

One of the central ideas of my research is that ethnicity is reflected in the formation and maintenance of constructed environments. My hypothesis is that because vast quantities of nonlocal ceramics are prevalent in the Moche Valley only during the Gallinazo Phase of the EIP, if a site was not occupied previously (indicated by local components that predate the Gallinazo Phase), then I assume decisions about settlement location, spatial organization and architectural form were made by nonlocal migrants. As will be discussed later, there are many indications that nonlocal ceramics are highland in origin. I infer that the occupants of sites with nonlocal, presumably highland-style pottery, are also highland. This dissertation provides evidence for this inference and speculates on its implications for understanding culture contact and interaction between coastal and highland groups living in the Moche Valley during the Gallinazo Phase of the EIP.

Understanding diverse settlement decisions helps archaeologists disentangle issues of cultural contact in pluralistic social settings of the past. I use the term ethnicity, but it is burdened with self-referential meanings that are practically indecipherable by the outside analyst. We understand now that ethnic identity is borne out of specific social organization, not the vagueness of culture. Fredrik Barth's (1969) revolutionary conceptualization of ethnicity stresses a fluid, self-ascribed and dynamic identification of group membership. Barth (1969:9) finds "categorical ethnic distinctions do not depend on an absence of mobility, contact and information, but do entail social processes of exclusion and incorporation whereby discrete categories are maintained despite changing participation and membership in the course of individual life histories." In the same text, he further emphasizes that ethnic categories will persist even when individuals move to new areas and mix with members of other ethnic identities (Barth 1969). The premise of Barth's interpretation of ethnic identity is that it originates from the interplay of inclusion in one group and exclusion from another.

Further describing the breadth and progression of theory concerning the concept of ethnicity is out of the scope of this dissertation (for review, see Barth 1969a, 1969b, 1969c, 1989, 1994; Blu 1980; Boas, F. 1974 [1887] and 1974 [1905]; Brumfiel 1994; Childe 1933; Jones 1997; Lightfoot et al. 1998; Trigger 1989). Siân Jones's (1997:84) chapter on multidimensional ethnicity was particularly useful for contextualizing an analytical framework for using the concept of ethnicity in my research. However, I use the term ethnicity in this dissertation as a heuristic device to describe two groups of people: a nonlocal population, presumably from the highlands, and a local coastal population. I use two primary sources for my assumptions about nonlocal pottery in the Moche Valley during this time period: Brian Billman's 1996 dissertation and Jennifer Ringberg's 2012 dissertation. Billman (2002) states that the most surprising aspect of his 1990-1991 Moche Valley survey was the presence of so many distinctly highland-style ceramics at many sites in the middle valley. Jennifer Ringberg's (2012) dissertation results describe two possibilities for nonlocal ceramics. Either they were produced in the adjacent highlands (Otuzco Basin and Carabamba Plateau) and transported to the Moche Valley, or they were produced in the middle valley with highland clays and tempers (Ringberg 2012). Further bioarchaeological evidence is needed to support the idea that nonlocal ceramics indeed correspond to highland ethnicity. In a recent article for the *SAA Archaeological Record*, investigating the bioarchaeology of migration in southern Peru Tiffany Tung points out, "if the strontium isotope ration obtained from a skeleton is distinct from that of the local area, then the person is likely a foreigner (Tung 2012:43).

While I understand that “concepts of ethnicity and identity have replaced the colonial paradigm and propositions of ‘pots as people’ are considered fallacies” (Cruz 2011:336), “they [ceramics] are understood to be products of a particular socio-cultural milieu such that ceramic variation will correspond with cultural variation at some level” (Croucher 2006:107). In this way, I use ceramic type presence/absence data as a proxy measure for the presence or absence of nonlocal and local decision-makers influencing the materiality of daily life, such as the construction or placement of households.

In addition, there are other lines of evidence pointing toward highland ethnicity of populations occupying sites indicated by nonlocal ceramics and coastal ethnicity at sites with local ceramics. Some of these lines of evidence include burial patterns from excavated contexts. With some exceptions, flexed burials are typically a highland phenomenon, while extended burials were more common among coastal populations in the area (Donnan and Mackey 1978). Two other interesting highland burial patterns are the internment of bodies in the household, and the use of above ground cysts called *chulpas* (Hyslop 1977). Also, there have been multiple studies regarding the differentiation of highland and coastal foodways, feasting and agricultural production (see Gumerman 1997; Quilter and Stocker 1983; Billman 2002). Perhaps the most pertinent material evidence for differentiation between my study groups is the differences between highland and coastal architecture (see Chicoine 2006; Moore 1992; Moseley and Mackey 1972; Sasser 1969). The chronology of sites occupied during the Gallinazo Phase of the EIP is less clear. It is difficult to order sites in prehistory occurring in such a short interval, which in this case is approximately 200 years. Even with the use of radiocarbon dating, the temporal component of site identification is often fuzzy. In the next chapter, I describe some of the lines of evidence I used for establishing a chronology. Excavated contexts from sites in the Moche and other neighboring valleys are used to seriate ceramic styles.

There is some agreement among scholars that the "origin myth" is the strongest bond between members of an ethnic group (see Anderson 1983, 2006; Nash 1996; Smith 1996), an aspect of culture pointed out long ago by Max Weber in his treatise *Economy and Society*, posthumously published in 1921 (Roth and Wittich 1978). Belief in a common origin is perhaps a prerequisite for defining the traditional “ethnic” group, while other aspects of culture like religion and language, which are important to determining the boundaries between ethnic categories (Jenkins 1994), remain negotiable (Barth 1969; Cornell 1996; and Conversi 1999). If the temporal and spatial dimensions of origin can be considered negotiable variables for ethnic groups, one should consider that the temporal dimension of origin is an abstract concept, while the spatial dimension can be visualized and identified. The spatial dimension of ethnicity is more readily perceived by members of a group.

This perceived spatial connection might be described as an *ethnoscape* (Appadurai 1996). An ethnoscape can be thought of as the territorialization of ethnic memory; in other words, it is the belief in a common spatial origin shared by members of a group (Smith 2002). The collective understanding of spatial origin allows people to move into other geographic space, but maintain their common ethnic identity. In this way, ethnoscapes produce space (Lefebvre 1991). Yet, social constructs of space and time are vulnerable to reorganization and modification. As landscapes change through time, so too will ethnoscapes.

In a broad anthropological sense, my research is focused on the significance of spatial memory in society. There exists a space between ethnoscapes, and I refer to this space as the *ethnotone*. The concept of an ethnotone has recently been used by Gunya (2004) to describe a wide zone of cohabitation in the Northern Caucasus, where contemporary ethnic groups coexist in a relatively conflict-free, resource-rich area. The notion of an ethnotone was first introduced to the archaeological community by Kennedy (1986:192) to replace the concept of core/periphery in intermediate areas of Maya society. Yet, over the years, the term periphery has seemingly won out because it does not prejudge the nature of the contents involved and allows for a variety of different interactions (Urban and Shortman 1986). However, I intend to reintroduce the concept of the ethnotone in this dissertation. In the middle Moche Valley during the Gallinazo Phase of the EIP, there are no clear "cores"; furthermore, I am discussing the place—both physical and liminal—where peripheries mix.

Like an ecotone, the zone of transition between ecologically distinct communities, an ethnotone represents the zone of transition between ethnically diverse communities. Between two biomes there are often hybrid biological species, in an ethnotone we might find material remnants of pluralistic society that are unique, indicating that social or political systems in this zone may have been somewhat different than those of adjacent communities. Unlike an ecotone, an ethnotone is not defined by environmental factors; rather, it is defined by spatial memory and sense of place. An ethnotone defines the space where pluralistic social interaction is most complex.

Prehistoric ethnotones are visible archaeologically by heterogeneous material culture located in a geographic space that is bounded by homogenous, and distinctly different, material culture on either side. Discrete variation in settlement decisions is also an indicator for the presence of an ethnotone. In culture contact scenarios whereby trade between two groups is clearly established, an ethnotone may not be represented in the archaeological record. In the Moche Valley, there is no evidence for widespread trade between coastal and highland groups prior to the Gallinazo Phase of the EIP. The presence of nonlocal highland-style pottery at domestic sites intermixed with households indicated by local ceramic traditions, implies the presence of an ethnotone rather than an extensive trade network.

An ethnotone is a zone of transition where ethnoscapes overlap. Mixing of culture in the ethnotone requires a certain level of complementarity. On political borders, the relationship between groups is often contentious. Lines in the sand precipitate conflict. It appears from my research that the interaction between nonlocal and local populations may have been more complementary than otherwise expected. For this reason, I find shortcomings in more common terms like “frontier”, “hinterland” and “no-man’s land”. These terms are fraught with conceptual pitfalls; but more importantly, none of them adequately describe the place of interest in my study. Again, this dissertation is not intended to be a forum on the debate of such terms, and perhaps the term ethnotone will not be accepted by the archaeological community. Nevertheless, the term conveys my concept for the zone of transition between ethnoscapes.

The Spatial Signature of Nonlocal Settlement

I based my assumptions about site type and occupation duration on surface-collected ceramics and visible architecture. Billman (1996) used three lines of evidence to date the nonlocal ceramic assemblage from the middle Moche Valley: ceramic studies from the Virú Valley (Bennett 1950; Ford and Willey 1949; Strong and Evan 1952); Theresa and John Topic's analysis of ceramics from highland areas adjacent to the Moche Valley (Topic and Topic 1982); and, his own analysis of coastal ceramics associated with highland ceramics on sites in the middle valley. All three of these independent lines of evidence indicated a

Gallinazo Phase through Early Moche Phase date for the ceramic types identified in this dissertation as nonlocal. Using this ceramic evidence, the response variable of my model dichotomizes the occupants of each site as either 'nonlocal' or 'local' where:

$$Y_i = \begin{cases} 1, & \text{if site i is nonlocal based on diagnostic ceramics} \\ 0, & \text{otherwise} \end{cases}.$$

I assume that $Y_i \sim \text{Binomial}(1,\ p_i)$, thus I develop a logistic model of occupation where the probability of nonlocal occupation at a particular site = p_i is based on the presence or absence of nonlocal ceramics found at surveyed sites (N = 437). I reduce the dataset to include only EIP sites (N = 284). Each site includes 26 fields of information. With that magnitude of data, I am able to approach the total settlement survey from multiple theoretical positions. In addition, with the MOP-GIS, the data is evaluated at many different scales of analysis. The highland settlement dataset is sometimes analyzed as a whole, but for most analyses samples are used.

If a site has only nonlocal components present it is considered to have been occupied by nonlocal residents. If only local components are present on a site, it is deemed local in origin. For this analysis, multi-component sites with nonlocal ceramics are considered nonlocal during the occupational period of interest. Multi-component sites were often excluded from analyses because archaeological interpretation of occupational history is difficult with surface collections alone. In these cases, I analyzed only the single-component sites from the Gallinazo Phase (N = 70). Interestingly, in this sample only 11 are local, while 59 are nonlocal. That translates to 84% of all single-component sites occupied during the Gallinazo

Phase of the EIP are nonlocal. The other interesting statistic regarding nonlocal occupation is that out of 114 total sites with a nonlocal component, 59 of them are single-component (slightly more than half). These general descriptive statistics are interesting because they allude to the foundation of my hypothesis that the migratory landscape was unique and constitutes an ethnotone. Perhaps some might think it is a distinction without difference. But, spatial analysis of settlement data in the Moche Valley indicates that there was an area of transition between nonlocal and local occupations. As ecotones shift with climate change, ethnotones change with the political climate. Once a critical mass of migrants was reached, contact with local groups produced a modified social environment.

Preliminary spatial analysis of the Moche Valley settlement survey data indicate that due to the varying size, location and defensive nature of sites, nonlocal leaders strove to control important corridors through the upper and middle Moche Valley and gain easy access to the neighboring Virú Valley. Billman (1996) constructed a conquest model to define the observed settlement pattern. In his model, nonlocal migrants had an economic incentive to stay in productive settlement locations and maintain strategic access to their homeland. Billman (1996) also finds that there existed three principal highland colonies in the middle valley, with elite families that lived in stylistically distinct residences nestled within exclusive compounds, further contained within sprawling, aggregated settlements. He cites defense as the primary reason for the observed spatial organization of elite compounds and settlement pattern of constituent clusters (Billman 1996).

In Billman's conquest model, economic and political hegemony over a region such as the Moche Valley would have been comprised of functionally interrelated systems (Sahlins 1970), possibly controlled by the use of legitimized force (Service 1962). Over the great span of time, his model accurately characterizes socio-political evolution in the region. Certainly in the centuries that followed the Gallinazo Phase of the EIP, successive Moche, Chimú and Inca rulers conquered large tracts of territory on the North Coast and maintained control in this way. In fact, Earle (1994:444) writes that the Inca "created mechanisms to exert and legitimize force over a world that had been composed of many separate polities, economies, and ethnic identities." There is no doubt that conflict-centered theories have provided countless researchers with a powerful lens through which to visualize settlement patterns across the Andean landscape.

Billman (1996) also accentuates the possibility that tension may have existed between highland elites, as well as between nonlocal and local communities. It is possible that the seemingly defensive characteristics observed at elite compounds (discussed in Chapter 4) might have been in place due to competition among nonlocal migrants. As migrations increased, more people were forced to settle on marginalized landscapes and attempt to make a living on less favorable land. Such a demographic transition may have given rise to conflict among nonlocal leaders. At this time, coastal populations withdrew further down valley and thereby represented a lessened threat. Without discounting the role that tension between nonlocal leaders played in migrant settlement decisions of the Gallinazo Phase, the most surprising result of my research is that violent conflict may have in fact declined for a brief period of time in the Moche Valley.

My analysis leads me to believe that what appears at first glance to be an inclination toward overtly defensive settlement decisions is more likely to have been a result of household social reproduction, particularly among the elite leaders around whom nonlocal migrants congregated. Because "material investment in dwellings is often aimed at crossgenerational socioeconomic stability" (Gijseghem 2001:13), decisions concerning spatial organization of highland settlements were probably driven by "the various strategies that household heads utilize[d] to achieve and maintain desired social statuses for themselves and their offspring" (Blanton 1994:19). For families migrating into a new and unpredictable natural environment, establishing and maintaining viable homesteads would have been crucial to insuring the reproductive success of their households. As a result, highland migrant settlement patterns may have been driven as much by a desire to maximize productivity and mitigate environmental risk as decisions borne out of fear from attack by coastal indigenous populations, or inter-ethnic conflict for that matter.

In contrast to nonlocal incursions, the subsequent rise of the Southern Moche polity in some ways begot a more violent era on the North Coast. This claim is substantiated by conquest during Moche expansion. While most Andean scholars would argue that the North Coast was relatively peaceful when consolidated under the Southern Moche polity, there remain depictions of violent conflict in the iconography of Moche material culture and friezes of human sacrifice at the height of their power. There are also substantial bioarchaeological indices of violence from human sacrifice found on the skeletal remains excavated from the site of Moche (Verano 2000). In addition, by the later Moche phases, widespread political reorganization led to construction of heavily fortified settlements. For a complete review of Moche warfare, see Alva and Donnan (1993) and Bawden (1996).

Preceding the Gallinazo Phase of the EIP, evidence from the Salinar Phase (ca. 400 BCE to the beginning of Common Era) shows a high degree of violence from raiding (Brennan 1980, 1982). Because violent conquest and sacrificial practices are prevalent in the subsequent Moche Phase (ca. 200-800 CE) as well, one might assume that during the interval of nonlocal migration in the valley, a history of violence and the threat of warfare were primary reasons that migrants built their houses on steep slopes in isolated and clustered settlements. However, my research indicates that there are a number of statistically significant explanations to the contrary. It appears interaction between migrants and indigenous groups in the Moche Valley during the EIP may have been less bellicose than previously thought. In fact, it is possible that there was a considerable reduction in hostile interactions during the Gallinazo Phase. Because irrigation networks continued to expand at this time, El Niño Southern Oscillation (ENSO) events probably resulted in relatively diminutive disruptions to agricultural production, thereby lessening population pressure on available resources and reducing competition. Although many of the sites in the valley that were occupied during this period have fortified attributes, my dissertation provides the basis for an argument that while migrants were no doubt conscious of the potential for conflict with indigenous populations, ostensibly it was not the over-arching theme of their daily lives. There is something quotidian represented in nonlocal architecture and settlement decisions, and my dissertation seeks to provide evidence that something is highland in nature.

Research Objectives

Populations with different ethnic identities have interacted in pluralistic social settings and landscapes throughout human history. Sometimes the mélange is a gradual process, a slow matriculation of unfamiliar people and alien customs assimilated cooperatively through social arrangements such as marriage. But often the process is abrupt, with a series of raids or larger-scale conflicts, followed by the occupation of one's homeland by the "other." Each manner of cross-cultural contact has broad implications for the trajectory of social and political development within any given society and those that will follow (Willey 1953).

Conflict, as a reality in the daily lives of people that once lived on the North Coast, is readily apparent in the architecture and settlement patterns throughout the study region. For example, large defensive walls and the aggregation of households suggest that nonlocal migrants and their coastal counterparts were at the very least *preparing* for violent conflict, if not actively engaged in it. The appearance of highland plainware at so many sites in the valley might suggest an increased presence of highland settlement by the Gallinazo Phase of the EIP. One may infer from the later disappearance of those same domestic ceramics that highlanders abandoned settlements in the Moche Valley before the Middle Moche Phase (ca. 400 CE). The nature of interaction between highland and coastal groups can be elucidated by identifying less obvious traces of migration, settlement decisions, and interaction in architecture and spatial organization. My research characterizes foreign settlements of the Gallinazo and Early Moche Phases as potentially highland in origin, and then identifies aspects of highland ethnicity in constructed environments. At the very least, this research offers insights into the nature of interaction between nonlocal and local populations on the North Coast during the EIP at a crucial time for socio-political development in the region.

My principal modeling effort is aimed at predicting the likelihood of nonlocal influence at sites in the Moche Valley. Those sites are analyzed with an eye toward intention of design and function. I further examine connections between migration into the valley and the trajectory of social and political development in the region. My dissertation is centered on two major research questions:

1. What is the ‘signature’ of migratory settlements in the Moche Valley during the Early Intermediate Period?

2. What was the nature of interaction between nonlocal and local groups that occupied the Moche Valley during that time period?

My research relies heavily on spatial analysis, with GIS and statistical modeling using generalized logistical regression and cluster analysis (primarily Principal Components Analysis). I used traditional archeological survey methods and analysis to collect data used in my spatial and statistical models. Spatial analysis in my dissertation is conducted with *ESRI’s ArcGIS*. The statistics run on the *R* programming language platform, with scripts adapted from the *Comprehensive R Archive Network* (CRAN) to conduct analyses. My goal is to describe the architecture, explore site spatial organization and settlement patterns.

From 1990 to 1991 Brian Billman conducted a systematic pedestrian survey of the middle Moche Valley, from which he was able to reconstruct a sequence of political development from the formation of the first autonomous village in the Late Preceramic Period (2500-1800 BCE) to the zenith of the Southern Moche polity (ca. 400 to 750 CE) (Billman 1996). My own research focuses more acutely on settlement in the valley during the EIP, and delves further into issues surrounding contact between ethnically distinct cultures. The principal objectives of my research are:

1. To quantify the aspects of architecture, spatial organization and settlement pattern unique to settlements containing nonlocal ceramic components.

2. To address issues of contact between nonlocal and local groups, as well as the nature of interaction between migrant groups.

3. To make preliminary inferences about the influence of nonlocal groups.

Dissertation Outline

Chapter 2 briefly discusses the Moche Valley physical environment, with a thorough discussion of El Niño Southern Oscillation (ENSO) and its potential effects on prehistoric society. The chapter concludes with a general, but detailed, overview of the North Coast prehistoric cultural chronology. Chapter 3 provides the backdrop for my research design by describing a history of settlement pattern studies in archaeology. The chapter closes with a brief history of GIS and description geospatial models. Chapter 4 details nonlocal architecture and settlement patterns. In this chapter, I detail architectural forms, construction techniques, as well as individual site organization and settlement orientation across the landscape. I define the characteristics for elite and common households, and provide a description of my interpretation of public, private, and semi-private space. Chapter 5 presents the results of spatial analysis and generalized logistic modeling to predict for attributes of nonlocal ethnicity. Chapter 6 delves into the 'archaeology of space' by analyzing interdependence in nonlocal settlement. I employ clustering and ordination techniques to analyze the nonlocal settlement pattern. The final chapter concludes with a brief summary of the project and my interpretation of the results. Chapter 7 closes with a concise plan for future research.

CHAPTER 2

THE MOCHE VALLEY

> THE CORRELATION of culture sequences provides the basic framework of archaeology, the essential understructure of any interpretations which may follow.
>
> I can only end on the hope that whoever undertakes the next such task of correlations will draw upon much new evidence from many places.
>
> (Willey 1958:353-372)

The Moche Valley watershed is drained by three rivers from the Peruvian Andes: the Moche, Sinsicap and Cuesta. The floodplain naturally supports confined riparian vegetation catchments, which have been substantially extended by a large network of canals. The valley floor is a vast network of dry channels filled with alluvial sediments and dispersed river cobbles. Such extreme geophysical characteristics, in addition to the hyper-aridity of the region, create a challenging environment in which to make a living [Figure 2-1]. However, the same ecological and geophysical characteristics that make the environment rugged lend themselves to the excellent conditions for preservation of archaeological material in the region. If it weren't for rampant looting, going all the way back to Spanish colonization, the archaeological landscape would be exceptional.

Figure 2-1. View of the middle Moche Valley from MV225 on Cerro León. There is a clear distinction between arable land and desert, which obviates the irrigation network. Center and right, architecture from MV223, an early Moche settlement, is visible.

North Coast climate is constant aside from oscillations associated with periodic El Niño events, but the greater Andean environment is characterized by variability. John Murra (1970) coined the term “vertical archipelago”, or verticality, to describe the importance of this factor in shaping the economic and settlement patterns that emerged in the Andes. The Moche Valley has exclusive resources available at specific elevations. From the coastal fishing village of Huanchaco to the pastures of Señal Cerro Tuanga, it rises more than 4,000 meters in less than 60 kilometers, as shown below in a 3d model of the entire Moche Valley watershed [Figure 2-2]. Because archaeologists deal with ancient infrastructure and networks, verticality as a model provides a viable economic perspective on prehistoric settlement decisions and interactions between highland and coastal populations. Throughout the Andean region, exchange of animal products for lowland crops is a well-known strategy for mitigating the effects of unpredictable agricultural yields at high elevations (Julien 1985:196).

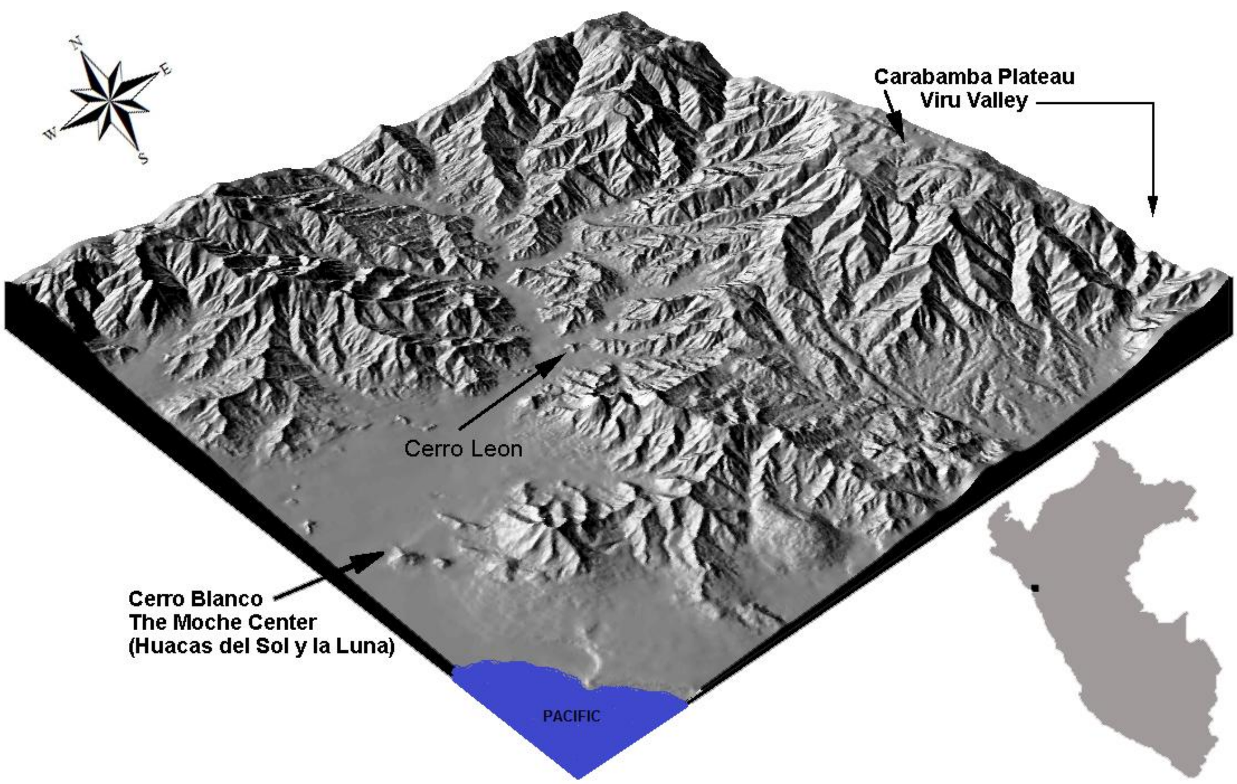


Figure 2-2. Hillshade 3d relief of the Moche Valley watershed Digital Elevation Model (30m resolution) indicating important locations discussed in the text. In this figure, one can easily make out the extreme verticality of the region.

The Southern Oscillation

El Niño, referring to the baby Jesus, was the term first used in the late nineteenth century by Peruvian fishermen to describe a mysterious episodic phenomenon that developed during the austral summer, often around Christmas. Today, we use the term to describe the 'warm' phase of a naturally occurring sea surface temperature oscillation, also known as El Niño Southern Oscillation, or ENSO. Dramatic El Niño events often create a near complete reversal in the Andean climate, not only in terms of sea surface temperature on the coast, but also sea level, which in turn results in changes to relative humidity, air pressure and wind velocity across the entire Andean region. The Southern Oscillation anomaly has an opposite phenomenon, called La Niña Southern Oscillation (LNSO); it is a 'cooling' of sea surface temperature. Whereas ENSO warming might generate extreme flooding, drawn-out LNSO events can cause extreme drought.

Weather patterns around the world are impacted by these periodic oscillations, but Andean South America is particularly vulnerable to climate change due to the fragility of ecosystems on the coast and in the highlands. During severe events, the coastal desert is inundated with heavy rainfall that can cause flash flooding, washing away topsoil, disrupting irrigation regimes and devastating entire crops. During severe events in the highlands, these same storms will saturate pastures, creating unfavorable conditions for herding and rot tuber crops such as potatoes. Under normal circumstances, the mean annual precipitation is sustained on the coast in large part by *la garúa* (the daily fog); and, what precipitation there is constitutes about 5mm of accumulation in lower elevations, to around 30mm near the Andean foothills (Barrena 1994). Although it is difficult to precisely determine the extent of damage from ENSO flooding on pre-historic societies, many archaeologists agree that it was an important episodic event that certainly had consequences for Andean populations making a living in their constricted ecosystems and constructed environments (Billman 1996; Moseley 1987, 1999; Shimada et al. 1991; Wells and Noller 1999). Populations living along the coast were also affected by mild climatic shifts, as any shift in sea temperature would have been significant with regard to maritime resources. As the abundant cold-water aquatic species abandon areas when even the slightest warm current moves in, warm-water fishes colonize the niche. However, this biological turn-over takes a relatively long time, and the process of populating the seas with new aquatic species rarely reaches an equivalent level before cooling begins again.

Often, sea surface temperature will change so suddenly that fish are trapped and beaches become littered with thousands of carcasses. Beyond the economic ramifications of such a mass fish kill, one can imagine that the phenomenon might have dramatic ideological consequences for prehistoric coastal populations, particularly if it were to reoccur generation after generation. Even during mild ENSO events, prevailing winds shift and change sea surface currents, which make *Caballitos de Totora* (reed constructed, single-person fishing vessels still used today) more difficult and dangerous to operate. In addition to all of these macro-environmental effects, there may have been other micro-ecological changes, such as a rise in plant fungus or agricultural pests. Influences of both mild and severe ENSO events are detected at all levels of the ecosystem. Past ENSO events, big and small, are recorded in the geologic record. There is no reason to assume that they were not as significant to Andean society and the ecosystem fifteen hundred years ago as they are to the Peruvian environments today. ENSO events can be tremendously significant for understanding prehistoric population/environment interaction.

El Niño is an extreme climate perturbation that periodically changes weather throughout the globe, often with dire consequences. Because it was first recognized in Peru, prehistoric and proto-historic El Niño events are well documented (Sandweiss and Quilter 2009). Aside from major climatic shifts associated with ENSO events, the North Coast climate is considerably constant and generally predictable. It is arid and warm, due to the rain-shadow effect of the Andes and proximity to the equator, respectively. Coastal peoples most likely adapted to ENSO events by anticipating the phenomenon through individual life histories (Roff 1992; Smith and Winterhalder 1992; Stearns 1992; Van Groenendael et al. 1994), and contingent cultural memory and group knowledge (Rappaport 1968; Vayda 1977). For example, fishermen probably noticed, as they do today, that warm-water species started showing up in their nets, which would indicate the beginning of an ENSO event. What they could not have known is the severity of the oscillation and its consequences.

Edward Lorenz, the meteorologist credited with ‘discovering’ chaos in 1960 and pioneering chaos theory while working on the problem of weather prediction, found that it is impossible to predict the weather accurately due to sensitive dependence on initial conditions, what became known as the *butterfly effect* (Lorenz 1963). Following the logic of chaos theory, the severity of any Southern Oscillation event was probably no more predictable a thousand years ago than it is today. As a result, prehistoric spatial patterns should be more apparent in relation to severe events, assuming that the cumulative effect of a severe event would have overwhelmed settlements. If prehistoric people indeed predicted the phenomenon and successfully mitigated risk to relatively diminutive events, changes in settlement pattern would not be visible in the archaeological record. Granted, while the true nature of human reaction to such events is not readily apparent in the archaeological record, the environmental disturbance itself is visible in the formation processes of alluvial deposition within cultural contexts. By dating large deposits from a random sample of sites on the North Coast, then cross-checking the dates with geologic records of significant events and comparing them to the cultural chronology, the examination of past weather events can yield new insight into settlement patterns during the Salinar-Gallinazo transition. For example, Huckleberry and Billman (2002) illustrate that the demonstratively increasing frequency of ENSO events at the beginning of the EIP influenced the settlement pattern at that time in the Moche Valley. The photograph below shows the destructive force of ENSO-related flash floods [Figure 2-3].

Figure 2-3. In the foreground, a very deep El Niño cut is visible in the upper Moche Valley.

After approximately 400 BCE, Billman (1996) cites evidence for increasing conflict in the Moche Valley; and, by the latter half of the Salinar Phase, population aggregation accelerated within large coastal communities. According to Billman (1996), evidence for warfare peaks at the beginning of the Gallinazo Phase, evidenced by further settlement aggregation on steeper hills with increased fortifications. Billman suggests a model wherein the perceived threat of conflict is more a product of competition among elites than from population pressure and political economies becoming more complex during the EIP (Billman 1996, 2002).

Huckleberry and Billman (2002) present evidence of paleoflood events and severe droughts in the Moche Valley. Their research is based on a radiocarbon-dated sequence of flood and debris flow deposits at Quebrada de los Chinos, an ephemeral tributary of the Moche River. The sequence includes 11 large floods dated between 500 BCE and 700 CE, with six dated between 300 BCE and 200 CE. Huckleberry and Billman (2002) infer from alluvial stratigraphy in the valley that there was an increased frequency of strong El Niño events, followed by prolonged droughts, further suggesting that increased environmental variability occurred during an apparent rise in defensive architecture and settlement patterns. However, Billman (1997) rejects population-oriented theories (e.g., Carneiro 1972; Rappaport 1968) for explaining conflict at this time because irrigated arable land was not scarce during the Gallinazo Phase.

Integrated food procurement strategies, fluctuating between fishing and agriculture, contributed greatly to the rise of sociopolitical complexity as early as 4,700 years ago (Shady et al. 2010). During this time, severe weather events associated with El Niño may have had repercussions on society that helped shape Andean cultural prehistory on the North Coast (Moseley 1992; Sandweiss et al. 2001). The Southern Oscillation changed considerably throughout the Holocene, generally increasing in strength and frequency (Quinn et al. 1987; Enfield 1989; Rodbell et al. 1999). Periods of sudden and dramatic climate change may have been correlated with periods of rapid cultural change. Political reorganization may have been connected to the increased frequency of El Niño, which generated environmental uncertainty, thus catalyzing the formation of trade and political alliances to offset losses, perhaps even causing engagement in warfare when other mitigating contingencies failed (Sandweiss et al. 2001).

For example, glacial ice-core analysis from the Quelccaya Ice Cap in southern Peru indicated several periods of extremely low precipitation as a result of LNSO: 540-610 CE, 650 -730 CE, and 1720- 1860, while periods of high precipitation are documented at 760-1040 and 1500- 1720 (Thompson et al. 1985). A severe drought is thought to have begun abruptly in 562 CE and lasted until nearly the end of the century (Shimada et al. 1991). It is staggering to imagine a 35-year drought from the perspective of the household-level smallholder, not to mention the broader political turmoil it would have caused. Famine would without a doubt have ensued from a generation-long drought in a society dependent on irrigated agriculture. Some have gone so far as to say that there is a direct link between severe Southern Oscillation events and the collapse of Moche society (Shimada et al. 1991; Fagan 1999). What is equally important, and specifically relevant to my research, is that there are tangible geoarchaeological and paleoflood data suggesting that frequent El Niño events may have contributed to the political consolidation of ethnic coastal culture during the

Gallinazo Phase of the EIP, leading to the rise of the Southern Moche polity (Huckleberry and Billman 2002).

Huckleberry and Billman (2002) consider the paleoflood record proxy evidence for ENSO-related flooding of the Moche River. By comparing their paleoflood evidence with records of historic El Niño events in the 20th century, they extrapolate that increased flooding during the EIP represents episodic instability at a time when subsistence strategies of both marine resources and irrigated agriculture were particularly vulnerable to severe weather events caused by ENSO (Huckleberry and Billman 2002). If historic analogs are valid, and flood records at their study site and Moche River coincide, then floodplain dynamics and irrigation disruptions would have been at their highest during a 500-year interval between 300 BCE and 200 BCE, coincidentally (or perhaps not so coincidentally) the period for which material evidence indicates migrations to coastal valleys were at their highest (Huckleberry and Billman 2002).

Increased strength and frequency of flooding on the coast often translates to an increase in sustained drought across large areas of the highlands. Highland groups engaged in herding may have experienced food stress during this time as pastures respond to changing weather patterns and the reduction of easterly maritime Trade Winds (Waylen and Caviedes 1986). Slight changes in environmental conditions would have affected rain-fed agricultural systems of the highlands as well, making many agro-pastoral communities particularly vulnerable to disruptions, thereby prompting raids on communities at lower elevations.

There is strong evidence to support that increased frequency and severity of flooding would have directly impacted early agricultural systems of the Guañape Phase (ca. 1800 BCE to 1000 BCE), and perhaps even during the Early Salinar Phase of the EIP (Huckleberry and Billman 2002). Population pressure could have been a problem because areas under cultivation during the early stages of irrigation expansion were by-and-large adjacent to the river and primarily located in the middle valley, an area seemingly most susceptible to El Niño damage. However, Billman (1996) rejected population-oriented theories for explaining warfare during the Late Salinar and Gallinazo Phases of the EIP because the two most critical resources—arable land and irrigation water—were *not* in short supply; thus, population pressure on those resources would have been negligible. It is also a possibility that an increase in population could have increased the available labor pool with which to repair damage caused by catastrophic flooding. Instead, Billman (1996) favors a model whereby conflict was a result of competition between emerging elites. Nonetheless, both interpretations of culture contact are conflict-centered and derived from the position that a series of disruptive Southern Oscillation events beginning around 300 BCE may have led to hostile highland/coastal interaction in the Moche Valley leading up to the Gallinazo Phase.

The results of my research call into question conflict-centered theories about interactions between nonlocal migrant groups and indigenous communities living on the North Coast. While I believe ENSO events probably played a significant role in providing an impetus for population movements and infrastructure reorganization, the data do not currently exist to substantiate that assertion. While it is not known precisely why large volumes of highland pottery appear on the coast at this time, we might assume from Salinar Phase settlement patterns that if highlanders did migrate to the area because of environmental stress, early interactions between populations may have tended toward violence. Following this logic, it is valid to assume that tensions would have continued to run high into the Gallinazo Phase.

My research provides compelling evidence to the contrary. As I mentioned previously, relationships between the populations of interest in my study were probably less bellicose than previously thought. Settlement patterns of nonlocal migrants in the Moche Valley during the EIP are a result of clustering that occurred around status-striving elites filling open niches created by an expanding irrigation network. Elite households and their followers made a living in spite of environmental uncertainty, resulting from ENSO and LNSO weather events, or other natural disasters common to the region, like earthquakes.

North Coast Culture Chronology

The North Coast of Peru has a long and complicated cultural history [Table 1]. More than ten thousand years ago, the gradual process of adaptive dispersal guided archaic populations to settle ecological niches constrained by the extreme verticality of the Andes. By the Initial Period (after about 2000 BCE), different populations became firmly entrenched in their respective subsistence patterns. The end of the Preceramic Period, and subsequent onset of the Initial Period, is indicated by the production of pottery. With the introduction of stylized ceramic technology, stylistic distinctions serve as important markers in the region's archeological record [Figure 2-4]. Although not separated by great distances or physical barriers, materials used for production of ceramics and decoration styles were different. Groups creating unique ceramics developed distinct culture histories. We as archaeologists use artifacts, including ceramics, to identify groups and order their existence chronologically.

Figure 2-4. Sherds from storage vessels with roughly the same rim diameter, the nonlocal (presumably highland) example is on the left; the coastal example is pictured on the right.

Among the earliest records of the peopling of South America is an archaeological site at Tacahuay on the southern coast of Peru. The site dates to around 10,500 BCE and contains some of the earliest evidence of maritime-based economic activity in the New World (Keefer et al. 1998). To the north, between 9,000 and 7,000 BCE, Paijan culture represents one of the earliest and most significant human populations in the region, identified by the Paijan Point. The bifacial point is distinctively long, usually between 10cm and 20cm, and fashioned with a small tang on the hatch.

Paijan site selection indicates a propensity toward localization in resource rich and ecologically diversified environments. It is in such settings that "localization was associated with the exploitation of small, highly productive and compressed micro-environments (i.e., Pacific littoral, arid coastal plains, river bottoms, vegetated hillslopes), all within a one to three hour walk of centrally located campsites" (Dillehay 1999:211). Dillehay (1998) also finds that it is the appearance of increasingly localized and aggregated, but not necessarily larger, social systems in this kind of ecological setting that may have been the most critical aspect of the development of risk reduction, exploitation of resource rich habitats, excess food and energy, and new social structures, all of which helped to plant the seeds of early civilization.

Table 1. North Coast Cultural Chronology

Est. Chronology	Andean Tradition	Moche Valley	Chicama Valley	Virú Valley	Santa Valley
1500	Hispanic	Historic	Conquista		
	Inca				
1350		Late Horizon		Estero	Late Tambo Real
	Late Chimú				
1150	Imperial Chimú	Late Intermediate Period	Imperial	Late Plata	Early Tambo Real
900	Early Chimú	Middle Horizon	Fusional	Tomoval	Late Tanguche
					Early Tanguche
700	Moche V				
	Moche IV				
	Moche III			Huancaco	Guadalupito
400	Moche II				
	Moche I				
					Late Suchimancillo
200	HEIP	Early Intermediate Period	Auge	Gallinazo	
					Early Suchimancillo
AD	Gallinazo				
0					
BC	Late Salinar				
			Evolutiva	Puerto Moorin	Vinzos
400	Early Salinar				
	Late Guañape	Early Horizon		Guañape	Cayhuamarca
1000					
	Middle Guañape				
1800	Early Guañape	Initial Period	Inicial Ceramica		
2500	Preceramic		Pre-Ceramica		

The settlement pattern of Preceramic Period sites on the North Coast indicates that early inhabitants intended to maximize access to fishing and hunting, harvesting shellfish and wild plants, while maintaining proximity to land used presumably for cultivation in the lower valleys. Preceramic settlements in many cases also had access to nearby *lomas*, or hills, rich in bromeliads for gathering, and by extension, good hunting grounds for terrestrial animals. At least two Preceramic Period sites in the Moche Valley, Padre Alban and Alto Salaverry, are indicative of this pattern, that is, continued exploitation of marine and faunal resources while increasing plant cultivation (Pozorski 1983). As Sandweiss (1996) notes, rising sea level after approximately 4,000 BCE (the beginning of the Late Preceramic Period) probably caused marine-based populations to move further inland, closer to farmers. Human settlement patterns during the Preceramic Period on the North Coast coevolved with changes in the natural environment (Wells and Noller 1999).

Examples of monumental architecture during the Late Preceramic Period (2700–1800/1500 BC) on the North Coast were recently reinterpreted by Shady (2006; Shady and Leyva 2003; Shady et al. 2010), with respect to her fieldwork at the site of Caral in the Supé Valley, as evidence of processual nucleation. Her interpretation places Andean “urbanism” of the *Norte Chico* civilization early in the cultural chronology. Shady submits that the complexity of spatial organization at Caral, and the diffusion of similar architecture across the North-Central Coast, is indicative of nascent statehood with a capital city and its associated administrative centers. However, Haas et al. (2004) have some reservations with regards to the centralized aspects of Caral’s wider political influence, while recognizing the notable complexity of the general phenomenon on the North Coast before the Initial Period. Research into this question is ongoing.

Initial Period

By the Early Guañape Phase of the Initial Period (approximately 2,000 BCE), dispersed settlements in the region had fully coalesced and a sedentary lifestyle became entrenched in the principal river valleys of the North Coast, ushered in by the development of very productive irrigated agricultural regimes. It is during this phase that widespread monumental construction began in earnest. By far the most ubiquitous style of monumental architecture constructed on the North Coast at this time, the U-shaped ceremonial center with associated minor mounds and sunken courts, is commonly associated with a communal social setting. These ceremonial centers are generally very large, and constructed without physical impedances, providing for ease of access. To describe Initial Period monumental architecture, I will highlight construction at two of the largest U-shaped centers on the North Coast: Las Haldas and Sechin Alto, both in the Casma Valley, just to the south of the Moche Valley. I will also describe the dramatic increase in surplus production and political control as indicated by monumental construction in the Moche Valley, primarily through a discussion of two centers, Huaca Menocucho and Caballo Muerto [Figure 2-5].

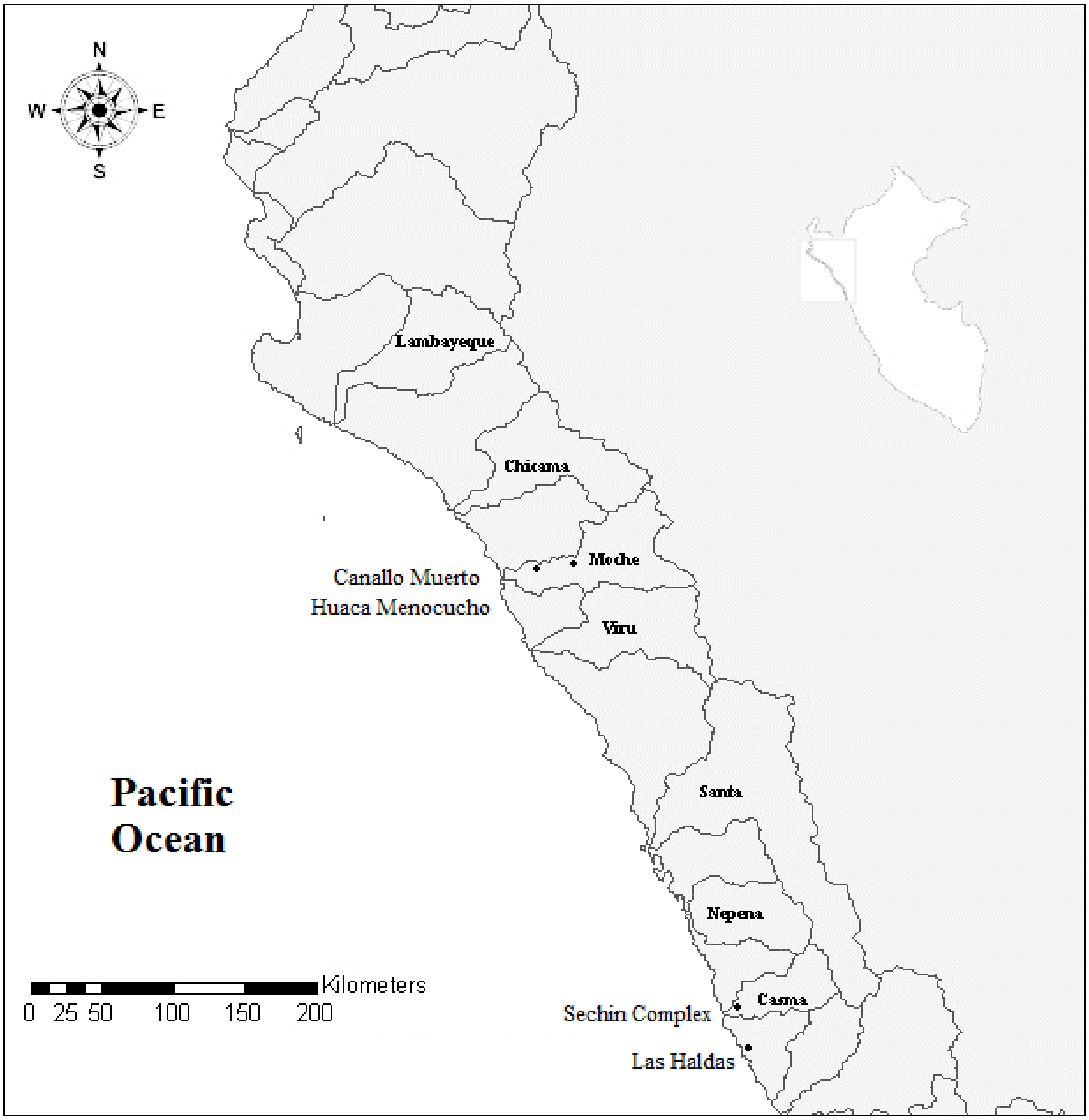


Figure 2-5. Northern river valleys with ceremonial centers discussed in this section.

Las Haldas is located roughly 100 m from the Pacific shoreline and is located 20 km south of the Casma River. The area was settled during the Late Preceramic Period, possibly as early as 3000 BCE. However, ceramics associated with the major phases of construction occur after 1650 BCE (Pozorski and Pozorski 1987). Las Haldas has 18 platform mounds and two sunken courts, with massive upright stone slabs facing the buildings and yellow or red clay floors (Matsuzama 1978). Excavated by the Pozorskis in the 1980's, middens contained many varieties of seafood remains, including deepwater fish, which requires advanced fishing technology; but they also found at this site, evidence for cultivation of maize, cotton, avocado, beans, squash, and gourd (Pozorski and Pozorski 1987). Some buildings were abandoned before completion, and while it is not known exactly why, one idea is that interaction with agriculturalists upriver drew people away from the coast (Pozorski and Pozorski 1987). This assertion is supported not only by the presence of food crops and cotton, but also by the discovery of a 2 km long section of a large causeway (60 m at its widest point), leading toward the river about 30 km from the coast (Pozorski and Pozorski 1987). This is some of the earliest evidence indicating mixed subsistence strategies, and potentially indicative of early cultural contact and interaction among different populations inhabiting North Coast river valleys.

The site of Sechin Alto was first surveyed by Julio C. Tello in the late 1930's; archaeologists that later worked at the Sechin Complex include Donald Collier, Donald Thompson, Rosa Fung, Carlos Williams, as well as Sheila and Thomas Pozorski. It is one of several U-shaped ceremonial centers in the Casma Valley, and broader coastal region, which may have been politically linked to Las Haldas during the Initial Period (Pozorski and Pozorski 1978). The Sechin Complex consists of multiple mounds, plazas and sunken circular courts. Williams (1980, 1985) estimated that the site includes more than 1000 ha of large buildings and platforms, and it is distinguished by the stone-faced platform that rises more than 30m above the valley floor, measuring approximately 275 m long by 230 m wide. At Cerro Sechin there are more than 300 bas-relief slabs of hard granite with intricate images (carved without metal tools) that depict processions of people carrying staffs interspersed with human body parts, most of which are bleeding trophy heads. Dated to around 1,200 BCE, the gruesome iconography is earlier than similar depictions at Chavín de Huántar, located in the highlands, dated to the beginning of the Early Horizon Period.

The meaning of such a motif is hard to interpret and no doubt carries diverse significance across different geographies and throughout time periods. Interestingly however, a very similar motif is found in the Olmec and Maya cultures, as well as in many areas in the Southeastern U.S. and among prehistoric cultures and geographies across North and South America. For whatever reason ancient populations carved these images, it seems that interpersonal violence tends to increase with emerging social complexity. At the Sechin complex, it is difficult to determine whether ceremonial lines depicted in the iconography are composed of warriors. They may be representations of mythical beings or real people, perhaps both. They could be evidence for veneration for war parties from this area during the Initial Period, but just as likely, they may represent a local response to raiding. Burger (1992) posits the depictions at Cerro Sechin do not indicate large-scale warfare because the complex is in a militarily vulnerable position and that the residents living nearby would have constructed more defensive structures in association with the site. On the other hand, while it is true that overtly defensive architecture does not appear in most of the river valleys on the North Coast until after the Initial Period, Sheila and Thomas Pozorski (1987) propose there is clear evidence for endemic conflict by this time period.

Based on a comparison of the economic control of land and water between the Late Preceramic Period and the Early Guañape Phase of the Initial Period, Billman (1999) calculates that in the latter, over 33,000 m^3 of ceremonial architecture were constructed, as compared with only 115 m^3 in the former. He further qualifies those numbers by stating that nearly all of the volume of ceremonial architecture was concentrated at Huaca Menocucho, with the remainder of the volume spread out across five small centers in the valley. Huaca Menocucho is located near the geographical center of the middle valley, where ritual ceremonies would have been more accessible. By the Middle Guañape Phase, Caballo Muerto, with an estimated 282,800 to 318,700 m^3 of new construction for ritual function, suggests increasing social stratification indicative of semi-private access to ritual ceremony (Billman 1999). According to Billman (1999) the communities surrounding Caballo Muerto, and two secondary sites at Puente Serrano and Huaca los Chinos, may have developed a three-tiered hierarchy of political power, mirrored by the tertiary structure of these monuments. The society may have been stratified by an elite group with control to a valley-wide labor pool; a secondary group of leaders with local labor pools; and a third tier of village leaders. However, by the Late Guañape Phase of the Initial Period, at the beginning of the Early Horizon Period, ceremonial architecture was in decline and no single center appears to have dominated the social landscape of the Moche Valley.

Early Horizon Period

The beginning of the Early Horizon in the greater Andean region is marked by the emergence of the Chavín culture in the north-central highlands after about 1000 BCE. This society displays the first good evidence for increased social stratification in the material culture of Andean prehistory. Large-scale efforts to organize labor and influence the extraction of an enormous amount of natural resources in order to alter the landscape and build temples with limited access suggests a high degree of asymmetrical power within Chavín society (Rodriquez and Rick 2004). Existence of an elite class, often referred to as shamanistic and known locally as the Cult of San Pedro (San Pedro is a hallucinogenic cactus), is indicative of an evolution of authority resulting from the intentional manipulation of constituent populations by those who planned and constructed the temples at Chavín de Huántar, the nexus of Andean society at that time (Rick 2005). The culture is also known for its advanced metallurgy; Chavín artisans invented techniques to develop beautiful golden objects unlike anything witnessed previously (Lothrop 1951). The sphere of Chavín influence extended westward from the highlands to the north and central coasts and into the eastern cloud forests. Interestingly, while their iconography is often suggestive of violence, there is little evidence for a standing army. Theirs was a conquest of ideology rather than bloodshed.

By the end of the Early Horizon, Chavín culture was in decline as the definitive social and political force in the region, but populations in both the highlands and on the coast continued to increase steadily. Along the North Coast, creation of arable land failed to keep pace with the demand for it (Carneiro 1970). Leaders that were able to mobilize enough labor to put land into agricultural production fared favorably well, and expansion of irrigation regimes augmented wide-spread demographic change, as well as increases in sociopolitical complexity. During this time in the Moche Valley, the Cupisnique ceramic tradition became prevalent. The Cupisnique culture had a unique style of adobe clay architecture, common on the arid North Coast, that was somewhat different from highland construction of the same period (for review on Cupisnique architecture on the coast, see Burger and Salazar-Burger 1991; Chicoine 2006; Pozorski 1995).

Indicated by the similarity of some artistic styles, perhaps there is a connection between Chavín and Cupisnique people, but unfortunately the relationship between them is not well established from the current archaeological record. Since Larco Hoyle first discovered the Cupisnique culture in 1939, the names have been used interchangeably in some of the literature on the North Coast. In recent years, there has been more resolute theoretical division on the subject. Cordy-Collins (1992) treats Cupisnique as a culture lasting from about 1000 BCE to 200 BCE, which corresponds to the Chavin culture in the highlands, and asserts that contact between the two groups was inevitable. On the other hand, Shimada (1994) describes the Cupisnique as having an ancestral relationship with Moche culture, but he gives no real credence to the possibility that Chavin directly influenced either culture.

The most convincing evidence for some continuity between Chavin and Cupisnique cultures is an adobe temple called Collud recently discovered in the Lambayeque Valley, just north of the Moche Valley. The temple includes imagery of the spider god, thought to be associated with rainfall, hunting, and warfare (Orozco 2008). Burger (1992) first identified the spider deity in stone bowls found at the Limón Carro site in the highlands near Cajamarca. The spider god no doubt had great political significance. In fact, famed Peruvian archaeologist Walter Alva believes that any emergent political group at this time would be associated with the spider god (Orozco 2008). Although it is too early to tell much about the coastal site of Collud, it is currently referred to as the Spider God Temple. The continuity of highland and coastal ideology there is intriguing. Alva also finds that the site is reported to include nearly every ancient Peruvian architectural style, from coastal polities like Chimú and Moche to Chavin, Huari and Inca, all highland polities (Orozco 2008).

The transition out of the Early Horizon Period may have been a time of turmoil and disorganization in the region, as it corresponds with the abandonment of Sechín Alto and other similar large ceremonial centers further south. After about 500 BCE, coastal populations spread out into dispersed settlements, suggesting a fracturing of regional ideology that had previously emphasized inclusion into one of a loosely connected congregation of localized semi-autonomous villages. Construction of monumental architecture declined dramatically after this transition, further indicating a wide-spread demographic move toward protectionism and isolationism among valley populations.

Early Intermediate Period

The beginning of the Early Intermediate Period (EIP) in the Moche Valley is indicated by the Salinar Phase (ca. 350 BCE). During the Early Salinar Phase, monumental construction was very different from that of the previous time period. Salinar ceremonial structures were built for much smaller groups (20 to 30 individuals), implying limited access to ritual gatherings. Local Salinar Phase leaders no longer commanded the authority to direct large-scale construction projects, and therefore probably did not stage large public rituals. However, semi-private rituals most likely remained important for reinforcing political power. It is at this time that construction of defensive architecture became increasingly prevalent. Settlements during the Salinar Phase are generally characterized by clustered hamlets of multiple residences, often in association to minor mounds, and usually located on fortified hilltops. This defensive pattern is a wider phenomenon of settlement orientation that affected much of the North Coast (Brennan 1982; Daggett 1985, 1987; Wilson 1988, 1995).

In the lower Moche Valley, the site of Cerro Arena is estimated to be over 200 ha and constitutes one of the largest nucleated residential sites on the North Coast, consisting of more than 2,000 separate structures. The settlement is the first large Salinar Phase site to be extensively excavated (Brennan 1980). Much of what we know about Salinar Phase settlement comes from investigations at Cerro Arena and informs our understanding of the development of urbanism on the North Coast. Billman (1996:212-215) suggests that during the early Salinar Phase, hierarchies formed at a number of autonomous clusters in the Moche Valley and nine of those clusters may have consolidated to form a loose confederacy from which the Cerro Arena polity appears to have exacted tribute. By the end of the Salinar Phase "the middle [Moche] valley population apparently was unified into a single polity centered at Cerro Oreja" roughly 9 km away from Cerro Arena, with no Salinar settlements in between (Billman 2002:389). It is during the Salinar Phase that construction of defensive architectural planning became increasingly prevalent, presumably due to increased raiding from the highlands or other coastal groups. In neighboring river valleys on the North Coast, such as the Virú and Santa River valleys, there are more than 60 documented hilltop bastions that date to the end of the Early Horizon or the beginning of the EIP (Topic and Topic 1978, 1987; Wilson 1988, 1995).

During the Gallinazo Phase of the EIP on the North Coast, populations grew, irrigation systems expanded, and there was an increasing centralization of political authority (Topic 1982). Correspondingly, there was a dramatic upsurge in construction projects for monumental structures known as *huacas*. Billman (2002) estimates a 400% rise in total area of monumental architecture from the Salinar Phase to the Gallinazo and Early Moche Phases of the EIP. To that end, there is often a measurable incongruence between residences of the middle valley at this time, in the size and relative location of structures, which presumably mirrors politically-sanctioned social stratification. The two largest Gallinazo sites are Pampa Cruz and Cerro Oreja; these two sites alone account for 37% of the known habitation area during this phase of the EIP (Billman 1996). During this period, nonlocal migrants begin to colonize coastal river valleys.

Pampa Cruz is located on a bluff above Huanchaco. In 2005, a colleague and I mapped the remaining portion of the site with a total station set up on the rooftop of the field house. Most of the site has been destroyed by development. It was a relatively large fishing village bounded on the west by the Pacific Ocean and on the northwest by the Rio Seco. Excavations were conducted at the site on four separate occasions by Donnan (1978), Mujica (Chan Chan-Moche Valley Project), Ricktenwald (Chan Chan-Moche Valley Project), and Barr (Instituto Nacional de Cultura, Peru). Mujica's and Ricktenwald's field notes in the Chan Chan-Moche Valley Project files contain considerable information on the site (Billman 1996). While the site has Salinar, Gallinazo, and Moche Phase deposits, the Gallinazo Phase occupation appears from test excavations to have been the most extensive settlement (Donnan 1978). There is one small huaca in association with this site.

Billman (1996) contends that Cerro Oreja may have had the highest density of habitations of any site in the valley. His preliminary survey data indicated that an average density of habitations at the site was probably between 25 and 50 per ha, which would indicate somewhere between 700 and 1,400 Gallinazo Phase households (Billman 1996). Substantial occupation at the site is indicated by the high densities of sherds on the surface; they number in the hundreds per square meter. It is impossible to walk to the site without crunching pottery underfoot. Although Cerro Oreja has Guañape, Salinar, Moche, and Chimú Phase occupations, like Pampa Cruz, the Gallinazo Phase occupation is the most extensive (Billman 1996).

Settlement patterns of the Gallinazo Phase are best characterized by widespread site abandonment in the upper middle valley and dramatic population increases in the lower middle valley and along the coast. At Pampa Cruz, which already had a considerably large late Salinar Phase population, occupation was continuous and appears to have grown substantially during the Gallinazo Phase (Billman 1996). In the lower middle valley between Cerro Oreja and the confluence of the Moche and Sinsicap Rivers, the area of habitation nearly doubled in the Gallinazo Phase from 46.44 to 81.14 ha (Billman 1996). The valley neck, where Cerro Oreja is located, experienced very high population growth, with an estimated 25% of the total Gallinazo Phase habitation concentrated there (Billman 1996). The large Salinar settlement at Cerro Arena was in effect abandoned by this time, and Cerro Oreja took its place as the largest habitation site in the Moche Valley.

As I mentioned in the my introduction, Billman (2002) states that the most surprising aspect of his survey was the high frequency with which he encountered what he classified as highland-style ceramics at sites occupied during the Gallinazo and Early Moche Phases of the EIP. Indeed, a significant amount of the sherds he collected from those sites are made with nonlocal vessel forms and decorations; and, when compared to coastal ceramics from the same period, the ceramics are made with distinctly different parent materials, paste and inclusions (Billman 1996). Preliminary spatial analysis of Billman's settlement data indicates that due to the varying size, location, and defensive nature of 114 sites with nonlocal components, it appears that these sites were situated as to control access to the upper and middle Moche valley, as well as important corridors to the neighboring Virú Valley. For highlanders, control of this area would have provided both the economic incentive of proximity to a prime coca-growing zone on the western slopes of the Andes and strategic access to the Carabamba Plateau and Otuzco Basin.

Billman (1996) concludes that there were three elite groups in the middle valley. These three clusters prove to be extremely significant in my investigation. The elite families of these groups appear to have lived in stylistically distinct residences with a higher degree of refined architectural craftsmanship. Their homes were exclusive compounds contained within larger, aggregated settlements. Architectural forms of elite and commoner households, of the nonlocal and local varieties, are described in Chapter 4.

Nonlocal elites may have derived their political status from control over production regimes and brought with them some degree of military power. One of these clusters occupied much of the prime coca-growing zone in the upper valley; control over the production and exchange of coca would have been an important source of economic influence. Comparison of surface collections from Billman's middle valley survey and the Virú Valley sequence (Bennett 1950; Ford and Willey 1949; Strong and Evans 1952) strongly suggests that both of these valleys indicate contemporaneous, nonlocal ceramics (Billman 1996). Compared to the entire North Coast culture history, the late Gallinazo Phase is not well understood. My project sheds light on the nature of interaction between nonlocal and local groups living in proximity to one another on the North Coast. The modeling effort highlights what is significant about nonlocal migrant spatial organization and settlements.

Early Intermediate Period: Rise of the Mochica

By the end of the Gallinazo Phase, a local polity known as the 'Gallinazo Group' had emerged in the neighboring Virú Valley, while the controlling entity in the lower Moche Valley remained centralized at Cerro Oreja and later organized into the southern Moche polity. During the early Moche Phase of the EIP, populations in the Moche and neighboring Chicama Valley merged into a nascent two-valley polity. The capital of the Southern Moche polity was relocated to the site of Moche, in the Moche Valley, and construction of two massive adobe pyramids began in the years that followed: Huaca del Sol and Huaca de la Luna. The Gallinazo Group in the Virú Valley eventually gave way to Moche hegemony, along with the rest of the North Coast. Seven hundred years of Moche cultural development from 100 to 750 CE is commonly divided into five temporal stages: *Moche I – V*, but often collapsed into three Moche Phases: Early, Middle and Late.

Completion of the Huacas by the Middle Moche Phase (Moche III) marks the climax of a thriving ideology and powerful military complex that sustained a political force that would control the region for many centuries to come. The Huacas at Moche may have demarcated a nexus of power. Many such alterations to the natural world command a level of attention that makes their symbolism undeniable (Yentsch and Beaudry 2001). Although difficult to prove, with such proximity to one another the monuments may represent dual authority at the seat of power. Andean moieties are based on a kin collective called an *ayllu* (see Moseley 1992:49). Some interpretations of the iconography on the interior walls of the structures allude to the possibility that Mochica society, at this stage of their development, had some version of a moiety socio-political structure. In any case, at this stage of political development it is unlikely that the two monuments represent opposing powers. However, during the Middle and Late Moche Phases of the EIP, between Moche III and IV, another large political center was established at Pampa Grande in the Lambayeque Valley to the north. As a result of this new political center, Moche power was distributed across confederations of related, allied polities (Pillsbury 2001:9-12).

By Moche V (ca. 700 CE), much of the territory under control of the capital at Moche may have been partially incorporated under a different regional administration characterized by a completely new style of nonlocal ceramics found in eight principal river valleys on the North Coast (Wilson 1998). Black-White-Red pottery was found in the Moche, Virú, Chao, Santa, Nepeña, Casma, Chicama, and Huarmey Valleys.

Middle Horizon Period

It is not entirely clear by what means the Mochica met their demise. It was likely a combination of sociopolitical and environmental events that led to collapse. Once the Moche political structure disbanded, kin groups may have returned to autonomous communities, creating an interval of settlement dispersal in the valley. It is not clearly established exactly when the North Coast became once again unified under the Chimú Empire. Considering the geographic proximity of the political capitals of the southern Moche polity and the Chimú Empire, it is likely that there was a connection between the two cultures. Much about Moche and Chimú societies attests to a high degree of serial continuity from one era to the next (see Fariss 2005). However, the remains of their respective material cultures, in both art and architecture, are clearly distinct from one another (Jackson 2004). There are two very good diagnostics that signal an end to the Moche/Chimú transition and the beginning of a strictly Chimú ceramic tradition: the wide-spread manufacture of grey ware ceramics [Figure 2-6]; and, a stylistic change from painted, incised designs to the quintessential Chimú press molded designs (Bawden 1982; Donnan and Mackey 1978).

Figure 2-6. Chimú press-mold grey ware.

Late Intermediate/Late Horizon Period

The Chimú Empire was at its peak for only a couple hundred years, a short period of time to rule the entire North Coast. With the help of an ally to the north, under the rule of Túpac Inca Yupanqui, the Inca Empire took complete control of Chimú territories by 1476 (Rowe 1948). For the next fifty years, the Inca expanded under the rule of Huayna Capac, until a bloody civil war broke out between Atahualpa and his older half-brother Huáscar. The ensuing civil war was long and costly. The empire was overextended geographically and still politically divided when the winds of the Pacific blew in a most iniquitous foe. A fleet of Spanish ships arrived on their shores in 1526 (Mura 1962).

After first contact, native South Americans were exposed to extremely virulent viruses. Millions that suffered from smallpox presented with raised fluid filled blisters on their skin, delirium, diarrhea, excessive bleeding, high fever, and in most cases, death. But smallpox was only the first epidemic. Typhus, influenza, diphtheria and measles all ravaged the population and tens of millions died as a result.

In 1529, Francisco Pizarro was granted permission by the Spanish crown to conquer Peru. During the height of the smallpox epidemic, he led three expeditions from Panama to the Andean region. He and his half brothers Gonzalo, Juan, and Hernando sacked and pillaged villages for the next two decades. By 1544, the conquistadors had subjugated most of the indigenous population, but a large faction of the Inca Empire held out and established a new capitol city at Vilcabamba (Mura 1962). For nearly thirty years there were skirmishes all over the Andean countryside and battles in and around major cities. Until finally, in 1572, Peruvian viceroy Francisco Toledo declared war on Vilcabamba (Mura 1962). With reinforcements from Spain, Toledo sacked Vilcabamba and captured the last Inca emperor. Upon returning to Cuzco, Túpac Amaru was executed and the rest is History.

Concluding Remarks

I think of North Coast culture history like the Pacific tide, as social and political transformation in a perpetual ebb and flow. As irrigation in the coastal river valleys expanded, new power regimes ushered in urbanism that swept across the region and brought with it political centralization and increased social stratification. In the highlands, a great civilization controlled the region with a cult-like ideological system, and later polities rose to power through military force. Many factors influenced the trajectory of social and political development across the region. The unique ecology and geography of the Andes certainly played a role in early settlement decisions, and climate perturbations fluctuating between long-term droughts and severe flood events probably influenced aspects of social and political change. The technological improvement of irrigated agriculture was perhaps the most significant factor for determining socio-political transformations on the Andean North Coast. As will be described in the following chapters, settlement patterns were in large part dictated by the manipulation and control over the irrigation network.

With regard to settlement pattern studies in Peru, Moore (1995) comments that more intensive investigations that incorporate excavated data are necessary if we are to address questions about the structure and dynamics of political and social integration, such as the articulation of household and state (Moore 1981, 1989; Stanish 1989), the organization of public economies (D'A1troy and Earle 1985; D'Altroy and Hastorf 1984; Moore 1988, 1991), the distribution of administrative institutions (Mackey 1987), or the ideological connections between core and periphery (Goldstein 1993) as manifested by prehistoric Andean society. Indeed, much of the nuanced past is out of reach for settlement pattern archaeology.

My research addresses archaeological issues related to locational planning and decision-making. At the site level, I am interested in construction styles and organization. I have integrated Billman's survey data with my own in a GIS database for spatial analysis. I have conducted statistical tests with the data, including descriptive statistics and generalized logistic regression models, cluster and factor analyses. The principal objectives of my research are to quantify aspects of architecture, spatial organization and settlement pattern, and then to use that information to describe contact and interaction in the Moche Valley during the EIP.

With the uncertainty of agro-pastoral subsistence strategies in the highlands, the expansion of viable farmland on the coast could have been an attractive incentive for migration. The settlement pattern of nonlocal migrants clearly demonstrates a desire to occupy important zones for cultivation of specific crops such as maize and coca, crops that cannot be grown successfully at high altitudes. Spatial organization of nonlocal households, particularly elite compounds, suggests a preference for hillside construction, but the nature of steep slope construction does not appear to be borne out of conflict. Simultaneously, local groups had moved, or were moving out of these zones, and aggregated at very large settlements near the mouth of the Moche River. Billman (1996) notes that between highland and coastal groups there appeared to have been a "no-man's land" that served as a substantive reminder to both sides that, for whatever reason, separation of space was important for maintaining their respective daily practices. My analysis indicates that the region of transition between nonlocal and local communities was occupied. There is no discernible "no-man's land" without more precise data on the temporality of occupation.

I believe it is useful to view nonlocal and local communities as living in an ethnotone. Regular interaction in an ethnotone can lead to hybrid forms of daily practice. My results indicate that during this short period of demographic reorganization, interactions were probably nonviolent between those living at sites with nonlocal ceramic components and those living at sites with local ceramic components. Site organization and the nature of settlement point toward complementarity in the everyday life among those living in the Moche Valley during the Gallinazo Phase of the EIP.

CHAPTER 3

SETTLEMENT ANALYSIS GIS

> The real heart of GIS for archaeologists is our ability to conduct spatial analysis on the patterns and relationships between archaeological sites, and between sites and their environmental context.
>
> (Madry 2004:17)

During the 19th century, the Industrial Revolution accelerated the spread of western science and ideology expansionism that paved the way to two World Wars. Ideas like progressivism, the view that society is like an organism, subject to growth from simple to complex, became very popular. And, while great scientific strides such as Charles Darwin's theory of evolution were made during the 19th century, many took notice of imminent social upheaval and warned against the expansion of 'modern' human ideals, alluded to by Mary Shelley in *The Modern Prometheus*; the distinguished novel better known as *Frankenstein*.

With the concept of biological evolution hijacked by early sociologists, progressivism became one of the underlying theories of unilineal evolution. Although now obsolete as a conceptual model of society, unilineal evolution significantly influenced the formative ideas of Lewis Henry Morgan. Morgan (1877) discussed ancient societies in his perennial classic by the same name as going through three stages of social evolution: savagery, barbarism and civilization, in which he allocated certain technological innovations to each stage of progress.

For example, fire was an early technological innovation that led to the use of the bow among primitive groups; animal domestication begot agriculture and metallurgy in barbaric societies. He viewed his own culture as having reached the final stage of civilization. Putting aside the misgivings of his early work, in *Ancient Societies* Morgan (1877) proposes a link between social progress and technological progress. He developed the theory that institutional, organizational or ideological change in society is brought about first by technological change, and this social construct went on to greatly influence Karl Marx and Friedrich Engels, as well as Julian Steward, V. Gordon Childe and Leslie White.

Morgan is also credited with developing modern kinship studies. He was the first to conceptualize humankind as developing from a matrilineal society. However, Morgan as a historical figure is a bit of a paradox. As a want-to-be politician, staunch capitalist and lawyer, he had a number of misguided policies regarding Native Americans, yet he produced the first significant ethnography of the Iroquois. In fact, his close friendships with Seneca tribesmen allowed him to write the detailed and descriptive text (Moses 2009). He had an assemblage of Iroquois-made artifacts that was the largest collection of material culture for any single group of Native Americans at that time (Tooker 1999). Through comparative analysis of his collection he identified a link between material culture and social structure. Morgan made many such contributions to the field of anthropology as a fledgling science. He was the first to systematically relate human settlement patterns with sociocultural evolution. In his final publication, *Houses and House-life of the American Aborigines*, he used cross-cultural analysis to compare Iroquois longhouses and Pueblo dwellings with Maya domestic structures, stating that "the plan of these houses, as well as those of Yucatán, seems to show that they were designed to be occupied by groups of persons composed of a number of families" (Morgan 1881:303-304).

Morgan was very influential to later scholars. For example, the cultural ecologist Julian Steward (1937) developed a theoretical basis for settlement pattern studies, specifically the relationship between human subsistence and the natural environment. In "The Urban Revolution", V. Gordon Childe (1950) was the first anthropologist to synthesize archaeological data with the concept of urbanism, and thus identify radical social transformations that came with reorganization of early cities and states. Perhaps most significant to the early development of settlement pattern studies was Leslie White's (1948) theory that social systems are determined by technological systems, which purposely echoed the earlier theories of Lewis Henry Morgan.

The emergence of modern settlement pattern archaeology is predominantly a result of Gordon Willey and James Ford's archaeological survey on the North Coast of Peru in 1946, as part of the multidisciplinary Virú Valley Project. The project was undertaken by encouragement from Julian Steward, who coined the term "settlement pattern studies" (Willey 1999:10). The many applications of settlement pattern analysis introduced by Willey have been invaluable to the study of Andean prehistory, as well as for archaeological theory in general. Using aerial photographs produced in 1942 to locate archaeological sites, then by conducting surface collections at those locations, the survey team documented over 300 sites spanning nearly 5,000 years of prehistory. They found that the role of 'natural' as well as 'constructed' environments, technological innovations, and demographic changes influenced the nature of interaction between all sites in the region (Ford and Willey 1949). Their study was aimed at interpretation of domestic and public architecture, such that sites were primarily dealt with in terms of overall site function. Willey (1953) classified surveyed sites as one of the following: domestic, community or ceremonial center, fortified refuge, or cemetery. Yet, as Moseley and Mackey (1972) indicate, categorizing site-level behavior in this all-encompassing way can be problematic because site categories determine the fineness and sophistication of settlement pattern reconstruction and synthesis. They proposed a new perspective on settlement pattern analysis adapted from *small site methodology*.

Small site methodology was originally a procedure for selecting a sample of diagnostic sherds for ceramic analysis developed by Alfred Kroeder. Kroeber (1963) observes that large sites often have ceramic assemblages that are heterogeneous and mixed. His theory was that varied examples of style from ceramic assortments at large sites may have been introduced by the diverse nature of individual craft specialists within larger populations (Kroeber 1963). Ceramic mixing was probably a result of the formation processes of construction techniques including leveling, filling and other remodeling events. He further notes that ceramic assemblages at small sites were more likely to be homogenous and unmixed, resulting in assemblages that represent a clearer picture of the local tradition; he called them "pure style" ceramics (Kroeber 1963). As discussed in the next chapter, I adapted the small site methodology for analyzing some aspects of highland architecture.

While Willey's classifications were overly generalized interpretations of culture-specific activities, it is widely recognized that his attention to detail was meticulous. The survey team painstakingly mapped most of the sites and coupled those maps with qualitative descriptions, capturing a wide range of spatially explicit settlement data. He was most concerned with the way buildings were located with respect to other buildings, and as a result, some of his generalized categories were broken down into subdivisions. For example, living sites were dichotomized such that sites with regularly arranged rooms were separated from those sites composed of scattered rooms. However, as Moseley (1972) points out, social factors behind these differences were not systematically investigated and Willey's subdivisions of living sites were basically morphological, providing his synthesis with little or no functional input. Considering the logistical issues of working on the coastal desert of Peru, along with the scholastic environment of the day, Willey's survey was a bold and innovative approach to the study of archaeological phenomena and spatial relationships. The Virú Valley Project settlement pattern survey has been—and will continue to be—used as a model for generations of archaeologists to come.

Most archaeologists studying settlement patterns in Peru following the Virú Valley Project turned their attention toward individual settlements (see Izumi and Sono [1963] at Kotosh; Bonavia [1968] at Abiseo; Lumbreras and Amat [1966] at Chavin; Morris and Thompson [1970] and Murra and Hadden [1966] at Huanuco Viejo; West [1967, 1970] at Chan Chan; and Rowe [1967] at Cuzco). The projects conducted by Michael West and John Rowe were particularly significant for the development of settlement pattern studies in the Andes. West (1967) undertook a survey of many buildings and roads in the most concentrated core area of settlement at Chan Chan. Chan Chan is one of the world's largest prehistoric urban centers, located in the Moche Valley near the modern city of Trujillo. His study sought to identify specific types of site-level architectural complexes and define the associated activities at those complexes. West (1970) investigated Chan Chan in terms of a 'community settlement pattern' and he sought to understand the nature of different networks that gave the community form. He attempted to isolate diverse residential, ceremonial, industrial and commercial areas in an effort to infer the various types of social interactions that took place in these areas. His research served to modify a generally held perception that oversimplified the complexity of Chan Chan and elevated the importance of a functional approach in the archaeology (Moseley 1972). As New Archaeology gained traction, archaeological settlement pattern surveys around the world became more *systematic* and *intensive* (Blanton 1978; Parson 1971; Sanders et al. 1979).

Perhaps the second most cited settlement pattern study in the North Coast Andean region was the ‘mega-project’ known as the Chan Chan Moche Valley Project (CCMVP), co-directed by Michael Moseley and Carol Mackey from 1969 to 1975. The focus of the CCMVP was on the large adobe complex of Chan Chan. The architecture on site is estimated to cover about 20 km^2 in total area, with the core area roughly measuring 6 km^2. Before the CCMVP, ruins of the Chimú Empire at Chan Chan had been sketched and roughly mapped by various Spanish chroniclers, but the CCMVP was the first scientific project to accurately map the entire site. The team used the most sophisticated technology available at the time, including aerial photographs for reconnaissance survey. The team gathered information on associated areas like the earlier site complex of Moche, with a specific focus on the adobe pyramids of Huaca de la Luna and Huaca del Sol. The team conducted pedestrian surveys in the lower Moche Valley and nearby Chicama Valley. Some data from these surveys are included in the GIS used for my project.

The CCMVP project was a landmark research program in the history of New World Archaeology (Quilter 2010). The CCMVP produced a number of articles and books. I focused on one text in particular, *Socio-Economic Organization of the Moche Valley, Peru,* *during the Chimú Occupation of Chan Chan* by Richard W. Keatinge and Kent C. Day (1973). Their research investigated the primary socioeconomic factors related to the administration of land, water and labor resources, as well as the production and distribution of goods. They were particularly interested in “urban” and “rural” contact and relations, specifically in the context of social systems surrounding *audiencias*, large U-shaped architectural structures. In keeping with Morgan’s theoretical underpinnings, and White's theory that social systems are determined by technological systems, Keatinge and Day (1973) argued that hydraulic systems stimulated the development of a non-egalitarian society.

What is most interesting about their research with respect to my own is that they were able to successfully integrate a multi-scalar dataset with somewhat limited amounts of architectural, settlement pattern, ecological, and ethnohistoric data in order to develop a functional hypothesis. They were primarily concerned with the interaction of site and landscape level features that provided a foundation for Chimú socio-economic systems. In their research, they identify the systemic interrelationship and feedback between the components or processes that fostered the growth and maintenance of this highly organized system: environmental conditions, urbanization, social stratification, and the accumulation and distribution of goods (Keatinge and Day 1973). These component categories are important for my research.

Finally, the settlement pattern study most relevant to my project is Brian Billman’s survey of the Moche Valley. Conducted primarily between 1990 and 1991, his research involved a systematic pedestrian survey of the middle Moche Valley on the North Coast. Billman combined his survey data from the middle valley with unpublished data from the

CCMVP. From these data, Billman (1996) reconstructed a sequence of political development in the Moche Valley and evaluated general theories of state evolution in light of this sequence of development. My project uses his settlement data from the middle valley, including the CCMVP data for the lower valley, and my own data from the upper valley to address culture contact and interaction in the Moche Valley ethnotone during the Gallinazo Phase of the Early Intermediate Period.

A Brief History of GIS

Humans have been interested in mapping the world around them for a very long time. Ancient Babylonian maps housed in the British Museum depict everything from geographic relationships of properties, roads and dwellings in Babylon, to cartographic models of the Middle East. Displayed on a wall of the Imperial Census Office in Rome is a 2,000-year old street map etched into a giant marble tablet. And, in 1858, the earliest known aerial photographs were captured from a balloon tethered over the Bievre Valley in France. One hundred years later, during the Cuban Missile Crisis, U2-derived aerial photography of Russian nuclear activity provided President Kennedy the evidence he needed to authorize a naval blockade which may have averted WWIII.

“GIS” has evolved from an acronym to a stand-alone term; commonly used today to describe both a type of spatially-explicit database, as well as refer to the process of spatial analysis. In short, a Geographic Information System integrates hardware, software, and multi-scalar data (the GIS database) for encapsulating, organizing, and analyzing geographically referenced data in order to produce spatial information products. GIS is used to interpret and visualize real-world phenomena. It assists scientists in resolving spatial relationships and allows us to present those data in a way that is readily understood and easily shared with others. Modern advancements in GIS technology continue to provide new capabilities for analyzing patterns of spatial and temporal data at multiple scales.

GIS as it is most commonly used today can be traced to Ian McHarg's 1971 book *Design with Nature*. Ian McHarg was a landscape architect in the United States. He is credited with inventing the Mylar overlay technique. *Mylar* is the brand name for a type of transparent polyester film ubiquitously used in university classrooms for overhead projections of notes and visual aids before *PowerPoint*. McHarg (1971) added different colors to each of his Mylar maps to represent different levels of landscape suitability for ecological planning. When backlit, the resulting graduated colors represented levels he qualitatively assigned and ranked for visualization of landscape suitability. GIS data are still referred to as 'layers'.

At this time in the north, a computer-assisted information system for storing and analyzing geographic data was being developed by Canadian Geographic Information Systems (CGIS). The final days of working with analog maps were foreshadowed in the early 1970s when CGIS rolled out the first spatially explicit inventory of natural resources using a raster data structure. Many spatial analysis applications were introduced over the next decade, and in the early 1980s, Environmental Sciences Research Institute (ESRI) released *ArcInfo* on the *Unix* computing platform. For most users, *ArcInfo* and the Geographic Resources Analysis Support System (GRASS), an open-access platform, constituted the pinnacle of GIS. That is, until ESRI introduced *ArcView* in the early 1990s. *ArcView*, as the graphical-user interface (GUI) version of *ArcInfo*, allowed ESRI to enter untapped markets.

GUI programs had become the industry standard, because by then most people were using Windows-based operating systems on personal computers. *ArcView* performs spatial analyses, modeling, spatial statistics, and visualization, all within an advanced georelational data structure on your PC. Today, the program is many generations advanced and is now called *ArcGIS*. I use *ArcGIS* and *ArcInfo* software for spatial analysis, modeling and visualizations.

Perhaps the most important aspect of GIS in archaeology is its capability to merge and analyze different types of data in order to create new information products. Archaeological data is often multi-scalar. For archaeologists, GIS can facilitate mapping depositional relationships of artifacts or provide a well-structured descriptive and analytical tool for identifying spatial patterns across settlements. At the site-level, GIS can be used to capture, visualize, and analyze archaeological information in context. At the landscape-level, GIS allows many layers of data to be viewed together during survey and analysis. Since the implementation of desktop GIS, professional archaeologists have been provided with a powerful analytical tool to efficiently manage and share information about archaeological sites.

Spatial proximity has always been an important concept in archaeology, as it is often used to explain overlaps and/or disparities between cultural groups (Aldenderfer 1996; Wheatly and Gillings 2002). Space in anthropological thought can be seen as a referent for characterizing regional cultural variation in very broad spatial terms (Aldenderfer 1996; Kroeber 1939). In his discussion of field research within cultural ecology, Julian Steward (1955) proposed an examination of 1) the interrelationship between productive technology and the environment; 2) behavioral patterns associated with environmental exploitation; and 3) the extent to which exploitive behaviors affect other aspects of society. He believed that ecosystems are spatially referenced and that human interaction within them is variable as a product of spatial and temporal energy availability within that system (Julian Steward 1955). An example of this perspective toward research into humans and the environment is in no place more evident than in the Virú Valley settlement pattern survey discussed previously.

Given the diachronic nature of prehistoric data, archaeology is in a particularly advantageous position to test and refine theories about the socio-ecological complexities of past societies (Freter 1997). Recent improvements in the quality and quantity of data documenting prehistoric environmental change, computer-assisted manipulation of geospatial information, advances in retrieving archaeological data, as well as the introduction of new and innovative methods and interdisciplinary theories, have created a unique opportunity for archaeologists using GIS. Integration across the social, natural and spatial sciences is crucial for better understanding issues such as prehistoric population/environment interaction, culture contact, and socio-political economies of the past.

Archaeological Geomatics

GIS is under the umbrella of spatial science. The Spatial Sciences are composed of a broad collection of disciplines concerned with the measurement, management, analysis and display of spatial information describing the natural and/or built environments of our planet. As spatial science methodology, GIS and related technologies are referred to as *Geomatics*. Archaeological Geomatics refers to spatial science as used in archaeological settings.

By bringing spatial science methods to bear on anthropological theory, Archaeological Geomatics has powerful predictive capacities useful for supplementing traditional archaeological data. Used in many scientific disciplines, both natural and social, modern GIS provides researchers with 'at your fingers' functionality. Access to advanced spatial technologies allows researchers the ability to conduct ever more sophisticated inquiries. What an archaeologist is able to do with GIS is only limited by the computational power of their equipment and the quality of their datasets. Conceptualizing analytical processes remains the most significant obstacle to overcome because "computers cannot be expected to perform a task that we are unable to formulate in our own minds" (Mehrer 2006: Preface).

There are two types of data in a GIS, spatial and non-spatial. Spatial data is divided by those data that have Cartesian reference and those data that have geographic reference. For the non-geographic spatial data, X-Y coordinates of data points are placed on an arbitrary grid. For example, a planview is spatial data that can be entered into a GIS. It tells you where an artifact is located within a 2x2 m grid, but it does not tell you where that artifact is on the face of the earth. For geospatial data, there are geographic coordinates that come in many different formats, such as Universal Transverse Mercator (UTM), latitude/longitude, or decimal degrees (for thorough review of coordinate systems see Dana 1999).

Non-spatial data are information products like indices, charts or other types of tabular records. Non-spatial data are often 'joined' or 'related' to spatial data in a GIS for analysis. Using *ArcGIS*, the *Joins* function temporarily combines item definitions and values of two tables based on a shared attribute in both datasets (e.g., an archaeological site number). Alternatively, one computes relationships in ArcGIS with the *Relates* function.

Relationships are defined as properties of an ArcMap layer and are most often used to improve editing for spatial analysis. Joining data is better suited for basic query, data visualization and labeling. Below, I discuss in detail the GIS I used for my study.

The Moche Origins Project Geographic Information System (MOP-GIS)

The MOP-GIS contains archaeological, historical, ecological, biophysical and geological datasets, as well as multiple stereo-paired aerial photographs and several gigabytes of satellite imagery. I have compiled dozens of small and large-scale maps of everything from North Coast geography to the complete canal network. By far, the two most important components of the MOP-GIS for my research are the Digital Elevation Model (DEM) and the total settlement shapefile. The former was created between 2004 and 2006. It was built from 20 individual Computer Aided Design (CAD) drawing files (.dwg). Thousands of individual line segments were snapped together to generate continuous contour lines, then elevation values at 25 m intervals were manually entered using the analog maps as reference. Once the contours were cleaned and elevation values were verified, the resulting maps were combined to create a single coverage of the Moche Valley watershed at 30m resolution. As a side note, drawing files can be produced in both 2d and 3d (with elevation as the 3rd dimension). Due to budgetary restrictions of my project, we opted to purchase the 2d versions of maps produced by Peru's *Programa Especial de Titulación de Tierras* (PETT) of the Department of the Peruvian Agricultural Ministry. The elevation values had to be manually entered. Using *ArcInfo*, the Moche Valley watershed was generated by cleaning edge effects of combining individual maps with a moving window analysis, then interpolating flow direction and flow accumulation grids.

Another important dataset for my project was the Moche Valley total settlement data, the *MVTS_poly* as it is known in the MOP-GIS database. It was derived from Billman's 1990-1991 survey. I digitized hand-drawn site polygons he traced on 1:10,000 scale topographic maps acquired from PETT in the early 1990s. These original survey data were also combined with unpublished site data from Moseley and Mackey's architectural survey of the lower Moche Valley. Most of the sites involved in my study were groundtruthed with GPS, and others were virtually surveyed using satellite imagery and aerial photographs. Integration of cultural data with the DEM generated a model of settlement in the valley. Design of the model is described in the next section of this chapter.

The MOP-GIS contains the following remotely sensed data acquired from multiple sources. There are many sources of high resolution data, such as SPOT (*Système Pour l'Observation de la Terre*, translated from the French as, "System for Earth Observation") and IKONOS (from the Greek word for image), which is imagery produced by Lockheed Martin Corporation's commercial satellite; but, they were too expensive or not available for the research area. Remotely sensed data sources included in the MOP-GIS database are:

- Aerial photography (1950s through 1970s)
- Declassified Satellite Imagery - 1 (1996 through 2002)
- Earth Observing-1, or EO-1, Advanced Land Imager (2001)
- Landsat 4-5 Thematic Mapper, known as TM (July 1982 to present)
- Landsat 7 ETM, or Enhanced Thematic Mapper + International Ground Stations
- Landsat 7 ETM + (June 1999 - May 2003)
- Landsat Orthorectified ETM + Pansharpened (2001)
- Landsat Orthorectified TM (2000)

I also produced a 5m resolution DEM of Cerro León in the middle Moche Valley using a *Leica Geosystems* total station. The job took three people over two months to complete during the field season of 2004, and the resulting 15,000 individual data points were processed to create isolines for elevation contours of the landform. In addition, a complete architectural layout of the MV225 site was produced. A "total station" is an Electronic Distance Measuring device (EDM) and a theodolite combined in one machine. It can quickly measure horizontal and vertical angles, and horizontal and vertical distances. An EDM sends out a light signal and measures the time it takes for that signal to travel from the EDM to a reflective prism and back again, using the rate-times-time algorithm to measure distance. The theodolite is a digital version of a traditional transit, an instrument that measures horizontal and vertical angles.

Fieldwork for mapping Cerro León began by walking over the area to find suitable set-up stations. It is immeasurable how much time can be lost by setting up the total station multiple times. Moreover, moving the instrument inevitably introduces errors in precision. Luckily, we were able to find a number of elevated positions that allowed us a relatively unobstructed view of the entire mountain. The instrument we used has a range of about 1 km, so we were able to develop communication techniques which allowed us to complete much of the survey from a handful of stations. Occasionally, hand signals were needed to address issues when radio communication was not possible due to forgotten fresh batteries or noise from high winds. There was one time in particular that my assistant comically attempted to inform me that she needed her tape measure and that she left it in the box.

Once the raw data was collected, I used *ArcGIS* to contour it. The software uses a triangulated-irregular network (TIN) to model the landform surface as a series of planar, triangular elements, each of which contains three neighboring data points. As I mentioned previously, there were over 15,000 points recorded for this project. As a rule, the more data points you have, the better your precision and accuracy will be. As a procedural note, it is very important for the person moving the prism to mentally visualize the totality of what is being mapped in order to assess the appropriateness of specific data points. Counterintuitive to most impressions about land survey, the most important job is not running the total station; once you get the commonly frustrating set-up down, it is a matter of point and click. Rather, it is jockeying the rod that is the more challenging job. It is this person that makes decisions about data point locations and takes detailed notes on the landform for reconstruction of a digital model. Because contour lines are not smooth initially, subtleties of topography are usually adjusted manually during post-processing. Given the particularities of the situation, it was fortunate that during the 2004 season I was running the rod and taking notes, along with another very competent assistant. Although we unexpectedly lost the crew member running the total station that season, using the raw data and my notes I was able to recreate the job and adjust our maps, while still representing the actual topography of the landform and spatial relationships of the architecture. Due to circumstances out of my control, the task of post-processing the Cerro León data was particularly more arduous than it should have been otherwise; but, the final result was well worth the effort [Figure 3-1].

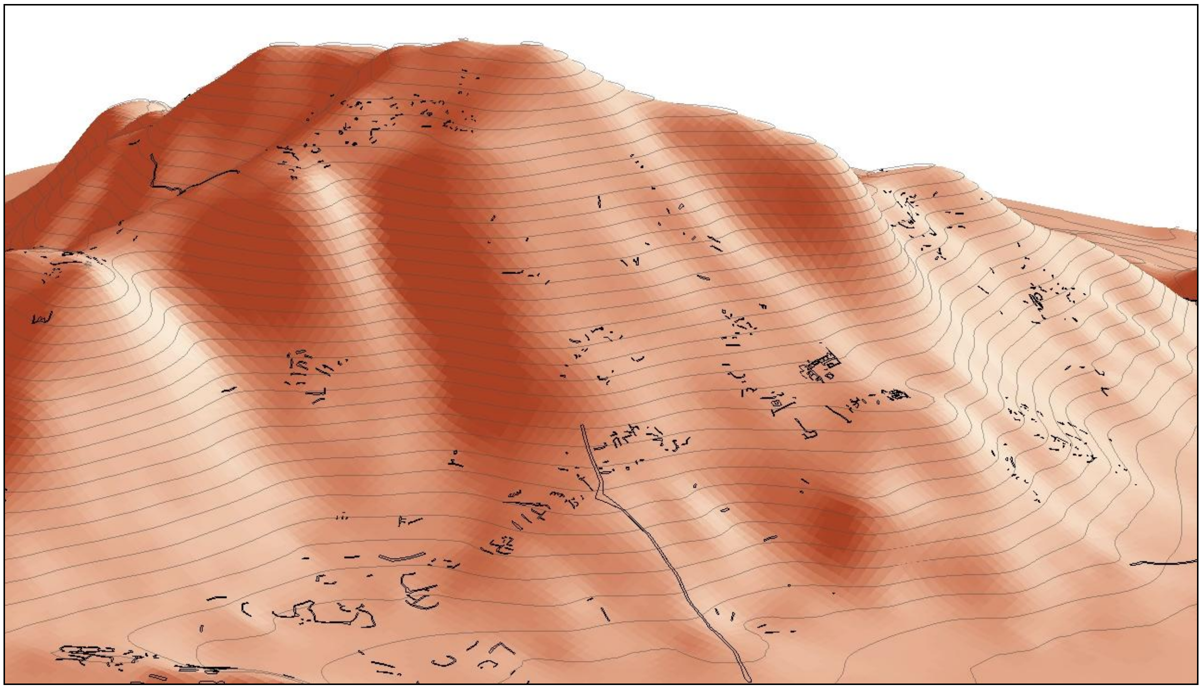


Figure 3-1. A 3d Model of the Cerro León landform with MV225 site architecture.

I used the MOP-GIS to create a number of explanatory variables to consider when modeling nonlocal and local sites. I mean "explanatory" in the statistical sense, such that variables are indicated to represent significant patterns. I derived these variables by implementing a battery of spatial analyses on multiple data sets.

A list of the analyses that I did use in my study are as follows:

- Query and description (general data query to describe spatial characteristics)
- Measurement (functional distances, friction surfaces and least-cost path analysis)
- Classification (neighborhood functions and buffers)
- Terrain analysis (elevation, verticality, slope, aspect, shape, and viewshed)
- Statistical surfaces (non-topographical and topographical interpolations)
- Spatial arrangement (area patterns, directionality, distance and adjacency).

Model Building

Conceptualizing one's specific geographic reality is the first step in building a GIS. In the modern age we model reality using digital data. When I began working on this project in 2003, digital representations of the earth were not as commonplace as they are now with the popularity of dashboard GPS and the ubiquity of *Google Earth*. What is still a mystery to many is how those digital realities are created. The first step in building a digital model of real-world phenomena is to choose what structure is most appropriate. Generally speaking, there are three structures for spatial data:

1. Raster, or Grid, model continuous surfaces
2. Vector, or Point/Line/Polygon, model discrete phenomena
3. Triangulated Irregular Network, or TIN (not used in my study)

When analyzing spatial data, conversion between vector and raster models is sometimes required. Data model conversion can create problems for accuracy and precision. The quality of a converted data model is contingent upon two things: the resolution of the original data and the process by which it is converted. For example, if any vector file fell below my threshold of 30 m resolution, I would not rasterize it because my base layer (the DEM) is 30 m resolution. In cases when rasterization was necessary, and possible, I used one of the following three methods: cell centroid, majority weighting, or priority weighting. For the centroid method the value at the center of each cell is assigned to the entire cell. This process is simple but can over represent small area values. The second method, majority weighting, returns the same value that covers the majority of an area. The final approach is priority weighting, which assigns the most important value as defined by the analyst to the entire cell. The latter method assures the presence of crucial spatial information that can be lost with the former methods, but is more time consuming.

It is important to maintain quality control when building spatial data models. Seven areas of quality control from the American Society for Photogrammetry and Remote Sensing are:

1. **Lineage**: the process of reviewing, checking and documenting all sources for materials from which information products were derived
2. **Positional accuracy**: how well information products represent two levels of geographic reality, planimetric space and elevation
3. **Attribute accuracy**: how well the GIS describes material reality
4. **Logistical accuracy**: (also known as logistical consistency) is a measure of how well geospatial data conform to real-world reliability
5. **Temporal accuracy**: the degree to which time is represented accurately in the GIS
6. **Semantic consistency**: also called semantic conformity, insures that data housed in a GIS are uniform and coded correctly
7. **Completeness** of database

Geospatial data in the MOP-GIS are held to a high standard of precision and accuracy. The lineage of all data in the MOP-GIS is recorded as metadata associated with each file. In every case, it is our intention to acquire the best available data for the MOP-GIS. Positional accuracy is always a concern for information products, particularly those that require *georeferencing*, a common procedure in archaeology because we often deal with historic maps. When analog maps are digitized, georeferencing defines the virtual map's location in geographic space so that it can be analyzed in a GIS. This process is done by 'pinning' down an image with mapped reference points that correspond to geographic coordinates in the real world. Once a map is digitized and georeferenced, it must be checked for positional accuracy. The most common technique used to check positional accuracy is to calculate the Root Mean Square Error (RMSE). The RMSE finds the square root of the mean squared error of a statistical estimator[1]. *ArcGIS* will calculate RMSE automatically in order to evaluate the positional accuracy of a derived information product. The acceptable standard error for MOP-GIS georeferenced data is less than 2.50 m.

The final three points for quality assurance are temporal accuracy, semantic consistency and completeness. Sources for checking temporal accuracy include archaeological, geophysical and geological data. Consistency requires that file names be intuitive and file structures are systematic, also an ASPRS standard. Completeness is a self-referential component of any GIS, but an honest attempt to assemble all relevant data should be considered obligatory. The MOP-GIS and its information products are a result of a decade of data acquisition and steadfast adherence to the principals outlined above.

[1] A statistical estimator approximates a quantity based on observed data, and the mean squared error represents the difference between values implied by an estimator and actual values.

Concluding remarks

There is compelling evidence for a settlement 'signature'; by which, I refer to architectural style as well as spatial organization and placement of sites relative to the overall settlement pattern. For my research, I used modeled probabilities with confidence intervals to add weight to the interpretation of ceramics found on the surface of prehistoric sites. Migration of foreigners to the North Coast is significant if it can be substantiated. It is apparent through large quantities of nonlocal pottery found during comprehensive pedestrian survey that the relatively sudden appearance of foreign material culture is probably correlated with a migration of nonlocal people.

In this chapter, I provided a background for settlement pattern studies and gave a brief history of the rise of GIS in archaeology. One of the most recognized ways in which GIS is used in our field is predictive survey. For decades, predictive survey has been instrumental for professionals conducting survey in both academic archaeology and cultural resource management (CRM). Because I am dealing with data from a comprehensive survey of the middle, lower, and portions of the upper Moche Valley, I am not trying to predict the geographic location of archaeological sites; I already know where sites are located. I use the MOP-GIS to derive spatially-explicit variables from samples of known archaeological sites, and then test these variables statistically to predict for occupational history. Once occupational histories are confirmed relative to social and environmental variables, I use the models to speculate on issues of culture contact and interaction.

Spatial analysis is often viewed first as the physical interactions between places on a landscape, and when those places are of human origin the analysis of social interconnections is considered secondary (Batty 2005). My study relies heavily on spatial analysis of human settlement; but here, the physical and social interconnectedness between sites is evaluated equally. In fact, in my study one is not validated without the other. Billman (1999) indicates that the key to successful settlement pattern archaeology is tailoring research questions to the appropriate scale of analysis and developing database systems, especially GIS, which allow for the easy manipulation of spatial scales. From a methodological perspective, this dissertation provides another example of the usefulness of geospatial modeling in archaeology. In Chapter 5, I discuss the results of my modeling effort using the MOP-GIS database to describe the spatial signature of migrant settlement. In Chapter 6, I use variables derived from spatial analysis to statistically evaluate relationships of nonlocal sites to one another. The following chapter describes architectural forms of interest in my study to provide a backdrop for the spatial and statistical analyses I use to infer contact and demonstrate complementarity between nonlocal and local inhabitants of the Moche Valley, Gallinazo Phase ethnotone.

CHAPTER 4

MIGRANT HOUSEHOLDS

> Because the household is defined by domestic criteria, it provides the best means of characterizing the resident population and differentiating between discrete ethnic groups. Due to the fact that the household is most directly associated with the domestic activities of resident peoples on archeological sites, it is superior in characterizing that population and factoring out nonlocal or exotic influences.
>
> (Stanish 1989:8)

Many early Andean scholars contributed to the reconstruction of a North Coast cultural chronology using variation in ceramics (see Bennett 1950; Collier 1955; Kroeber 1925, 1926, 1930; Larco Hoyle 1938, 1939, 1945a, 1945b, 1946 1948; Strong and Evans 1952; Uhle 1902, 1913; Willey 1946, 1946b, 1953). This traditional framework provides the model used by archaeologists for explanation of artifact variation between distinct cultural traditions because the "formal, spatial, quantitative, and relational" properties of artifact variability are clearly culturally distinct within designated time periods (Schiffer 1987:13-23); (for detailed descriptions of the four dimensions of artifact variability, see Rathje and Schiffer 1982). As with most, North Coast culture histories are also based on ceramic diagnostics. The spatial and temporal components of cultural affiliation for surface collected ceramics used in my study rely on interpretations of artifact variation prepared by past archaeologists. Through studies such as Max Uhle's early discoveries in 1902, Larco Hoyle's extensive excavations through the 1930s and 1940s, the Virú Valley Project in the 1960's, the Chan Chan Moche

Valley Project in the 1970's and 1980's and Brian Billman's middle valley survey in the 1990s, Andean ceramics are well documented.

Artifact assemblages from the Andean North Coast are comprehensive, and our understanding of the archaeological record continues to grow with continued research. However, interpretations of regional variability often change; ostensibly the results of models based on these interpretations also change. While I am making the case that nonlocal ceramic components appear to be highland in origin, thus occupants at sites with nonlocal pottery are probably ethnic-highlanders, the reader should keep in mind that the relationship between ethnicity and material culture is tied to accurate interpretation of artifact variability.

There are many formal and stylistic differences between local and nonlocal pottery found in the Moche Valley during the Gallinazo Phase of the EIP. One such distinction is the constricted mouths and elongated rims of highland-style jars. Billman (1996:265) describes "the primary utilitarian form [as] a globular olla with a constricted mouth and long, everted rim". There is often a thick band of red paint found on the interior lip of highland-style ceramics [Figure 4-1]. Perhaps the characteristic that most clearly distinguishes the two types of plainware pottery on the North Coast is paste color. The parent material of nonlocal ceramics is brown to reddish brown, noticeably different from the burnt-orange appearance of contemporaneous local ceramics [as shown previously in Figure 2-4].

Figure 4-1. Example of highland-style red slip decoration on interior lip of a rim.

By looking at actor-specific artifacts such as ceramic sherds, we are often able to resolve ambiguities of individual materiality and daily practice. Yet, pots are highly mobile material objects. It is difficult to distinguish between the commonalities and differences of settlement decisions with such transportable material evidence. When found, the current location of an artifact is known, but we rarely know its life history and how it came to rest there; any assumptions we make about the relationship of an object to its place of discovery should be tempered with that limitation. Alternatively, because households are fixed on the physical landscape, prehistoric decisions regarding daily practice can be understood through an analysis of spaces for living, playing, working and dying.

Ethnic groups often differ substantially with regard to settlement planning and architectural construction, and by extension, so do the cultural meanings of built environments (Isbell 1997; Moore 1996). Geoffrey Conrad (1993) finds that architecture is one of the most sensitive material indicators of ethnicity and confirms that differences between societies are reflected in the nature, size, composition, and material correlates of the household. Stanish (1989:12) writes that "ethnographic data support the proposition that the organization of Andean households varies between differing ethnic groups". Many built environments are of great antiquity in the Andes because their meaning is replicated through ethnic identity, e.g., areas for ancestor worship (Doyle 1988), facilities for ritual consumption and feasting (Hastorf 1989), and material remnants of systems for balanced reciprocity (Isbell 1977; Moore 1989). Through analysis of the use of space as a constituent element of daily life, archaeologists are better prepared to provide an answer to one of our discipline's most elusive questions: if we resolve to use inherently <u>immaterial</u> concepts such as ethnic identity for our theoretical underpinnings, then in what ways can we improve our interpretations of <u>material</u> culture to fit this paradigm?

Cerro León

The most extensive household-level archaeological investigation ever undertaken in the Moche Valley to date is at the site of Cerro León. Excavations here began over a decade ago and continue today. I first worked at the site in 2002. The area has a very long prehistoric occupational history, spanning multiple cultural phases, including a significant nonlocal interval. Most of the population settled on the north side of the mountain through the millennia. MV224 is a small single-component Gallinazo Phase domestic site built on the northwestern slope facing the river. MV225 is a large multi-component domestic site built across the entire north-facing slope of the mountain, with an elite compound at its center. MV223 is a single-component Early Moche Phase habitation site that is located below the mountain in an area called Cerro León *bajo*. The south side of the mountain has three separate nonlocal single-component habitations: MV230, MV236 and MV237 [Figure 4-2].

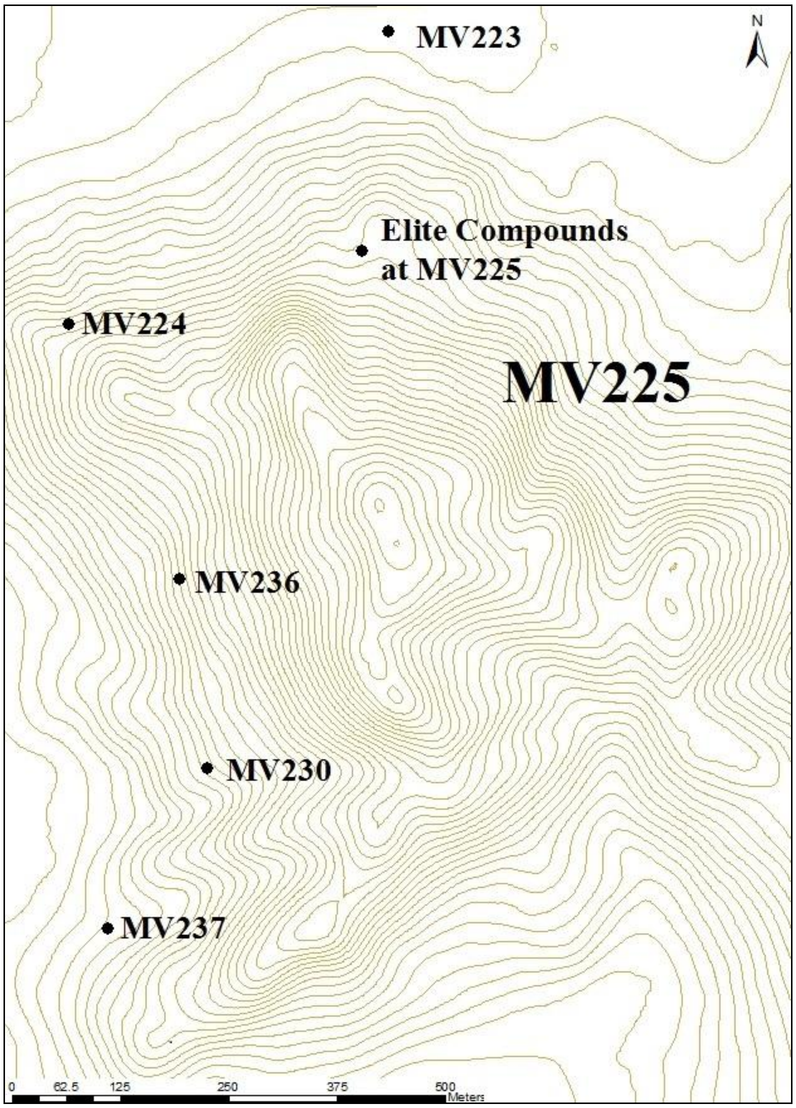


Figure 4-2. Sites at Cerro León (5 m contour intervals).

One of the most comprehensive architectural surveys ever completed in the Moche Valley was also conducted at Cerro León. MV225 is considered the *a priori* nonlocal settlement in my study because it is the largest, presumably highland, settlement with regard to area of constructed space and situated at the edge of the ethnotone nearest to indigenous settlements. The site is strategically placed with regard to upper valley access and important confluences of the irrigation network. MV225 covers the entire north and north-westerly facing slopes of the mountain, with approximately 2 hectares of measurable architecture, more than three-quarters of which is designated as domestic space (Fariss 2008). However, the site was once much larger than is recorded. Large areas of the site were inaccessible for total station survey because of unstable surfaces and extremely steep slopes. When I include the potential area defined by rubble wall fall with the measured area of intact walls, using a general guideline of 10 m^2 of floor space per person, the population living on Cerro León during its peak could have been in the many hundreds of individuals. At MV225, we have focused our excavation efforts on the elite compound and another associated minor compound below it [Figure 4-3].

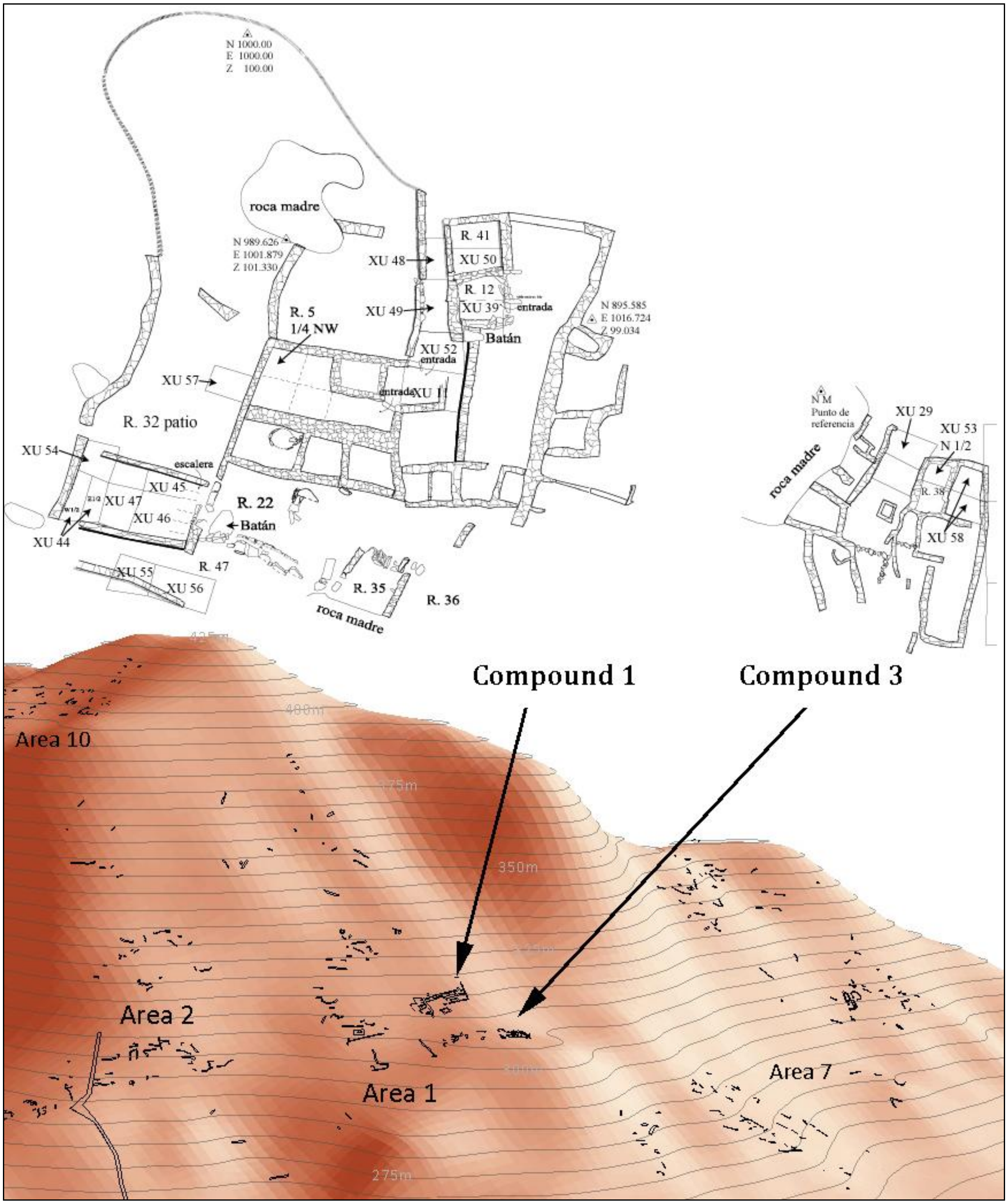


Figure 4-3. Cerro León with architectural areas indicated; Compounds 1 and 3, the elite residences, have been completely excavated (compound illustrations by Jennifer Ringberg).

The leading ceramicist and co-director of the MOP wrote that "the Cerro León pottery assemblage appears to have a closer affiliation to the adjacent sierra than to the classic Gallinazo occupations closer to the coast" (Ringberg 2003:54). The nonlocal plainware pottery indicates that the site has an affiliation with highland culture. The architectural qualifications (discussed in the next section) and the presence of kaolin at MV225 further support its status as an ethnic-highland elite compound. Kaolin is in appearance a porcelain-like fineware. It is rare on the North Coast prior to the Moche Phase of the EIP. Sherds from Cajamarca Serrano style kaolin vessels, like those pictured below [Figure 4-4], have been recovered from excavated contexts at Cerro León. Starting in the Late Moche Phase of the EIP, a coastal version of this highland style was produced with local variants in the Lambayeque and the Jequetepeque-Chamán region (Rucabado-Yong 2006:41).

Figure 4-4. Examples of Cajamarca Serrano style kaolin vessels (photo credit: *Proyecto Arqueológico San José de Moro* archives).

MV225 was built adjacent to an earlier coastal Gallinazo settlement constructed on the northwest slope of Cerro León, known as MV224. The Gallinazo site was built on very steep slope, considerably steeper than MV225, and was heavily fortified with large defensive walls and small, aggregated rooms. An adobe structure at the top of the site was destroyed by fire. Excavations revealed that the roof collapsed on top of a clean floor. The observation that no materials were trapped between the roof and the floor implies that the room was abandoned before it was set ablaze. The mode of abandonment at MV224 is not known, nor is the timing; but the site does not appear to have been re-occupied by nonlocal inhabitants.

MV223, an Early Moche Phase settlement, is constructed below Cerro León. It is a large site, nearly traversing the entire wash below. Much of it has been destroyed by modern development, but we have taken measures to protect the remainder of the site. Excavations at MV223 will continue during the summer field season of 2012. A 5 m resolution land survey of the wash and a map of all architecture will be included with the existing Cerro León model. In addition, the milling stone survey I conducted on the mountain will be expanded to include the wash below. Survey and excavation (including samples for flotation) should yield a great deal of multi-scalar data for comparative analysis of the occupational phases at Cerro León.

Social Space, Practice and Place

Daily practices "are predicated upon, and embody within themselves, the fundamental notions of temporal, spatial, and social ordering that underlie and organize the system as a whole" (Ortner 1984:154). In either a peaceful or violent living environment, there will be observable differences between households, because individuals order their daily lives according to broad principals of social organization and cultural categories of identity and style (Lightfoot et al. 1998:201). This perspective is exemplified by Bourdieu's (1977) concept of *habitus*, the cornerstone of practice theory, which conveys the totality of learned habits and informs individual style (or taste). When settlement decisions and architecture are considered in this way, we gain deeper insight into the daily lives of the individuals we believe made settlement decisions so long ago. The concept is useful to help transform the material remnants of prehistoric society into representations of social constructs like power,

Power dynamics must be understood in order to adequately describe complementarities and/or competition among prehistoric peoples.

Take for example the idea that defensive settlement patterns indicate conflict, or at the very least, preparation for conflict. My research shows that we should not make assumptions about conflict from survey of the architecture alone. I augmented the available settlement survey data with GIS and analyzed the total dataset with careful spatial analysis and robust statistical techniques. While not excluding interpersonal violence as the impetus for earlier settlement patterns, I am confident that daily life in Moche Valley during the Gallinazo Phase was not always overtly confrontational. To that end, Elizabeth Arkush and Charles Stanish (2005) lay out what site and landscape-level features do or do not indicate about defensibility, including "great" walls or incomplete walls, parapets (or the absence thereof), multiple doors, refuges, and lack of water sources. Billman's survey contains much of these data for each site. He may have drawn conclusions about the defensive nature of the overall settlement pattern from observation of these features at some of the sites in his survey.

There has been much written about the archaeological indicators of warfare (see Haas 1999 and 2001; LeBlanc 1999; Redmond 1994, Vencl 1984, Walker 1989; Wilcox and Haas 1994). I am reluctant to describe prehistoric interpersonal violence in all cases as warfare because of the ubiquitous nature of ritualized combat in the Andes. While Arkush and Stanish (2005) stress that ritual and war should not be considered mutually exclusive, in most cases ritualized combat takes place at a set place and time. One should assume that communities involved in such sanctioned battles have nothing to fear from an unannounced attack. I found that most of the settlements in the Moche Valley established after the Salinar

Phase of the EIP are not overtly defensive in nature, but the data do not support assumptions about ritualized combat.

It is not my intention to shoehorn a complex sequence of real events into a virtual reality of statistical models based on inferences and interpolations. I fully recognize that human society is conditioned upon stochastic events that project unintended consequences into the future. Archaeologists should not attempt to overly explain the nuanced events of everyday life from the material remnants of past society. In the classic texts we can read about a love affair that started a war between great nations, but there is no wall or sherd, nor bone or phytolith, that will tell that tale. However, I do believe there are many ways of approaching multi-scalar datasets and conceptualizing analytical models that allow us to differentiate ethnicities, describe settlements, and illustrate aspects of interaction among prehistoric people.

Architectural Forms

The concept of use can include many distinct forms. I use the following simplified classification scheme for identifying architecture in my study: public, private, and semi-private structures. Described below, these architectural forms represent use categories pertinent to my investigation. With respect to architectural function, one might distinguish 'use' based on the traditional attributes of size and location, but also on "style" (Hodder 1990). I did record the traditional attributes of rooms, but I also evaluated the arrangement of rooms relative to other rooms. I evaluated structures not only by architectural form, but also quality of construction, potential labor investment, and arrangement of associated features.

While public buildings often serve as focal points and are "distinct for functional and ideological reasons" (Marcus and Flannery 1996:87), domestic buildings are the most common type of structure in most communities, and changes in domestic architecture are viewed as "highly significant, often singling a shift in adaptation, household organization, political complexity, social status, or ethnic identity" (Bermann 1993:115). Identifying domestic architecture is the first step in modeling ethnicity because domestic structures "have stylistic features that can be used to determine the ethnic or cultural affiliations of the builders" (Aldenderfer and Stanish 1993:8). I assume that a house (i.e. private architecture) is primarily built by those planning to live in it, with help from extended families or groups with communal arrangements that have a long tradition of efficient construction techniques (McGuire and Schiffer 1983:278). Considering that efficient construction techniques are operationalized across the community and subject only to the most gradual changes, I expect contemporaneous households to have similar key architectural components.

While many aspects of Andean society are communal, each household probably performed most of its daily domestic activities independently. Domestic areas are characterized by "repetitive facilities and material culture" (Winter 1976:25). For example, most all houses have a hearth to warm and feed those living together. In my study, private architecture is identified by a lack of direct access, adjoining rooms that are small enough to be covered by a single roof and have intramural features, including secondary walls, patios, or benches. There is usually domestic trash in association with private architecture. Plainware sherd scatters inside rooms like those described above provided more evidence for classification of a structure as private (Bawden 1990).

Private architecture is also defined by structures and features restricted to certain individuals for production and consumption behavior necessary to maintain a household (Wilk and Netting 1984). Case in point, because batanes are symbolic of domestic daily practice at MV225, the interpretation of milling activity was important for accurately characterizing the spatial organization of architecture at Cerro León (Fariss 2008). A systematic survey of milling stones was useful for distinguishing between private, public and semi-private areas. An investigation of milling stones within the context of a comprehensive architectural survey illustrated use-areas for residents, as well as highlighted potential interactions between classes at MV225 (Fariss 2008). The model from Cerro León is used here for identifying similar architectural features at all sites in the settlement database.

In contrast to private architecture, structures intended for public-use traverse the domestic sphere by pulling resources and people away from households in order to carry out organized activities (Dillehay 1990). Through pedestrian survey, visible public architecture was identified in two ways: 1) size; and/or, 2) the lack of intramural features and domestic trash. At Moche Valley sites, public use areas are usually large, many of them too large to have been covered by a single roof. Most public-use areas do not exhibit intramural features systematized across the community.

Some architecture is considered semi-private by a presumed right to use determined by access. In a situation where a semi-private area appeared to be associated with a domestic structure, an inference can be made toward the power of that resident to mobilize labor in order to erect architecture where only a few individuals lived, but select others had access (see Costin and Earle 1989). Pozorski and Pozorski (2011:448) have this to say about architectural symbolism and notions of power:

> Traditionally, studies of architecture and political power or centralization have focused on such topics as extent of monumental construction and/or access patterns and restrictions in order to document elite power and privilege. Repetitive patterns, especially in architectural layout, can suggest associations between architectural forms and specific activities. Such patterns, taken together with a high degree of standardization, can also provide evidence of strong polity control. More broadly, the occurrence of coincident architectural complexes or traits at different sites can minimally serve to demonstrate connections between sites, but may also document polity expansion and intrusion.

I surveyed new areas in the upper valley and revisited sites in the middle valley to verify cultural components of occupation. I groundtruthed all locations with GPS and averaged the iterations to provide an estimated positional error of less than one meter. In order to provide a valid description of nonlocal architecture in the Moche Valley, I was compelled to reduce the total population to only single-component sites (n = 59). For comparative analysis of strictly nonlocal architecture I adapted small site methodology, as described in Chapter 2. Single-component sites are considered to represent a 'pure style' from which inferences can be made about architectural form and spatial organization. If a given site has only nonlocal ceramics present on the surface, then I assume the site's physical attributes are also nonlocal.

For descriptive examination of settlement and architecture associated with nonlocal ceramics, the total population of single-component sites was subjected to a directed sampling strategy whereby from nine study areas one site was selected for comprehensive survey and mapping [Figure 4-5]. In addition to the single-component sample sites, elite clusters and examples of Gallinazo and Early Moche Phase sites were surveyed. Previously recorded sites were resurveyed using a combination of GPS tracking and the traditional cartographic compass and chain technique. Site designation is MV (Moche Valley) and number.

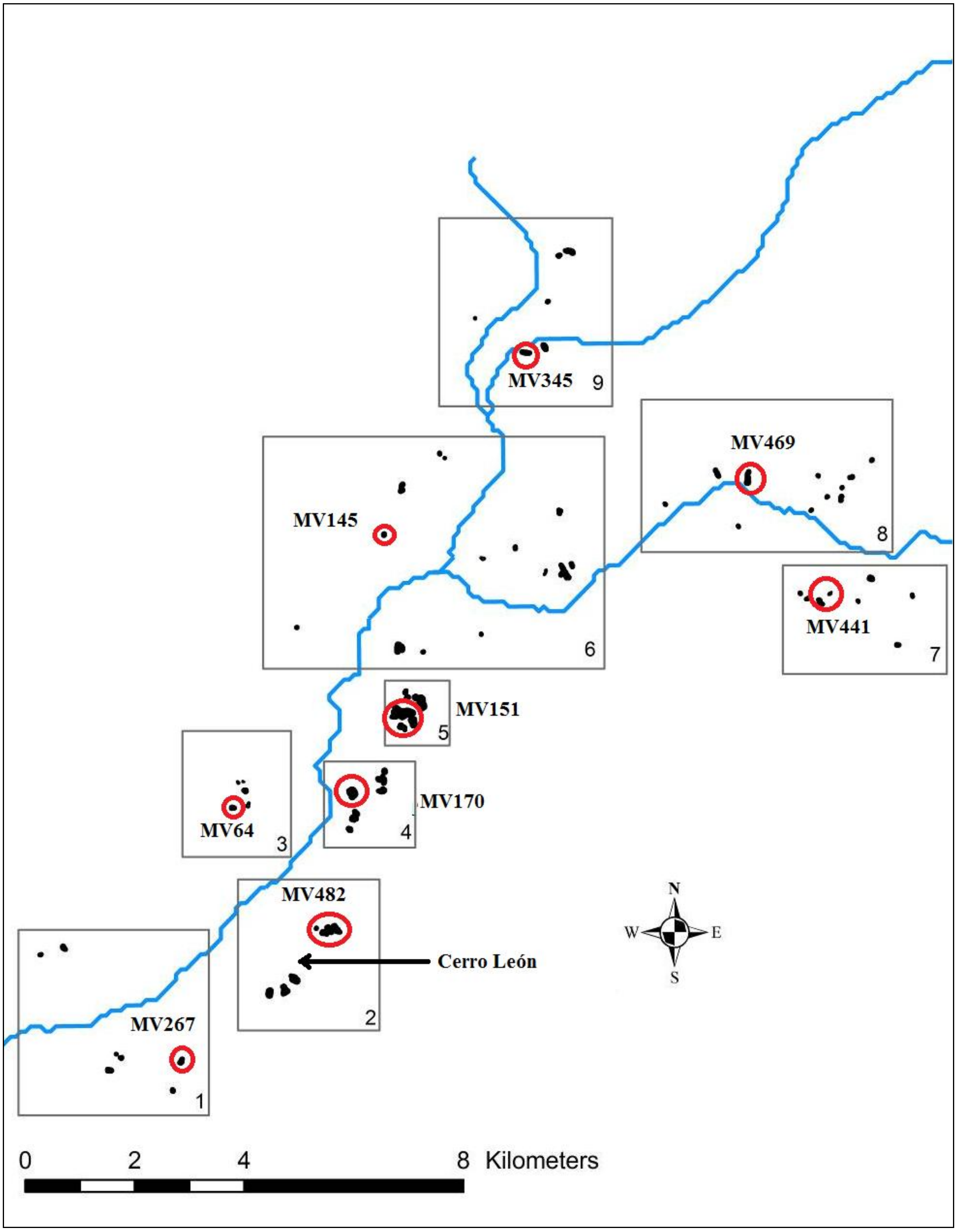


Figure 4-5. Nine single-component nonlocal site areas with sample sites indicated by red circles. Cerro León is identified in study area 2.

There are universalities to migratory settlement. The most noticeable pattern is that nonlocal sites are clustered around elite compounds. All sites are built on hillsides above the wash in proximity to irrigation canals and fields. Sites on the south side of the Moche River outnumber sites on the north side of the river 4 to 1. Most are built on moderate to steep slope, with a cut-and-fill terracing method that follows the natural contour of the topography. These retaining walls are usually double-faced at larger, 'wealthier' sites, while walls at smaller, more 'common' sites are relatively crude. Of the nine sites intensively surveyed, there are approximately 20 private rooms for every public space. However, if semi-private rooms are considered, the ratio falls to 5 private rooms for every 1 semi-private and/or public space. It appears that semi-private space played an important role in the spatial organization of nonlocal settlement.

The average room size across all sample sites is approximately 8 m^2. I do not have sufficient data to compare this finding to local sites, nor do I currently have sufficient data to compare nonlocal sites in the Moche Valley with sites in the highlands. My sense is that migrants typically built smaller, more compact structures as compared to their coastal neighbors. The largest average room size is 28 m^2, as compared to 2 m^2 for the smallest. This result, while not surprising, is telling. In nearly every case, one or two of the rooms at a site are disproportionately large compared to the rest, while there are a great number of very small rooms, rooms too small to have been living quarters. Using ethnographic evidence from descendent communities in the region, it is likely that the largest rooms belonged to the head-of-household, while the very small rooms were used for his or her storage (Fariss 2004). Descriptive statistics of these sites are listed in the following table [Table 2].

Table 2: Counts and sizes of room types for 9 single-component sample sites.

Site #	Private Rooms	Public Rooms	Semi-Private Rooms	Possible Corrals	Average Room (m²)	Largest Room (m²)	Smallest Room (m²)
64	18	0	2	0	8.5	18	2
151	47	1	12	2	12.5	30	1
170	76	0	22	1	12	48	1
267	19	0	0	0	6	12	2
345/346	14	0	0	0	4	4	4
385	36	1	8	1	9.5	40	1
441	26	1	5	0	8	36	2
469	30	0	0	0	7.5	25	4
482	69	1	18	0	8	40	1

MV64

This site is in the wash below, and directly across from Ciudad de Dios, MV83/84. While Ciudad is not part of the survey sample, it is a significant habitation site in the valley. Excavations took place at MV83/84 from 1998 to 2002. MV64 is indicated to be nonlocal by the singular presence of plainware ceramics with straight flaring rims and red slip. There is a moderate level of surface sherd density, at about 5-10 per m². Non-ceramic artifacts on site include basic lithic tools like scrapers [Figure 4-6], manos and batanes [Figure 4-7]; and a few examples of the more exotic lithic tool known as a donut stone [Figure 4-8]. The function of donut stones is not clearly established. The traditional interpretation is that they were used as mace heads or digging stick clod-breakers; yet, they might have been fishing net weights (Eling 1987:171) or water flow regulators in canals (Shimada 1994a:211). More recent studies from the Maya region of Central America have shown similar artifacts may have been used as “thigh-supported spindle-whorls” (Tomasic 2012:215).

Figures 4-6. Scraper. **4-7**. Batane with mano. **4-8.** Broken donut stone.

The architecture at MV64 is distinctively different from nearby coastal sites, MV75 and MV78. There are two types of walls here, as with all of the other sites in this sample. The style most associated with elite residences, which I call *slab and fill* [Figure 4-9], would have taken considerably more labor investment to erect. Slab and fill walls are generally large and very sturdy. This style is associated with elite status and is found predominately at larger, more established sites in the study area.

Figure 4-9. Slab and fill masonry wall in photo, with field map in profile.

The other most important type of wall construction is found at this site, as well as all of the other sites in the study. Pictured below with a profile drawing of a wall from MV64, is the wall type *stacked stone* (sometimes referred to as *dry-stack*) [Figure 4-10]. Stacked stone is most commonly associated with terraces. It is commonly found at large sites for delineation of intramural rooms. Most significantly, it is the only wall type found at most of the smaller sites that are not associated with elite status.

Figure 4-10. Stacked stone masonry wall, photo with field map in profile

MV151

MV151 is a very large site that could be considered a village if other sites in association are taken into account: MV149, MV150, MV155, MV179, and MV180 [Figure 4-11]. There is a large public-use area, probably a ceremonial center, located at the top of the site. It is positioned above two large, but non-defensive walls with open access. General habitation is constructed on steep slope with multiple well-built terraces. There appears to be one area of elite residence with two associated semi-private terraced features [Figure 4-12]. Single-component nonlocal designation is indicated by plainware ceramics with straight flaring rims and red slip. Decorated sherds present include white-on-red and white and orange-on-red. There is moderate surface sherd density, at 5-10 per m^2. Non-ceramic evidence on site includes basic lithic tools, including cores, manos and metates (batanes). Human bone on the surface is present, probably associated with looted graves. The area is heavily disturbed from looting.

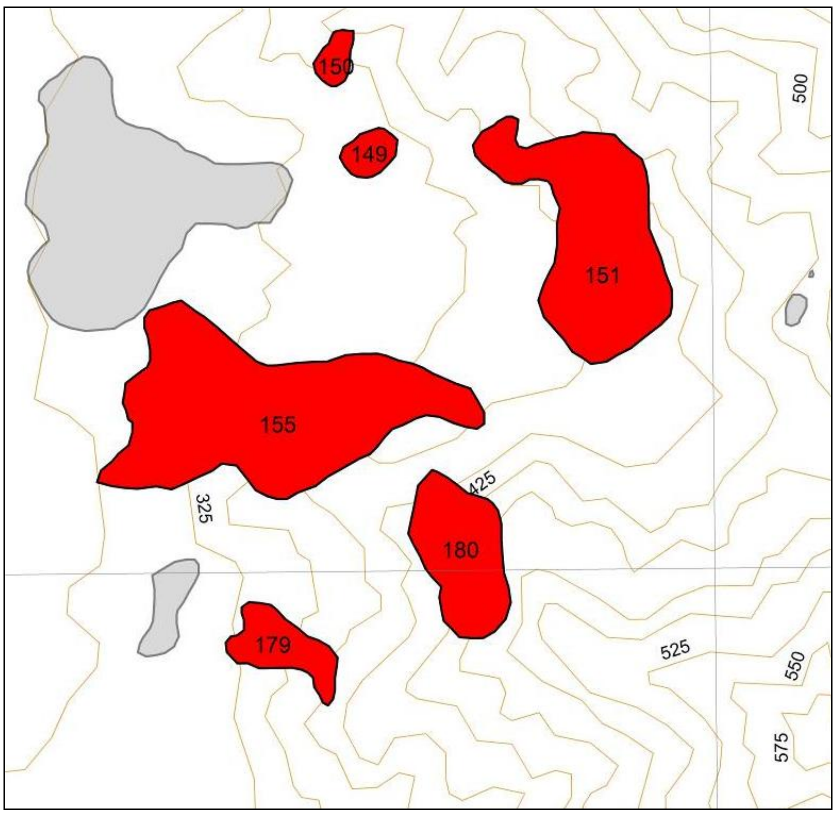


Figure 4-11. Nonlocal single-component elite cluster.

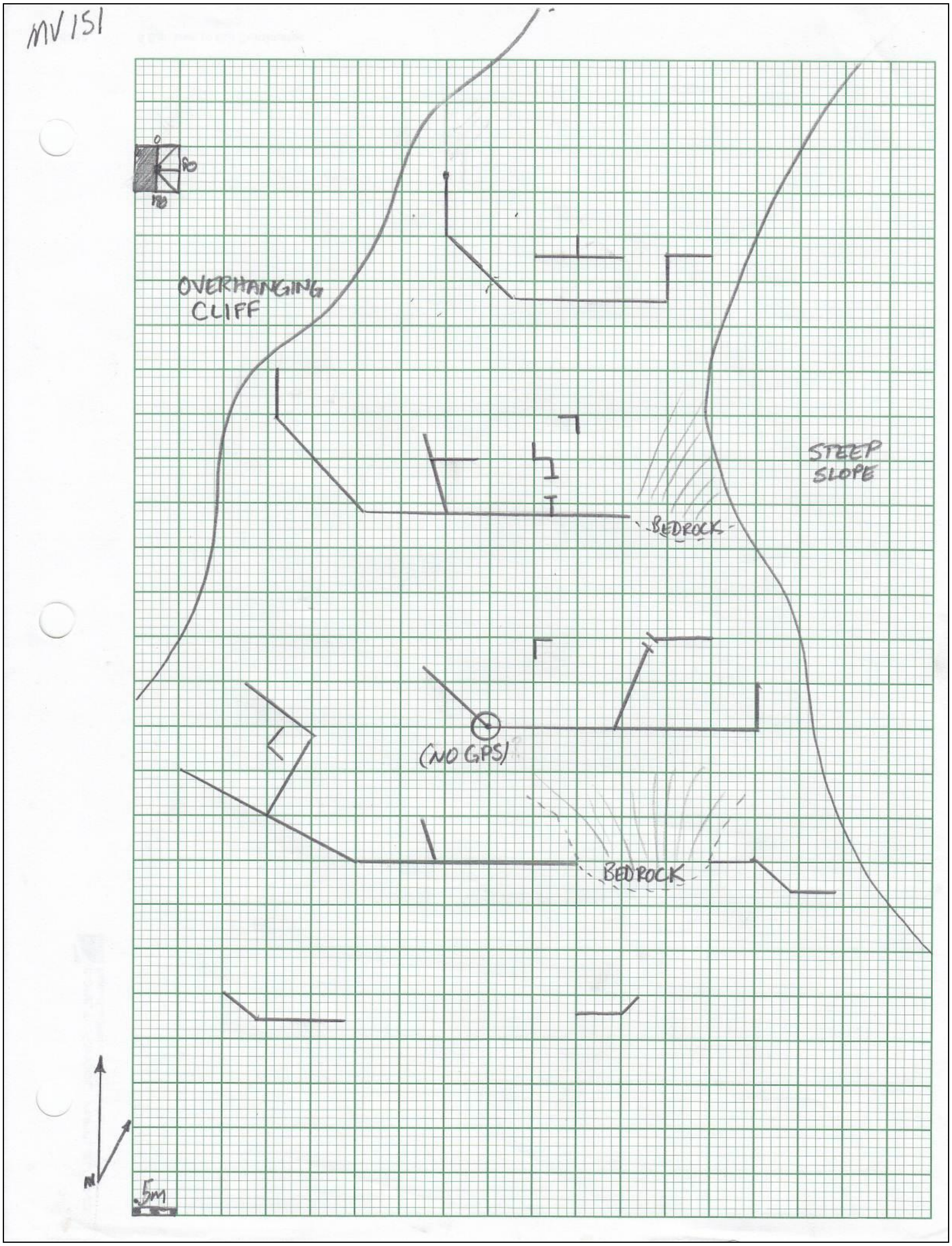


Figure 4-12. Planview of MV151.

MV170

This site is part of one of three elite clusters mentioned by Billman (1996) in his dissertation. Other sites in association with MV170 are: MV182, MV183, MV184, MV212, and MV214. This site has 16 well-constructed individual compounds, the most of any site in the Moche Valley during the EIP. The compounds are moderately sized, but densely packed with rooms. Each compound has evidence of at least one slab-lined burial cyst [Figure 4-13].

Figure 4-13. Example of an excavated slab-lined burial cyst from MV225 at Cerro León.

During initial survey at this site, Billman noted under *disturbance to site* that the location was "well preserved, [with] intact compounds, [and] limited looting" (Billman 1990). When I surveyed this site in 2010, I found the integrity of the site to be very poor. It has been heavily looted over the last twenty years. Nearly all of the walls have been reduced to rubble, and there is recent looter activity inside many of the old pits.

Single-component nonlocal designation of this site is indicated by the presence of red slipped, red clay plainwares with both long and short, straight flaring rims. There are some white on red decorated sherds present, including some artifacts with incised designs and burnishing. Billman (1990) indicated that he collected 1 kaolin bowl fragment with an incised decoration. No new kaolin artifacts were recovered during the most recent survey. The surface sherd density is moderate at approximately 5-10 per m^2. Another interesting, and novel, architectural feature is the niche [Figure 4-14]. One such niche was excavated in Compound 3 at MV225 and Julio Rucabado (personal communication) proposed that because of its relatively small size, such a niche might have been used to house idols or other personal talismans. There is one large retaining wall that surrounds the site, creating a visual barrier, but this wall does not appear to have provided a defensive parameter to the site. There were no sling stones or donut stones found on site. Other lithic materials include basic domestic tools including hoes, cores, manos and batanes.

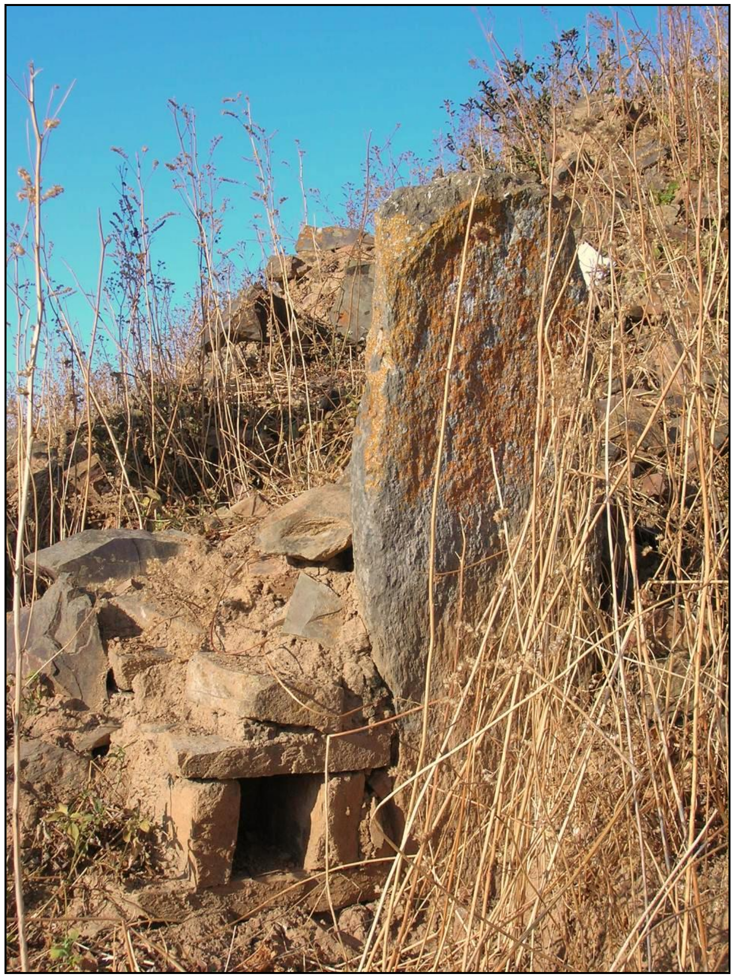


Figure 4-14. Example of a niche embedded in a wall.

MV267

MV267 is a small habitation site with no elite residences. There are approximately 12 individual habitations, with 1 to 5 small rooms each, widely dispersed across the site area. Walls are poorly constructed and relatively small. Rooms across the entire site are constructed with poorly consolidated stack stone masonry walls in shallow trenched terraces. There is little domestic trash and no batanes are present on site; however, there is a small sherd scatter at the bottom of the hill near a large batane, very close to agricultural fields.

There are a number of multi-component sites in proximity. There is no way to determine if this batane was used by the inhabitants of MV267. It is possible that the site evinced a short or seasonal occupation, or that the domestic trash was carried off, including batanes small enough to be carried, and used by another group living in the area. The site is indicated to be single-component nonlocal by red plainware. There is a very low density of surface sherds on this site, about 1-5 per m^2.

MV345

MV345 is located on a ridge top overlooking the confluence of the Sinsicap and Cuesta Rivers. The vista is remarkable, with a clear view of large irrigated fields below. The site is situated in the prime coca growing zone (discussed in the next chapter). Although most of the actual site has been destroyed by modern construction, there are traces of a few foundations and associated walls on the perimeter of the site. The slope below the ridge is covered with modern trash.

The site is indicated to be single-component nonlocal by sherds scattered around a modern concrete foundation, including red slip plainwares with long and short flaring rims. Billman collected 1 kaolin rim sherd during his survey (Billman 1990). No other diagnostics were identified. Sherd scatter is displaced due to disturbance at the site; as a result, there is no good estimate of density. There are a number of lithic tools in association with the site, including cores, manos, hoes, and batanes. There is some bone, possibly human. Billman noted that he identified some llama bone at the site (Billman 1990).

Because there is no way to measure the architecture at this site, I resurveyed the site just upslope from it, MV346. It is probably associated with MV345, as it too is a single-component nonlocal site indicated by the presence of red sipped plainware with long and short flaring rims. No decorated ceramics were found. The sherd density is light, at approximately 1-5 per m^2. There was no bone or other lithic artifacts found at this site. The architecture at MV346 is poorly constructed and the rooms are very small. Crude foundations are built on individual terraces that were probably used to erect cane pole structures similar to those found in the area today.

MV385

MV385 is constructed on a long narrow ridgeline. It consists of two major terraces, naturally conforming to the topography. The site appears to have one rather large, possibly elite compound with comparatively large rooms. The compound has limited access from the rest of the site. The walls are well-constructed and large in this area. The overall layout of the site implies considerable planning and labor were involved for construction. There is a clear partition between the upper (possible elite compound) and lower areas of the site. The lower area of the site consists of densely packed, smaller rooms with walls that are moderately well-constructed, but not as finely constructed as the ones above. The upper portion of MV385 has a single access point to multiple interconnected rooms [Figure 4-15].

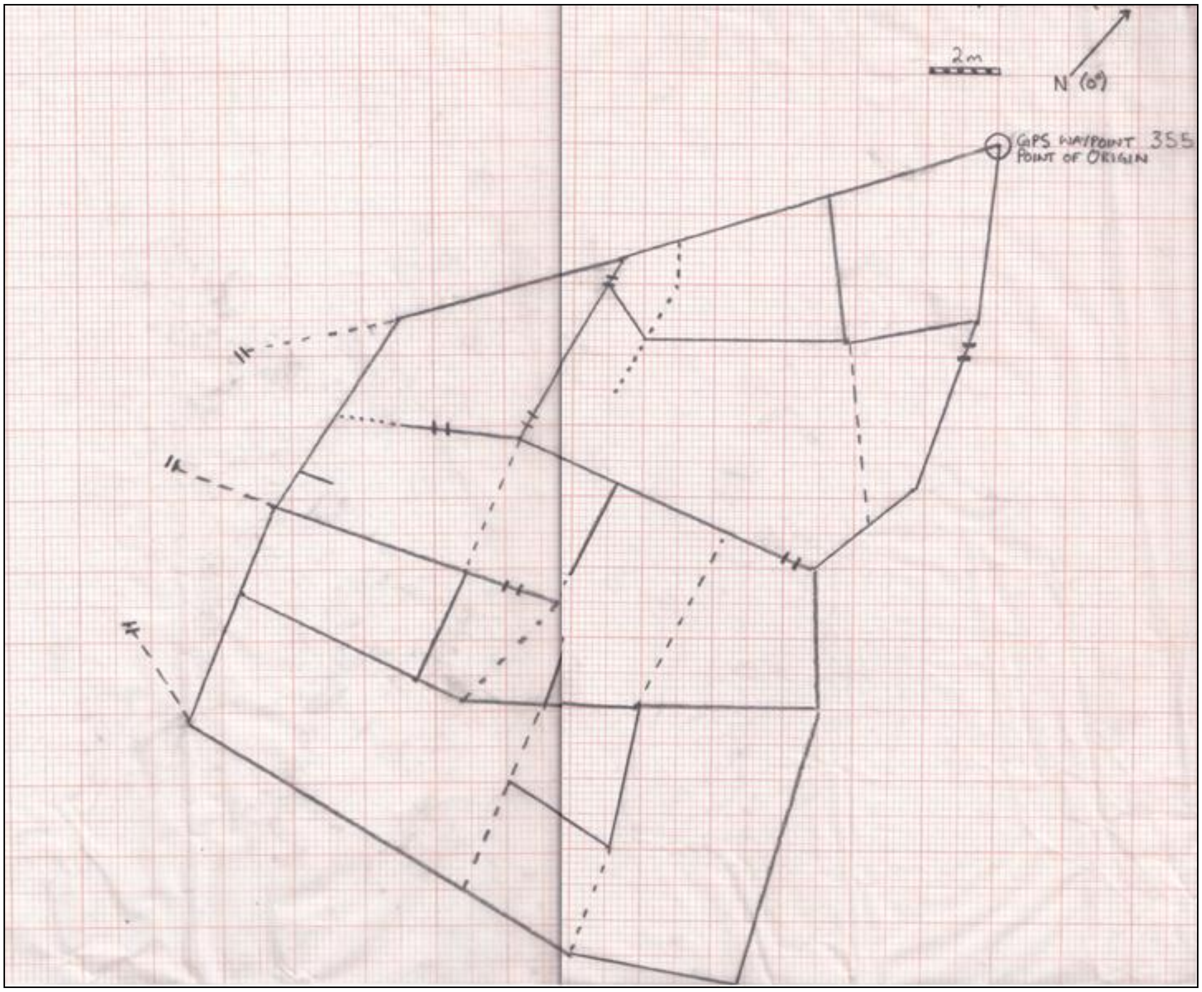


Figure 4-15. Planview of the upper portion of MV385; solid lines indicate complete walls and dashed lines indicate wall foundations. Doors jams are represented by the double dash.

The site is indicated to be single-component nonlocal by the presence of multiple red slipped plainware artifacts. There are some incised and burnished ceramics, as well as some polychromatic sherds with combinations of red, orange and white slip. In addition, there were some fragments of kaolin bowls found previously by Billman (1990). The sherd density is moderately light, with approximately 5 per m². There are many lithic tools scattered around the site; five batanes were identified. There were no projectiles or mace heads discovered, and although the site is built on steep slope with an elevated position, there seem to be no overtly defensive walls. There is no bone on the surface of the site. The site is moderately looted. Very large stones from the rubble wall fall cover much of the ground surface, providing some measure of protection from looting. As a result, the integrity of the site is moderately well preserved compared to other sites in the area.

MV441

MV441 is a small village located on a steep ridge just below the Carabamba Plateau, the proposed homeland of highlanders migrating into the Moche Valley during the Gallinazo Phase of the EIP (Billman 2002; Ringberg 2012). The site is located less than 1 km below a nonlocal hilltop fort. There is a visible path between the two that has prehistoric footings on the steepest portions of the climb. The site consists of six excavated terraces on the southeast side of the ridge following the natural contour of the slope. Each terrace is supported with double-faced retaining walls. The terrace at the very top is void of intramural walls and has no domestic debris. It was probably not used as a habitation platform like the five below it. There are also seven smaller terraces with habitation architecture on the north side of the ridge.

The site is indicated to be single-component nonlocal by the presence of plainware with straight flaring rims and red slip. Some decorated sherds include white-on-red and white-and-orange-on-red. There is moderate surface sherd density at 5-10 per m^2. There was no bone encountered on the ground surface. There are a few lithic artifacts, including manos and flakes. There is one large batane located on the north side on the site. The integrity of the site is good, probably due to its secluded location. There is looting, but the majority of disturbance to the site has been a result of erosion.

MV469

MV469 is considerably large and spread out, likely a moderately sized village. It consists of multiple long and shallow terraces constructed on the side of a very steep slope. Most of the architecture is degraded from heavy erosion due to flood events and loosely consolidated soil. While only five terraces are still visible, it is apparent that there used to be more. The site is indicated to be single-component nonlocal by the presence of plainware with straight flaring rims and red slip. There were no decorated sherds collected at this site. There is very light artifact density, less than 1 per m². What is most interesting to note about this site is its proximity to a very large cluster of considerably smaller sites [Figure 4-16]. There are a number of single-component sites about one kilometer up the valley from MV469, with not more than two or three rooms each. It appears as if most of these sites were occupied for a very short period of time. The architecture at these sites is crude and probably did not take much labor investment to construct. These sites may have been seasonally occupied.

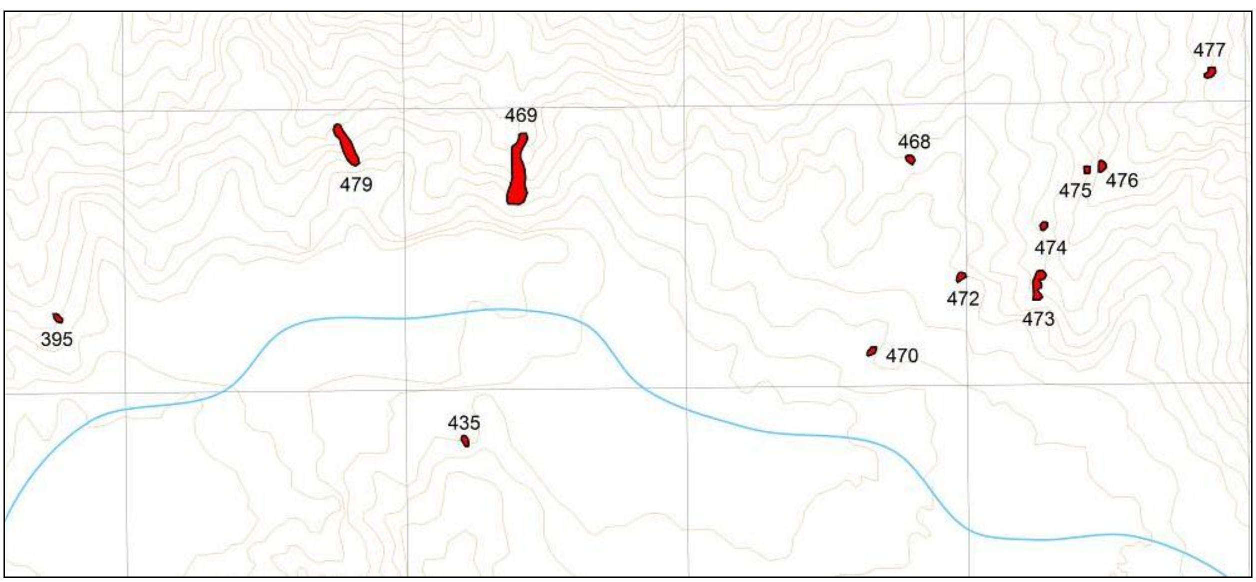


Figure 4-16. Cluster of very small sites in association with MV469, less than 1km east.

MV482

MV482 is located directly across Quebrada León from MV225. The full extent of both sites is reciprocally visible. It is a very large site, but does not appear to have been densely occupied considering the lack of intramural architecture and domestic trash. The layout of the site is quite different from other nonlocal sites in the sample. There are long footpaths, shored up by well-constructed masonry walls connecting pockets of architecture on the cliff side. This pattern is in opposition to densely packed terraces built with the natural contour of the topography. At this site, the planners formed the land to fit their needs. Many of the walls on this site are massive and must have taken a considerable amount of labor investment to construct. Also, most of the walls are double-sided and buried rather deeply in the soil. In some cases the bedrock is carved out to fit the pattern of construction. There are over 60 structures here, but not one them is noticeably larger than any other. There does not appear to be a notable elite residence at this site. There is a large platform built into the side of the mountain, with a bench on the back, against the mountain. The platform was heavily looted, and the surface integrity is poor. The platform space is accessible. It is not restricted by walls or natural impediments. It is considered public space. Behind the platform, up three narrow chutes that rise to the top of the mountain, there are multiple large retaining walls and terraces to the summit [Figure 4-17].

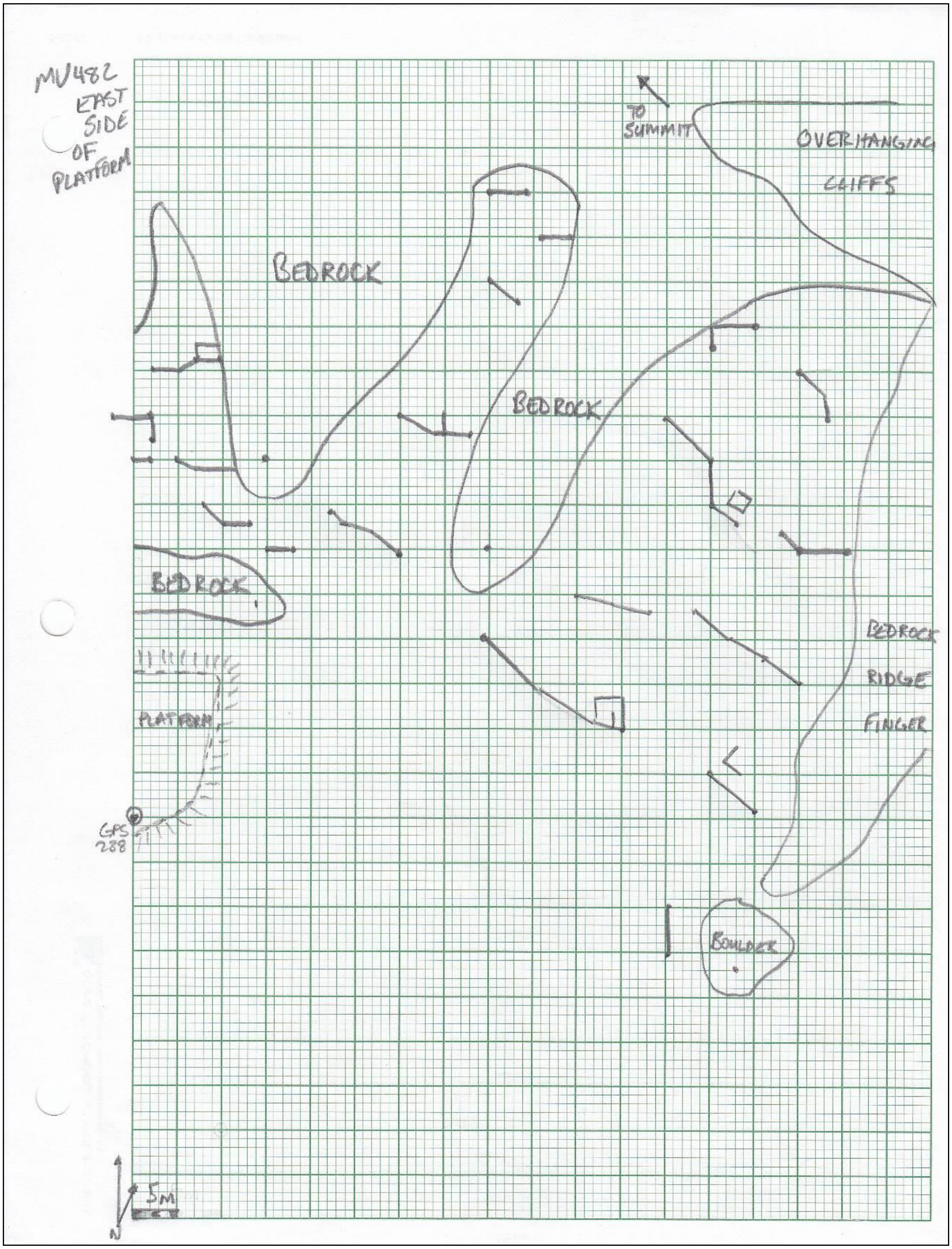


Figure 4-17. Planview of architecture at MV482.

The site is indicated to be single-component nonlocal by plainware with straight flaring rims and red slip. There are some decorated sherds, including white-on-red, and white-and-orange-on-red. There were some burnished and incised sherds collected, and it is noted that one kaolin bowl fragment was recovered during earlier survey at this site (Billman 1990). The surface artifact density is moderate, at 5-10 per m^2. There is some bone present on the surface, particularly just below the large platform. In the terracing above the platform there are multiple batanes. In addition to what I recorded, it is noted by Billman (1990) that there are large amounts of lithic materials, including cores, flakes, hoes, and manos. There is a very large quantity of small rooms (<2 m^2) on this site. Small rooms such as the one pictured below were dug into the mountainside, and probably used for food products that require cool and dark storage [Figure 4-18].

Figure 4-18. Small room built into the side of the mountain, possibly for storage.

Although I searched extensively, there does not appear to be a corral associated with this site. It should be noted that below the site, in the most likely location for an animal enclosure, there are a number of modern homes with gardens. If there was once a corral associated with this site, it is likely no longer visible. There is a late Gallinazo Phase/Early Moche Phase single-component site located just below, designated as MV220. In comparison with excavated contexts from sites across the quebrada at Cerro León, this area presents a good location to test for transitional settlement patterns. This site would be a good place for further investigation, considering that there is no large ceremonial area like this on Cerro León; the nature of its proximity and visibility to MV225 could be significant.

Overview of Nonlocal Sites in the Moche Valley

The sample described above provides a good overview of the different types of sites one might encounter in the middle and upper valley regions. All surveyed sites are built on moderate to steep slope above the valley floor. All sites are in proximity to an elite compound. Elite compounds are architecturally defined by large masonry walls and well-defined rooms with limited access. These compounds are usually located on the ‘prime real estate’ of a settlement. They are almost always surrounded by smaller stacked stone structures that may have been the platform for a group of contiguous residences. These smaller residences are assumed to be representative of the style that the general population was afforded by limited access to resources and labor.

Domestic function at the single-component nonlocal sites described above is indicated by all—or some combination of—the following artifacts: plainware sherds, batanes, manos, and other stone tools, such as hoes, hammer and donut stones. Trash deposits are usually visible on the surface due to heavy looting. Items might include human and animal bone, marine shells, and charred plant remains. Sherds of plainware ceramics encountered include bowls, jars, and large and small cooking and storage vessels. Numerous sherds from fineware bottles, bowls, and plates are present at larger sites. The presence of fineware ceramics in those areas, along with well-constructed masonry walls and terraces, suggest that these compounds may have been occupied by elite households. Rarely, but sometimes in these areas, precious metal, beads and spindle whorls can be found. Smaller, simpler structures and crude compounds relegated to the more undesirable areas of a site were most likely commoner residences.

These site types are important for developing a clear picture of migrant settlement. At small sites, usually located high on ridge tops or steep slopes, one gets a sense of the stratified society these inhabitants may have endured. One of the most significant observations I made was the sheer distance and difficulty of maintaining access to water at some of these households.

At larger sites, and sites associated with elite compounds, there are almost always many populated commoner residences in addition to the centralized large masonry structures. The rooms are more than twice as large at these sites; even the rooms among the general population are slightly larger and better built than those at other sites. All of the elite compounds include one or more public area, many more semi-private rooms, and a large enclosure, which could have been used as a corral.

Wealth on the Hoof

Pastoralism is not considered to be a common subsistence strategy among prehistoric coastal populations. However, it was as it is now, a mainstay of highland existence (Shimada and Shimada 1985). In the Andean highlands today, beasts of burden are also used for food and wool. My research leads me to believe that such animals were kept in large numbers at the three elite highland clusters. There is evidence from MV225 that indicates pack animals were kept in an enclosure built in a protected wash about 50 m below and to the west of elite residential compounds at Cerro León [Figure 4-19].

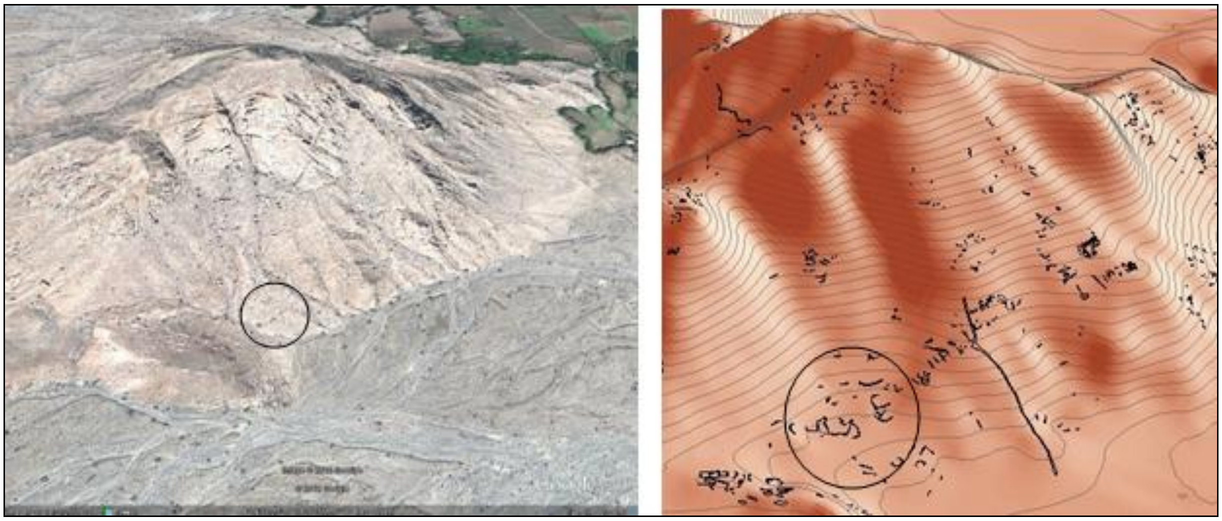


Figure 4-19. Area of potential animal enclosures; the image on the left is of Cerro León captured from *Google Earth* on January 20th, 2012; the image on the right is the architectural map at Cerro León generated from the MOP-GIS DEM (5m contour intervals).

Wealth on the hoof is an inextricable part of highland culture. Animals indicate wealth and status. Prehistoric livestock were llamas and alpacas [Figure 4-20]. Fortunately, because soils are particularly sensitive to changes caused by socio-ecological dynamics on the landscape (e.g. tending of herds of large animals) they can be a great source of spatially explicit, action-specific data (Peterson and Mohler 2002). A contiguous architectural structure that does not appear to be ceremonial, lacks intramural features, and is too large to be roofed by available materials could have been a corral. Continued use of such an enclosure by prehistoric animals would have enriched phosphorus (P) in the soil.

Figure 4-20. Llamas carrying climbing gear in the foreground; alpaca herd in the background

An inorganic element not commonly found in sterile desert sands, high P levels are often considered a by-product of animal waste (Sullivan and Kealhofer 2004). Phosphorus is widely distributed in nature, yet it is not found by itself in elemental form. Elemental P is very reactive and will combine with oxygen when exposed to soil, air or water. In such natural systems, P exists as phosphate, a chemical form of P whereby the atom is surrounded by 4 oxygen (O) atoms. Orthophosphate, the simplest phosphate, has a slightly different chemical make-up depending on the environment in which it is contained, from acidic to alkaline conditions. There are many methods for evaluating the level of P in a system. Choosing the correct method requires careful consideration of the source.

As demonstrated by Peterson and Mohler (2002) in the North Carolina Sandhills, a relatively simple and inexpensive P test-strip technique is available for evaluating cultural activity at sandy soil sites similar to those found in Peru. Using this method at Cerro León, soil from a designated area of MV225 was compared to three randomly selected soil samples from sterile locations not in association with architecture. The simple test revealed slightly higher than normal levels of phosphorus in the areas that appear to be corrals. The P test I used was recommended for soils with pH less than 7.0. The test reports P in *parts per million* (ppm). Phosphorus is not mobile in the soil; therefore, it should only be tested on the topsoil (0-6"). Relative levels for the P test were: Very Low = 1-5 ppm, Low 6-10 ppm, Medium 11-15 ppm, High = 16-20 ppm, Very High > 20 ppm. For my study, 10 random samples of topsoil were taken within each area tested. The score for each area is an average of all ten tests. The chart below [Figure 4-21] shows the level of P indicated by the average of all test-strips for the potential animal enclosure at MV225 and three other sample areas.

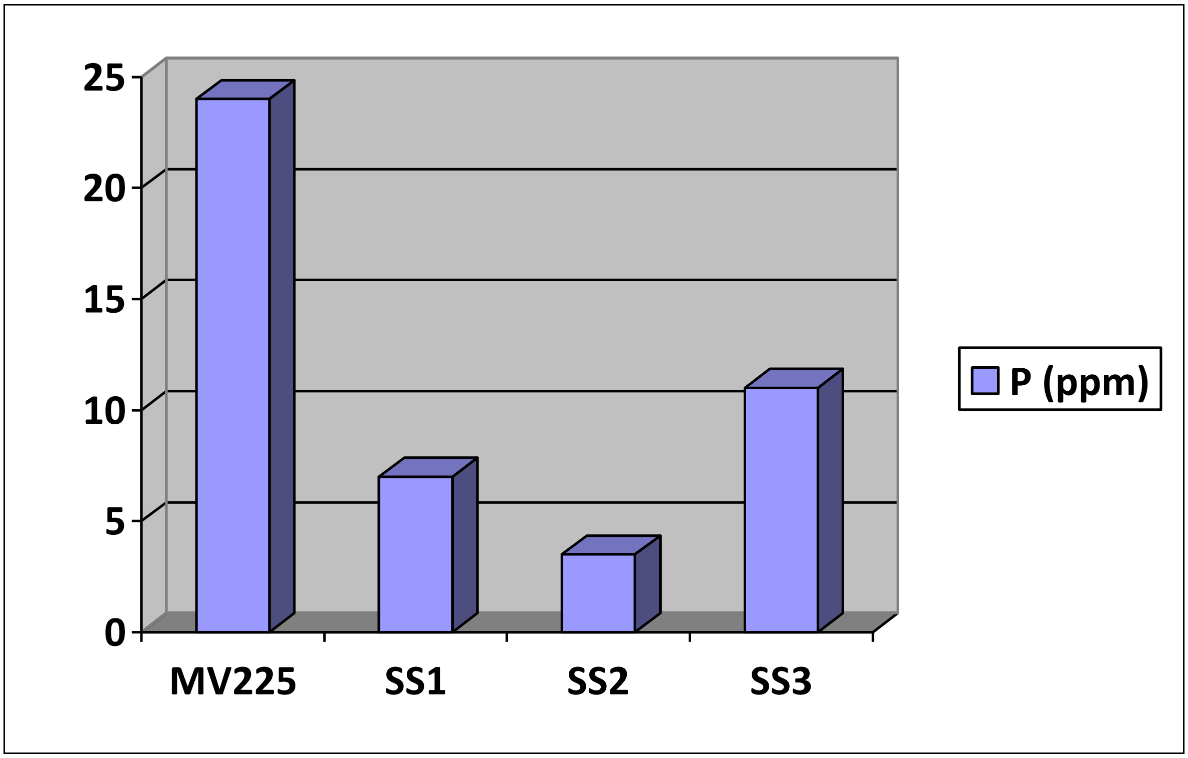


Figure 4-21. Average parts per million (ppm) of Phosphorus (P) at MV225 compared to random Soil Samples (SS) 1 – 3 in Quebrada León.

Albeit compelling, these findings are preliminary and considered strictly anecdotal. The P data as they stand now are not conclusive. However, there is reason to believe that the use of the area as an animal enclosure might be indicated by a more robust and systematic sampling method. Considering the theoretical implications of concluding that this area of MV225 was in fact a prehistoric corral, I feel a more precise study of soil chemistries is necessary. In the concluding chapter of this dissertation I discuss further the possibility for future directions involving a more sensitive study of soil chemistries at MV225, as well as at other sites in the Moche Valley.

Concluding Remarks

In this chapter, I describe architectural forms associated with nonlocal ceramics and illustrate the unique nature of migrant settlement in the Moche Valley. I believe that archaeological diagnostics for ethnicity are greatly improved by collecting, interpreting, and understanding evidence from architectural analysis and settlement pattern studies. It is also important to remember that archaeological interpretations of regionalized variability in material culture will likely change over time as new evidence and methods are brought into the fold. Models based on these interpretations must remain data independent, so that they are operational regardless of the current interpretation of material culture.

I identified three categories of architecture: public, private, and semi-private. They play a vital role in my interpretation of culture contact and interaction between nonlocal migrants and the indigenous coastal communities living in the Moche Valley during the EIP. For this study, I evaluate site architecture not only by form, but also by quality of construction, potential labor investment and the arrangement of associated features and their potential functions. The nine sites used for detailed description of migrant architecture were carefully mapped and surveyed multiple times. The architecture and collections from these sites were compared with data from MV225 at Cerro León. Cerro León is considered a good baseline for comparison because it is one of the largest nonlocal elite compounds on the North Coast and it is situated at a strategic location near a large local settlement at Cerro Oreja, the penultimate controlling polity in the region. A better understanding of culture contact in the Moche Valley during the Gallinazo Phase of the EIP will inform our understanding of a vitally significant period of Andean socio-political development.

Every site included in the survey is built on a hillside above the valley floor; finding 100% of sites located in the same physical setting is interesting. The remainder of this dissertation explores the reasons for this and other phenomena. There are many shades of grey between the black and white of an elite/commoner dichotomy, but determining the nuanced levels of class in migrant society is out of reach for this study. Therefore, sites are dichotomized by elite compounds and commoner dwellings. Both elite compounds and commoner dwellings are important for understanding migration and settlement in the Moche Valley during the EIP. Smaller sites associated with commoners are usually located on very steep slopes, or in some cases, on ridge tops very far away from fields and water. Elite compounds and larger sites associated with elite compounds have rooms that are more than twice as large; even the rooms belonging to the general population in these clusters are slightly larger and better constructed. All of the elite compounds include one or more public area, many more semi-private rooms; and, elite compounds usually have a large enclosure nearby, which could have been used as a corral. The elite compounds are architecturally defined by large masonry walls and well-defined rooms with limited access, usually located in the best areas with respect to resources. The elite compounds are usually surrounded by smaller structures that may have consisted of constituent resident households. It is highly likely that observed settlement clusters are also in some way a representation of a kinship system.

Claude Lévi-Strauss is strongly associated with the study of kinship systems. He developed the concept of *sociétés à maison* (house societies), the idea that the house is a key principle of social organization and a materialization of kinship (Lévi-Strauss 1987:151). For my study, the house is an important element of migrant society. Occasionally, the concept is used for conceptualizing the significance of domestic structures (Borič, 2003), and to understand material markers in complex prehistoric societies (Gillespie and Joyce 2000); such as with the Maya, where the relevance of houses as opposed to kinship is not absolutely clear (Houston and McAnany 2003:36-38). Houston and McAnany (2003) suggest that the Royal Court model may be more appropriate than the house model for understanding elite Maya society. However, the house society model is a good fit for characterizing elite society of nonlocal migrants in the Moche Valley, because it poses a structural form whereby daily practice is culturally contingent.

Given the theoretical framework for using architecture and settlement patterns to contextualize ethnicity, we must first recognize that archaeological datasets containing such information are often multi-scalar. Careful treatment of this type of data is important. The data used in my models include public, private and semi-private architecture a sites, as well as measurements for social distancing between sites (i.e. mobility and clustering) and proximity of sites to landscape features (i.e. field distance and suitable land for certain types of crops). These measures combined are considered settlement "proxemics". The concept of settlement proxemics plays a vital role in the interpretation of site placement. It is a way to explain behavior through constructed space. I have compiled inventories for the regional geography and local ecology related to settlement. These datasets provide the context for contact and interaction between nonlocal migrants and local groups living in proximity to one another. I investigate settlement patterns of entire communities, as well as architectural features of both common and elite households.

If interactions between human communities are relatively peaceful and cooperative, then one would expect the settlement pattern to appear normalized. On the other hand, if groups are in a relatively constant state of conflict, whereby a majority of the population is either engaged in regular combat or preparing for it, then one would expect that daily life for individuals is destabilized. In this case, household-level spatial organization and the overall arrangement of settlements would appear considerably more diverse. If conflict was endemic during the Gallinazo Phase, then nonlocal settlements in the Moche Valley would have trended toward logistically strategic locations, not in proximity to local settlements. It does not appear that settlement decisions at this time in the valley were driven by conflict.

CHAPTER 5

GEOSPATIAL MODELING OF A MIGRATORY LANDSCAPE

> Usually place unfolds greater associative power than time because it is more intuitively vivid. It is insolubly associated with memory, especially where the mutual relations involved are unique and emotionally charged. And because of the reciprocal relationship between memory and place, place remains the pivot around which memory entwines individuals in correlations that have taken on an ideal hue.
>
> (Simmel 1908:635)

Ethnicity is a concept of inclusion or exclusion from a group that is based on *non-material* cultural links such as kinship, religion, language, or the notion of shared territory. I describe populations of interest in this study by the latter, shared territory; they either belong to a local, indigenous community or to a nonlocal, migrating community. Differentiation of ethnicity can provide archaeologists with a better understanding of the interaction between geographic regions, particularly with respect to territoriality and political economy. If we define ethnicity by its non-material traits, the question then becomes for archaeologists: how do we distinguish ancient ethnicity when our craft, at its core, relies so heavily on the interpretation of material culture?

As Aldenderfer and Stanish (1993:7) point out, the underlying problem is that "if ethnicity is a self-referential, situational concept, we are going to have great difficulty finding it represented in the archaeological record". Aldenderfer and Stanish (1993) focus their analyses on ethnic groups in the Titicaca Basin, including the Tiwanaku, the Aymara, and other indigenous groups in the Osmore-Moquegua Valley. In their study, they show that each group exhibits homogenous characteristics that are observable and definable, particularly at the household level (Aldenderfer and Stanish 1993).

I began the last chapter with a discussion on the analysis of artifact variation and how it is used to spatially and chronologically order culture histories. In this chapter, I use ethnicity to order traits belonging to nonlocal and local communities on the North Coast. Artifact variation to describe culture history should not be confused with variation in ceramic tradition, because “a tradition may exist for any cultural trait or combination of traits” (Haury 1956:38); and, as a consequence, it is possible to have a tradition practiced by more than one ethnic group (Fortier 2001). As Emerson and McElrath (2001:199) point out, if ethnicity can provide “a social boundedness that we believe can, in certain circumstances, be equated with the archaeological recognition of local traditions”, then it is a way for archaeologists to operationalize the concept of tradition. Emerson and McElrath (2001) also call attention to the idea that ethnicity provides an avenue for archaeologists to conceptualize many local traditions as components of a differentiation. This sense of being different is part of a collective consciousness, which in many cases is dramatically expressed when culture contact situations involve asymmetrical power relations (Scarry 2001).

Many archaeologists in the Andes and elsewhere (see Creamer and Haas 1985; Ferguson 1990; Flannery 1972; Fried 1975; Haas 1990; Hodder 1979; Kimes et al 1982; Shennan 1989) note that ways of dealing with environmental stressors and/or social and political stress from migration, disenfranchised minority status, or violent conflict are factors for differentiation of ethnicity. Not surprisingly, differences in ethnicity are most evident in situations where people unexpectedly come into contact and a new social reality suddenly emerges, like that of refugees fleeing a war. But, in situations where two groups interact periodically over time, live in proximity, and have been aware of the other's existence for generations, the differences between groups can be more challenging to perceive archaeologically. Culture contact in the former example falls under the rubric of the core/periphery concept, while contact and interaction in the second scenario is analogous to the notion of an ethnotone.

Recognition of difference between ethnicities is crucial for understanding group interaction, because it is in those differences that we perceive the formation of society (Sassaman 2001). McClure (2007:485) and Sullivan and Rodning (2001:109) find that social structures and power relationships are embedded in the landscapes in which people live and interact with each other. There is a long history of interaction between highland and coastal populations in the Andes, perhaps dating all the way back to the Initial Period. By the Salinar Phase of the EIP, evidence for periodic raiding of the middle valley by highlanders is well established (Billman 1996). It appears that just a few generations later, during the following Gallinazo Phase, nonlocal and local groups are living together in the same location. I use architecture and settlement patterns as media to discern ethnicity, culture contact, and social interaction among communities living in a pluralistic social environment.

Data Analysis

Recall that my first objective is to capture the spatial signature of nonlocal settlements. In this chapter, I discuss the signature as a calculation of logarithmic odds that specific explanatory variables define a particular trait or set of traits for ethnicity. All of the survey data was tested independently in my model. Useful data from the survey was then combined with variables derived from the MOP-GIS.

Using the statistical package *R*, I calculated the predictive power of specific variables using one-to-one logistic regression from four data groups: general, defensibility, architecture and proxemics. Logistic regression is a type of statistical analysis that predicts the outcome of a binary dependent variable (only two possible outcomes, e.g., 'nonlocal' or 'local') based on one or more predictors. Under the general data group, nine possibilities are given for the categorical variable “function”. The functional classes are: multifunction, elite compound, domestic, non-domestic otherwise specified, fort, isolated occurrence (these are usually artifact scatters without architecture), Huaca (major ceremonial structure), ceremonial otherwise specified (minor ceremonial structure), and cemetery. Function as a categorical measure of difference is not statistically significant, but descriptive statistics show that nonlocal settlement is almost exclusively made up of domestic architecture. Also under the general data group, a test of site area indicates that the average local site is nearly three times the size of the average nonlocal site. Area was tested using only single-component sites. The last two tests in this data group indicate that there is significant difference between nonlocal and local sites with regard to average elevation and side of the Moche River on which a site is located.

Under the category of defensibility, two variables are significant for predicting nonlocal affiliation: slope and visibility. There are seven other variables under this data group. They are: proximity to cliffs, aggregated structures, perimeter walls, access walls, ditches, parapets, and the presence of sling stones (or other weapons). When tested independently, none of these variables indicate a statistically significant difference between nonlocal and local settlement.

As previously mentioned, distinguishing nuanced levels of class is out of reach for this survey. Only two variables, elite and common, are given under the data group of architecture. Although subjective, site status was carefully considered. Residences are evidenced by the type of wall construction (i.e. masonry form, lithic materials used and potential labor investment). Fineware ceramics like kaolin, and other rare artifacts like precious metals or shell beads, are good indicators for the elite status of residents at a particular site. Placement on the landscape is also a factor in the decision to characterize a site as elite or not. And finally, composition of rooms, overall design of the site and complexity of its spatial organization are all factors for identifying site status. In one-to-one logistical regression, the presence of elite structures proves to be significant for predicting nonlocal settlement, while common architecture is not.

Proxemics, the final data group, contains six variables: mobility, crop suitability, distance from nearest agricultural field, distance to available water (canal or river), clustering of sites and interaction between sites. As mentioned previously, the concept of settlement proxemics plays a vital role in the interpretation of constructed space within and between settlements. Understanding settlement proxemics can help explain decisions behind constructed space. The variable mobility is a measure of freedom of movement between sites and important landscape features. Mobility is considered a significant predictor for nonlocal settlement locations relative to accessibility to the highlands. Crop suitability was tested for two agricultural products because of their social significance, maize and coca. The Agro-Ecological Zonation (AEZ) model interpolates suitability zones of production. Proximity to high yield zones is significant for predicting nonlocal settlement. Two distance measures were conducted. The first, distance to agricultural fields (regardless of what can be optimally grown there) is not considered significant for predicting nonlocal settlement. Nonlocal sites are not significantly further away from agricultural fields than their local neighbors. Distance to water is also not a significant predictor of nonlocal settlement.

Nonlocal site clustering is obvious. From survey alone, one can tell that sites are clumped together on the landscape. Multiple analyses indicate the significance of clustering for predicting nonlocal settlement. The reason for clustering is not readily apparent; k-means and Principal Components Analysis were employed to explain the data variance. Lastly, interaction between sites was to be tested. A network analysis was initiated, but the available data are inadequate.

Testing different types of explanatory variables derived from several surveys and a comprehensive GIS database allows for detection of multi-scalar differences between distinctly different populations. With such an approach, we are better prepared to explore ethnic differentiation and speculate on the implications for culture contact and interaction. I calculated the predictive power of multiple explanatory variables as evidence for nonlocal settlement. The table below summarizes my results [Table 3]. In the remainder of this chapter, I discuss each of those variables in more detail.

Table 3. Nonlocal settlement signature model summary. *Level 1* variables are site-level and *Level 2* variables are landscape-level, each is categorized (highlighted); effect is the power of a variable (trait) to predict for nonlocal sites.

	VARIABLE	DESCRIPTION	TYPE	SOURCE	LEVEL	EFFECT
RESPONSE	**Nonlocal**	Diagnostic ceramics	Dichotomous	Survey	1	+
EXPLANATORY	*GENERAL*					
	Function	Multiple classes	Categorical	Survey	1	-
	Area	Site Size (hectare)	Continuous	Survey	1	+
	Elevation	Altitude of site	Continuous	GIS	2	+
	Moche River	Side of the river	Dichotomous	Survey	2	+
	DEFENSABILITY					
	Slope	Degree of slope	Continuous	GIS	2	+
	Cliffs	Structure near cliff	Dichotomous	Survey	1	-
	Aggregation	Structures adjacent	Dichotomous	Survey	1	-
	Perimeter	Perimeter wall	Dichotomous	Survey	1	-
	Access	Access walls	Dichotomous	Survey	1	-
	Ditched	Presence/Absence	Dichotomous	Survey	1	-
	Parapets	Presence/Absence	Dichotomous	Survey	1	-
	Sling stones	Presence/Absence	Dichotomous	Survey	1	-
	Visibility	Neighbors visible	Proportional	GIS	2	+
	ARCHITECTURE					
	Elite	Walls, placement and artifacts	Dichotomous	Survey	1	+
	Common	Walls, placement and artifacts	Dichotomous	Survey	1	-
	PROXEMICS					
	Mobility	Movement between sites and features	Continuous	GIS	2	+
	Crop suitability	Index value for coca and maize	Continuous	GIS	2	+
	Distance to fields	Mean distance to agricultural fields	Continuous	Survey	2	-
	Distance to water	Mean distance to available water	Continuous	GIS	2	-
	Clustering	Multiple variables	Proportional	K-means/PCA	2	+
	Interaction	Strength of interaction between nonlocal sites	Proportional	Network analysis	2	N/A
RANDOM EFFECT	Period/Phase designation	Temporal component	Categorical	Survey	X	X

The composition of settlement in the Moche Valley changed with the arrival of nonlocal migrants. Clusters of sites popped up around river confluences and at key points of inflection on the irrigation network. Migrants settling the valley built smaller sites compared to their new neighbors. The average area of a nonlocal site is .9 ha, while the average local site is 3.5 ha [Figure 5-1].

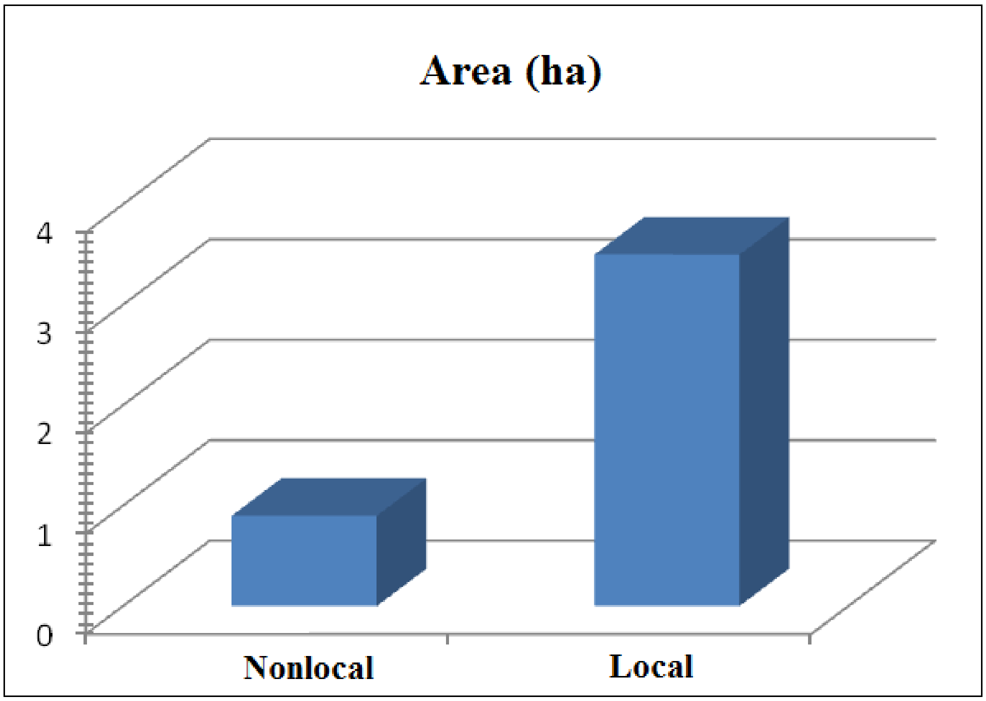
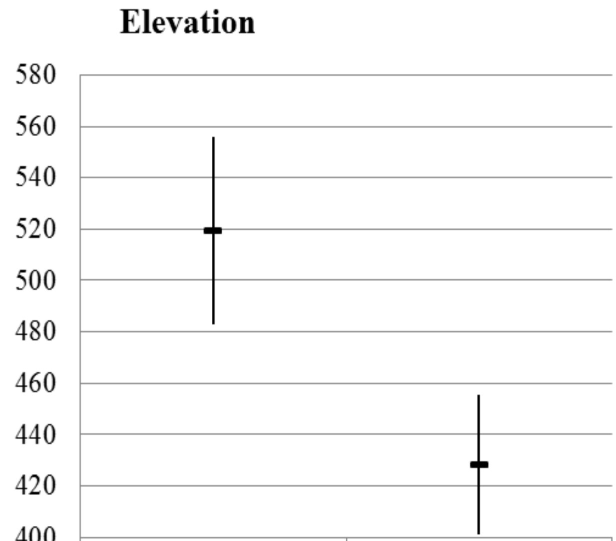


Figure 5-1. Area comparison of single-component EIP sites (N = 87).

Size and location are distinctive characteristics of nonlocal sites. Common domestic sites are generally no bigger than would be necessary to accommodate a few extended families, whereas the average local site is large enough to have housed multiple families. There is a predicted probability, with 95 percent confidence (.0485), that nonlocal sites are more likely than local sites to occur on the south side of the Moche River during the Gallinazo Phase of the EIP. Correspondingly, the Carabama Plateau and Otuzco Valley are south of the Moche River.

In a non-conflict centered scenario, over multiple generations relatively small groups migrated into the valley to build farms in niches of unoccupied territory not already under production by local families. Most of the new land that became available by expansion of the irrigation network was in the upper middle valley. The average nonlocal site elevation is approximately 100 m higher than the average local site [Figure 5-2]. If nonlocal sites indeed belong to highland migrants, it makes sense that the upper valley regions were first to be populated as communities gradually matriculated into the lower middle valley. Currently, there is no good measure for the time frame of these migrations. Many of the sites in the upper valley and upper middle valley may have been abandoned by the time middle valley sites were occupied, but for the purpose of this model nonlocal sites are treated as contemporaneous; they were occupied during the Gallinazo Phase, for about two-hundred years, give or take a generation or two.



	Non-Local	Local
Upper Bound (95% CI)	555	455
Lower Bound (95% CI)	483	402
Mean Elevation (msl.)	519	428

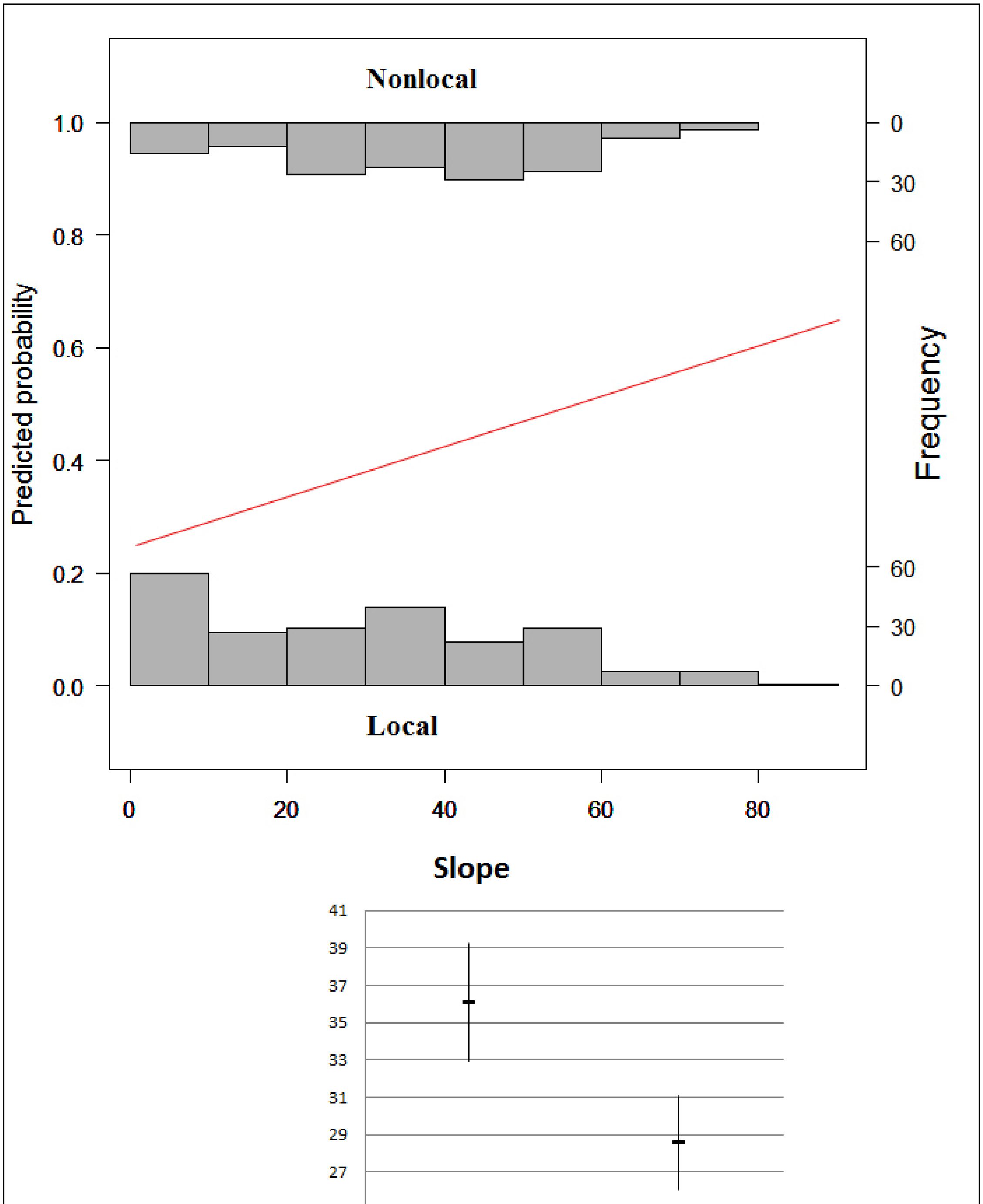
Figure 5-2. Comparison of average maximum elevavtions.

The Slope Model

It is the profoundly ubiquitous placement of nonlocal sites on steep slopes, coupled with the unambiguous lack of defensive components at those very same sites, which compelled me to consider alternatives to conflict-centered assumptions about culture contact and interaction in the Moche Valley at this time. I break away from conflict-centered assumptions about nonlocal settlement and call into question many tightly held beliefs concerning the tendency toward Andean warfare in general. It is possible that steep slope construction was the only defensive tactic migrants thought they needed, but my hypothesis is that if sites built on steep slopes do not have statistically significant inclusions of other defensive characteristics then steep slope construction is not motivated by militarily strategy.

Slope is mathematically defined as *rise* of an incline over *run* of that incline. Within a GIS environment, the change in elevation between cells of a DEM at a given spatial resolution is what constitutes slope. Slope in this case was derived from the MOP-GIS DEM at 30 m resolution. Initially, sites built on steep slopes were thought to be positively correlated with defensive strategy. Billman (1996) indicates that the settlement pattern of coastal communities shifted in this way as a risk mitigation strategy during the Salinar Phase of the EIP. His assumption was that if coastal people were responding to highland raiding in the Salinar Phase, then the observation that nonlocal sites are predominately located on hillsides must also be a reflection of conflict. A considerable body of literature devoted to settlement pattern analysis suggests a link between steep slope construction and conflict (Arkush and Stanish 2005; Carneiro 1970; Daggett 1985; Haas 2001; Ford and Willey 1949; and Wilson 1988 & 1995).

I began my investigation of this question by fitting a Generalized Linear Model (GLM) to the presence-absence data for nonlocal occupation during the EIP using the single predictor 'steep slope construction'. Steep slope in this model is defined by architecture built on an average slope of 30° or more. I specified binomial for the family argument. I set my confidence intervals at 95 percent. The degree of slope at all sites occupied during the EIP were tested, regardless of occupational components (N = 284). As observed during survey, steep slope construction was wide-spread in the Moche Valley. The modeled probability of the linear function for this predictor indicates that steep slope construction is significantly differentiated between nonlocal and local settlements in the Moche Valley during the Gallinazo Phase of the EIP. As slope increases, so does the likelihood that a site built on that slope is nonlocal [Figure 5-3].



	Non-Local	Local
Upper Bound (95% CI)	39	31
Lower Bound (95% CI)	33	26
Mean Slope (degree)	36	29

Figure 5-3. Steep slope GLM with frequency distribution indicates at 95% confidence that steep slope construction is a statistically significant predictor for nonlocal sites.

It is likely that there were many reasons for building a little house on a big hill. In order to test the claim that steep slope construction is indicative of defensive strategy, I investigated the potential for a causal relationship between steep slope construction and other corollaries of defensibility. I combined steep slope with seven independent variables of defensive posturing:

1) proximity to cliffs
2) aggregated rooms
3) perimeter walls
4) access walls
5) ditches
6) parapets
7) presence/absence of weapons (mace heads and sling stones)

Using this transformation, sites built on slope equal to or greater than 30° were ranked 1 through 7 for having 1 or more (up to 7) of these additional attributes. The second model indicates that cumulative defensive characteristics are not a significant predictor for nonlocal sites built on steep slopes [Figure 5-4].

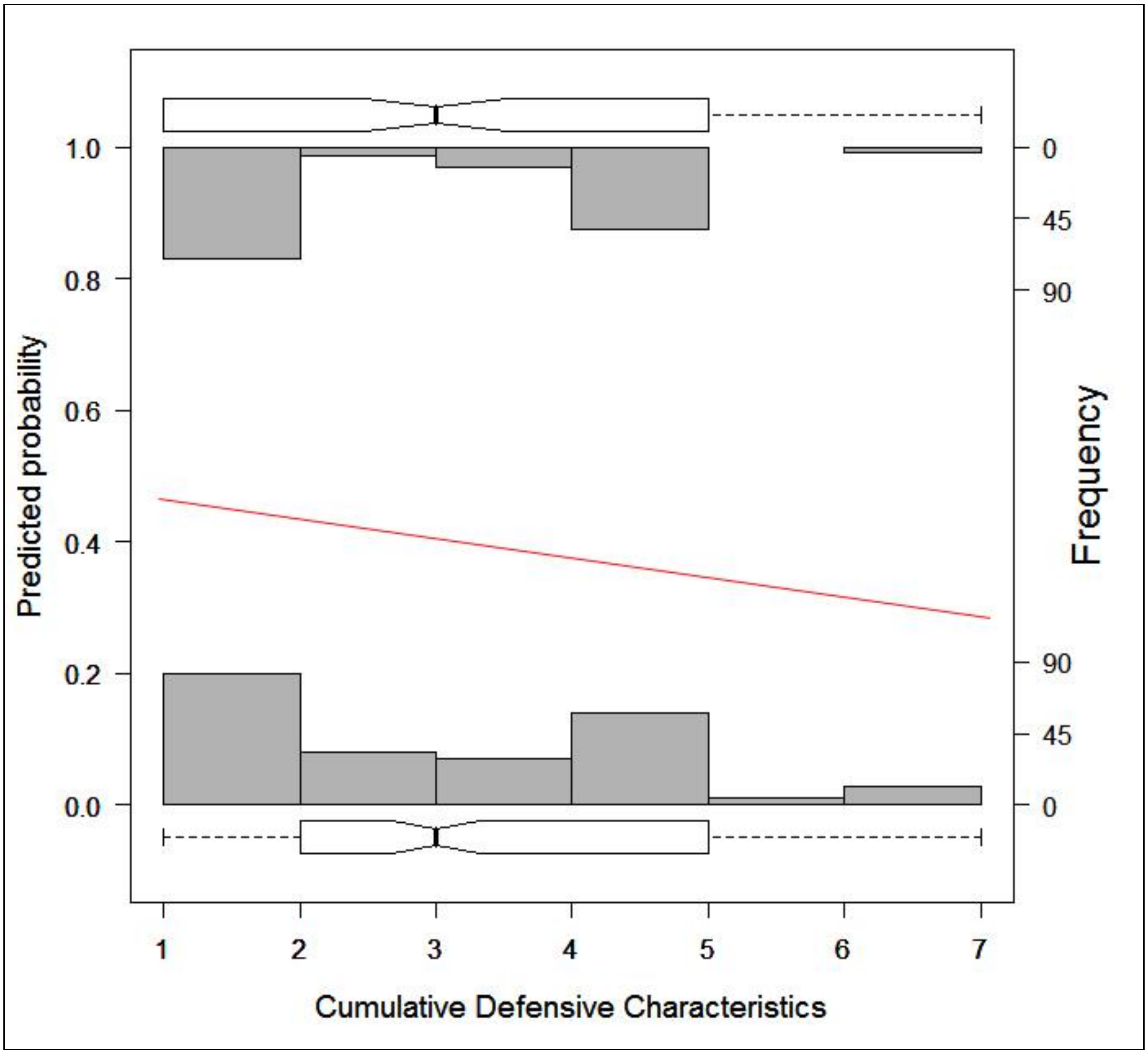


Figure 5-4. GLM showing lack of predictive power for cumulative defensive characteristics. With imbedded box plots of the frequency distribution histogram, this plot indicates the lack of power for cumulative defensive characteristics for predicting nonlocal steep slope sites.

While it is clear that building on steep slope is part of the nonlocal signature of settlement in the Moche Valley during the Gallinazo Phase of the EIP, archaeological interpretation of this finding should not necessarily be conflict-centered. Inference to the best explanation of these models is that the nature of interaction among these groups was probably less bellicose than previously thought. Consistent with this notion, Patricia Lambert (2011) presented recent mortuary evidence from Cerro Oreja, the largest local site occupied during the Gallinazo Phase, which demonstrates a significant decline in cranial trauma associated with violent conflict during this time period. If bioarchaeological evidence is ever brought into the fold of studying nonlocal migrants in the Moche Valley, one must take into account that while relatively high injury rates are often associated with aggression, they can also reflect the occupational risks of living and working on steep slopes (Lambert 2008).

Conflict-centered theories of culture contact and interaction persist in Andean archaeology, and for good reason. In many regions of the Andes, and at other time periods, it is obvious that ethnic conflict was endemic. Because nonlocal material culture is vastly reduced prior to the formation of the Southern Moche polity, it is reasonable to assume that "highland communities were forcibly removed from the Moche Valley" (Billman 1996:290). While it is possible that ethnic cleansing took place during the Early Moche Phase of the EIP, it is equally possible that nonlocal material culture faded as the ethnotone shifted further up the valley and people that stayed behind gradually became assimilated into Mochica culture. To know if communities were eliminated or forced out of the region, physical evidence of interpersonal violence is needed. Unfortunately, the fate of nonlocal communities in the Moche Valley prior to the rise of the Southern Moche polity is understudied. I suggest a continuity-model whereby nonlocal individuals eventually became local through cooperative social and economic institutions such as marriage and markets, respectively. Beyond interpersonal violence, it has been found that bioarchaeological techniques can also be used to identify gender-based migration patterns; such that, if sex-based differences in migration are detected, then it may be possible to reconstruct community organization as it relates to marriage (Tung 2012:44).

Results of the modeling discussed above show that living on very steep slope is a nonlocal decision probably not borne out of military strategy. Building on steep slope likely represented something more fundamental than functional. Perhaps settling on the steep slopes of the Moche Valley was an aesthetic choice. Furthermore, if it can be shown that the migrants were indeed highlanders, it is possible that living on the mountain rather than beneath it provided these people with a sense of normalcy in an otherwise alien environment. In any case, the models suggest that nonlocal settlements would have occurred on steep slopes in the Moche Valley with or without threat from a local population.

Cumulative Visibility Analysis

Visibility between contemporaneous sites was tested by conducting a Cumulative Visibility Analysis (CVA). Within a GIS environment, CVA identifies the cells in an input raster that can be seen from more than one observation point. In this case, the CVA is for cells visible from a given cluster of sites. Every cell in the output raster is valued by how many points are visible from each location and all cells that cannot be seen by an observer are given a value of zero. CVA is commonly used in archaeology to make inferences about the relationships of inter-visibility between related locations on a landscape (Wheatley 1995).

I initially predicted that this variable would be positively correlated with nonlocal settlement. As it turns out, inter-visibility among Gallinazo Phase sites is just significant enough to predict nonlocal occupation with confidence (.0495); yet, the fact is, sites regardless of occupational affiliation are predominately visible to other contemporaneous sites across the landscape. This is an underwhelming statistic considering the geophysical openness and treeless landscape of the valley, coupled with the elevated position of a vast majority of sites [Figure 5-5]. Site inter-visibility is not a strong predictor for nonlocal settlement decisions because local sites are predominately in view of one another as well. Below is a photograph taken from MV1000 on the ridge of Cerro Ramon. In 2006, I confirmed the site is predominately Chimú; but, there is a highland-style ceramic component present. I have reason to believe that excavation at MV1000 could reveal an earlier occupational phase for this site, placing it within the temporal range of the Gallinazo Phase migration interval. While MV1000 is not part of the settlement survey used for this project, the vantage point from here is indicative of a view afforded by the local topography.

Figure 5-5. View of the highlands above the Moche Valley from MV1000 on Cerro Ramon.

Interestingly, nonlocal site clusters are very much out of view from one another, indicating that nonlocal elites may not have been related; and perhaps further substantiating Billman's (1996) assertion that relationships between highland elites were tense. With regard to the militarily strategic placement of nonlocal forts in the middle valley, it is interesting to note that when viewshed analysis is conducted on the six single-component forts, three in the lower middle valley and three in the upper middle valley, nearly the entire Moche River watershed and irrigation regime are visible.

If the lack of site inter-visibility among nonlocal elite is considered a military tactic, then nonlocal communities may have been concerned with conflict. When the level of violence experienced by previous generations of the Salinar Phase is taken into account, we might assume that nonlocal leaders were at least somewhat concerned with military tactics in so far as they built six hilltop forts [Figure 5-6]. All of these sites are built near cliffs. Some of the sites have ditches and perimeter walls, which have parapets; and, at two of the forts sling stones are present.

Existence of these fortified places raises two questions in my mind: when were the sites built? And, were these sites used for protection from coastal armies or marauding highlanders, or both? Warfare is a social event that transcends individual life histories. Investigation into the chronology of these forts might tell us something about whether or not the migration interval was bookended by violence. Excavation at these sites could perhaps also help us understand violence among elites and/or between ethnic groups.

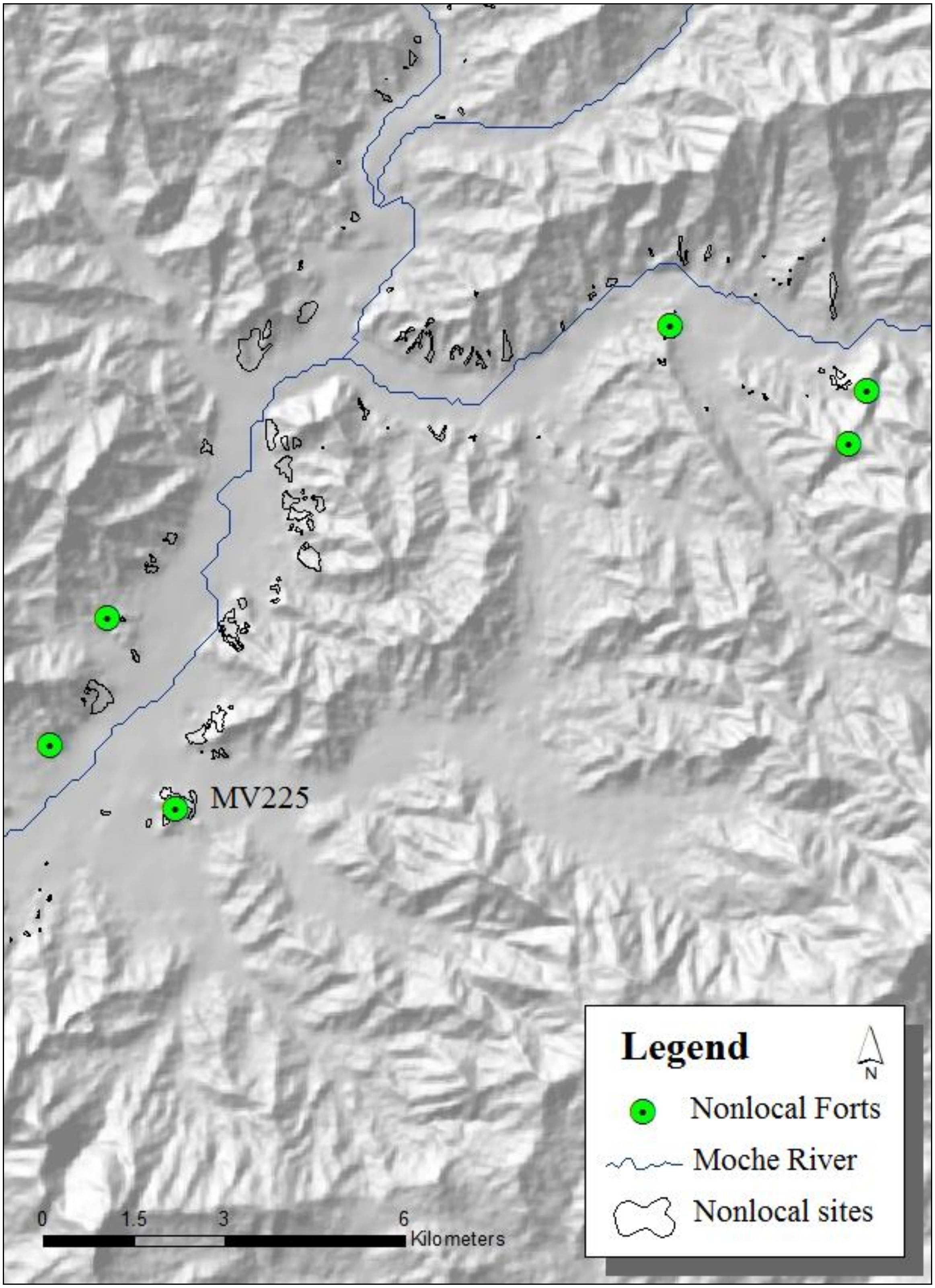


Figure 5-6. Location of 6 single-component forts in the study area; one is above MV225.

Questions about the nature of warfare during this interval will remain unanswered until further investigations are conducted. For this project, the most important question is whether or not site inter-visibility predicts for nonlocal settlement in the Moche Valley during the EIP. The answer is that while site inter-visibility is significant, it is not convincingly so. However, it must still be considered because the GLM indicates that CVA, as a variable, is positively correlated with nonlocal settlement. Yet, the borderline confidence of the result implies to me that site inter-visibility was probably important for all Gallinazo Phase families, regardless of the ethnic identity or political affiliation.

Modeling Mobility

The slope model is a frequently-used approach for determining least cost paths between locations (i.e., mobility). It has been used by many researchers in different fields of study over the years, and in many different physical environments (Lindgren 1967; Warntz 1957; Warren 1990; Wescott and Kuiper 2000). It bears noting that in the real world, travel costs are not strictly a function of slope, other impedances like ground cover, damage from extreme climatic events, or socio-cultural barriers (physical or imagined) are often present on a landscape. Given its composition and formation, the terrain in the Moche Valley is extremely unstable, as well as very steep. From personal experience, I know that the valley can be exceedingly difficult to traverse safely in some areas. On the other hand, the valley floor is filled with poorly sorted, unconsolidated flood debris. The physical characteristics of the valley floor are tantamount to a cracked and churned up desert that is relatively easy to traverse by simply following flash flood conduits and river drainages. In the Moche Valley, just as water takes the path of least resistance (as defined by slope), so do people. When you are walking in the coastal desert, it is often best to take the easiest path rather than the fastest path. With this in mind, 'least cost' should be equal to the least amount of energy exerted in getting from one place to another, rather than the least amount of time spent traveling from point 'a' to point 'b'.

Mobility is defined by calculating the path of least resistance between settlement samples. First, a friction surface based on slope for the entire valley is interpolated from the DEM, and then sites of interest are plotted on the resulting map. Execution of a least cost path analysis transforms the slope model into a cost distance model for traversing the generated friction surface via the path of least resistance. This is referred to as cost distance. Executing the Cost Distance function in *ArcMap* is prerequisite to a cost path analysis. The cost distance raster only tells you the least accumulated cost of getting from an individual cell to the source; it does not show you how best to get there. A direction raster provides the route to take from any given cell, along the least-cost path back to the source.

With regard to my investigation, cost path analysis determines the best possible route across Moche Valley terrain. The least amount of resistance is found on the path with the lowest degree of slope for each cell on the raster surface. To calculate the least accumulative cost from each cell to the nearest source, the Cost Distance function needs a source (nonlocal elite clusters) and a cost raster (interpolated from the DEM). The idea is that 'cost' increases as slope increases per a user-defined unit of land, which is defined here by the 30 m cell resolution of the Moche Valley DEM. Once the friction surface is derived, a cost distance raster is created and least cost paths are computed.

The degree to which nonlocal sites are oriented on the landscape with respect to ease of travel was initially predicted to be a significant predictor for settlement. Mobility between individual sites was not indicated to be significant using the standard GLM. However, when visualizing directionality of movement on the virtual landscape, clustering around elite compounds seemed to have been important for access to the Carrabamba Plateau and Otuzco Basin. This notion was tested by ranking clusters in terms of access to these locations on the landscape. To quantify access to highlands I used the Corridor function in *ArcMap*. It is part of the cost path family of operations, but works in a slightly different way.

With least cost corridor analysis, instead of returning an output raster with paths, it returns a raster whereby for each cell the accumulative cost of two input rasters is calculated. The sum of the two categorizes for each cell a least-cost corridor from one source to another source that passes through locations of interest. For this analysis, I connected the highlands (Carrabamba Plateau and Otuzco Basin) and nonlocal sites in the Moche Valley with the DEM to identify an optimal corridor for travel. To create these corridors, two cost accumulative rasters (one for each set of sources) were created using Cost Distance, just as I did with the least cost path analysis described above.

To test the predictive capability of this explanatory variable, I calculated the point density of local sites from the Gallinazo Phase and then grouped them into settlement clusters. Comparing clusters, I ranked access to the highlands as: 1 = little access; 1.5 = low to moderate; 2 = moderate; 2.5 = moderate to high; and 3 = exclusive access to one or both of the designated features. In the context of clusters rather than individual sites, mobility does prove to be decidedly correlated with nonlocal settlement [Figure 5-7].

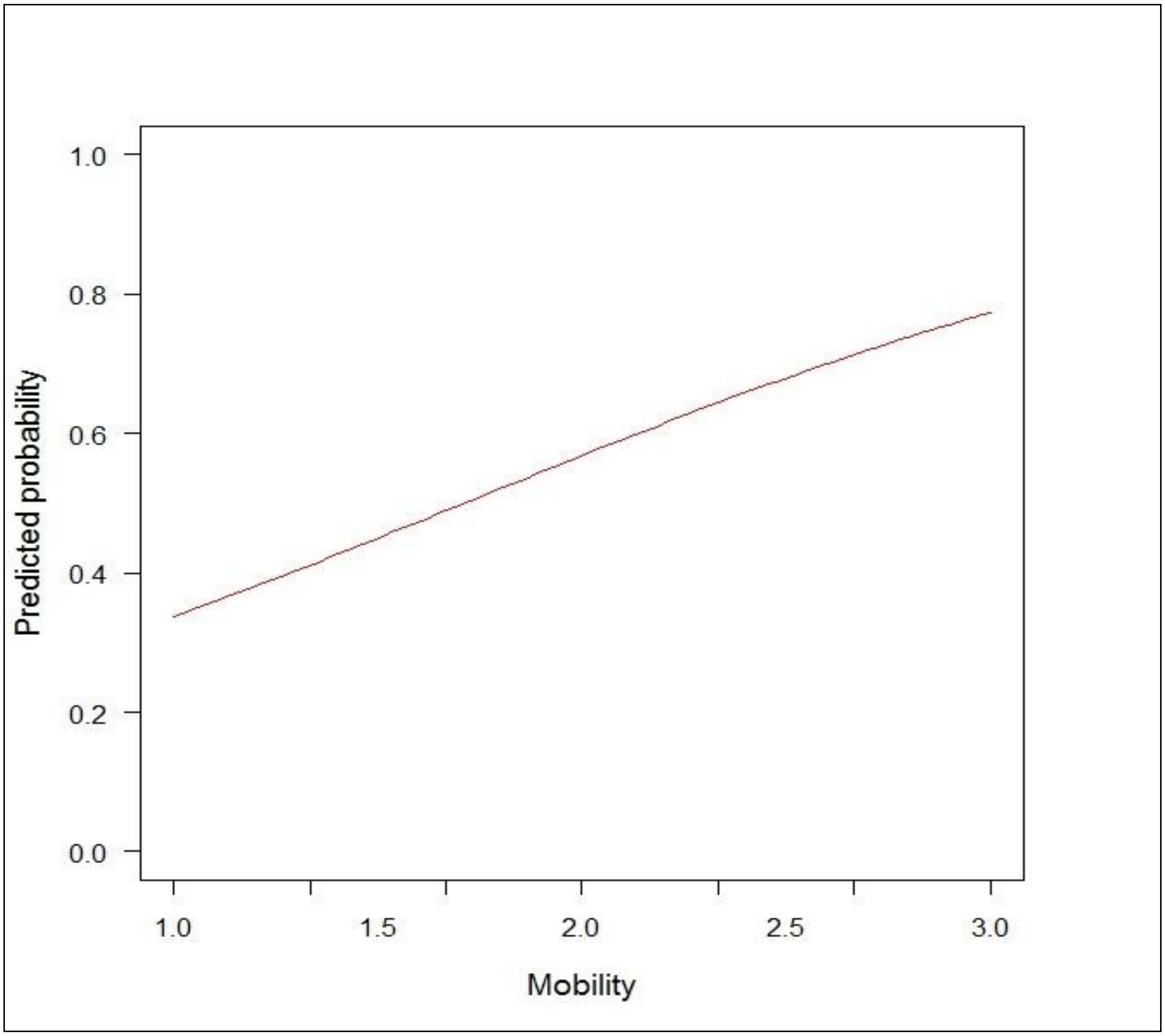


Figure 5-7. GLM plot of mobility; this analysis indicates a very strong probability that access to important landscape features is predicted for nonlocal settlement clusters as compared to local settlement clusters.

The distribution of Gallinazo Phase habitation sites relative to highland access routes is discussed by Billman (1996:253-263). The notion that nonlocals desired to maintain access to the highlands provides more evidence that migrants were ethnic-highlanders. As discussed above, my hypothesis is that migrants may have slowly matriculated into the valley as irrigation networks expanded, improving relatively small niches of unoccupied farm land.

Small dispersed sites sprung up first in the upper valley. Over time, with increasing numbers, nonlocal groups occupied more and more territory. Charismatic and powerful leaders emerged and their status as elite members of migrant society grew. Consequently, if the promise of agriculture is indeed what brought traditional agro-pastoralists down from the highlands, then the next step for my investigation is to consider the implications of migrant agriculture in the Moche Valley.

Agro-Ecological Zonation (AEZ)

Crop suitability as a model variable was generated using Agro-Ecological Zonation (AEZ). AEZ studies carried out in the past mainly dealt with rain-fed agriculture, irrigation resources were largely ignored until the GIS-based Chitwan District AEZ project in Nepal successfully integrated artificial hydrology (Pariyar and Singh 1994). My AEZ is modeled after the Chitwan project. The MOP-GIS was used to generate a hybrid verticality model that reclassifies elevation gradients by cultivation parameters taken from multiple sources, including reports from the Food and Agriculture Organization of the United Nations (FAO), *Empresa Nacional de la Coca S.A.* (the Peruvian state-owned company that monopolizes the legal sale of coca), and *Centro de Estudios y de Desarrollo Agrario del Perú* (NGO dedicated to rural development projects in Peru). Elevation, slope, crop water requirements, sensitivity to drought, soil composition requirements, toleration of UV radiation and wind exposure are among the cultivation parameters retrieved for my target cultigens, *Zea mays* (maize) and *Erythroxylon coca* (coca).

Going beyond elevation as the only determinant of suitability, the MOP-AEZ is a robust model for analysis of prehistoric cultivation. It was constructed for the Moche Valley watershed using multiple coverages to create four 'regimes': temperature, topographic, moisture and soil [Figure 5-8]. While not used for my study, estimated labor availability could also be included in the current AEZ, using settlement population estimates based on the site survey polygons and irrigation network buffers. One way to generalize population size at the community level is to estimate carrying capacity of an area by proximity to irrigation canals. Billman (1997) notes that population was evenly distributed along the middle valley in a series of irrigation communities; and each community probably consisted of approximately 140 people.

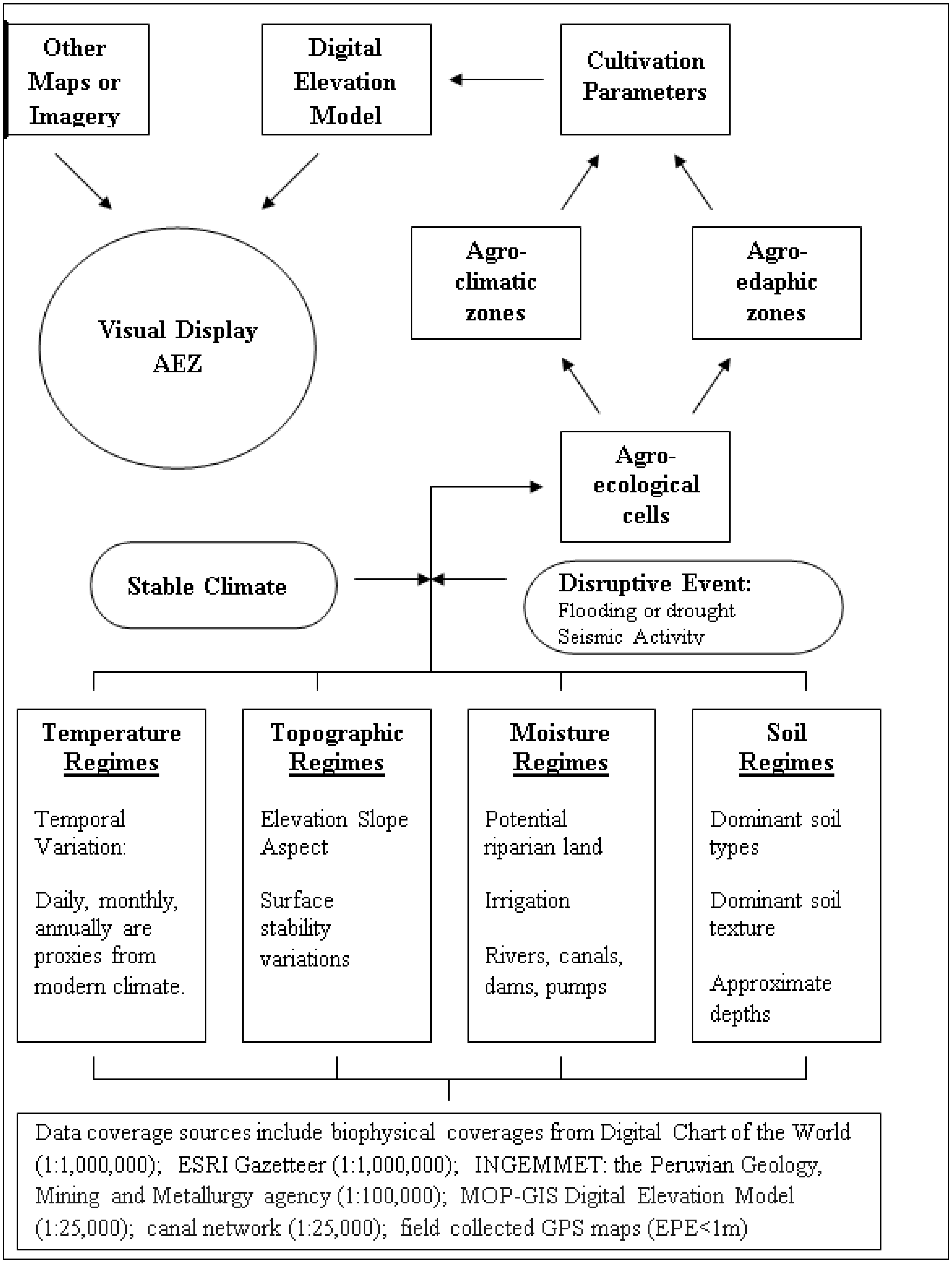


Figure 5-8. Agro-Ecological Zonation GIS model flowchart.

Land capability maps were combined with cultivation parameters to derive a composite map that defines a zone of maximum suitability for the target cultigens within the study area. Most nonlocal sites are located within zones for high potential of crop-specific production. Wind disturbances are rarely an issue for cultivation in the Moche Valley. The soils are deep in the alluvial plain and rich in iron and other nutrients necessary for agricultural production. Steep slope is not an issue here due to the fact that the irrigation network does not extend far enough upslope, and there is not enough rain to support terraced agriculture. As ubiquitous as it is in other regions of Peru, terracing is limited in this region. Intense solar radiation can present a problem, but multi-cropping with taller shady plants or planting on north facing slopes often overcome this problem.

While I only am concerned with maize and coca for this project, I did test other agricultural products such as cotton and gourds, and, unsurprisingly, these can be grown throughout the valley. For all intents and purposes, an irrigated Moche Valley is an agricultural paradise. Below is a layout of highland sites relative to the primary production zones generated by the AEZ for maize and coca, given the qualifying temporal parameters of a stable climate and a full-capacity irrigation network [Figure 5-9].

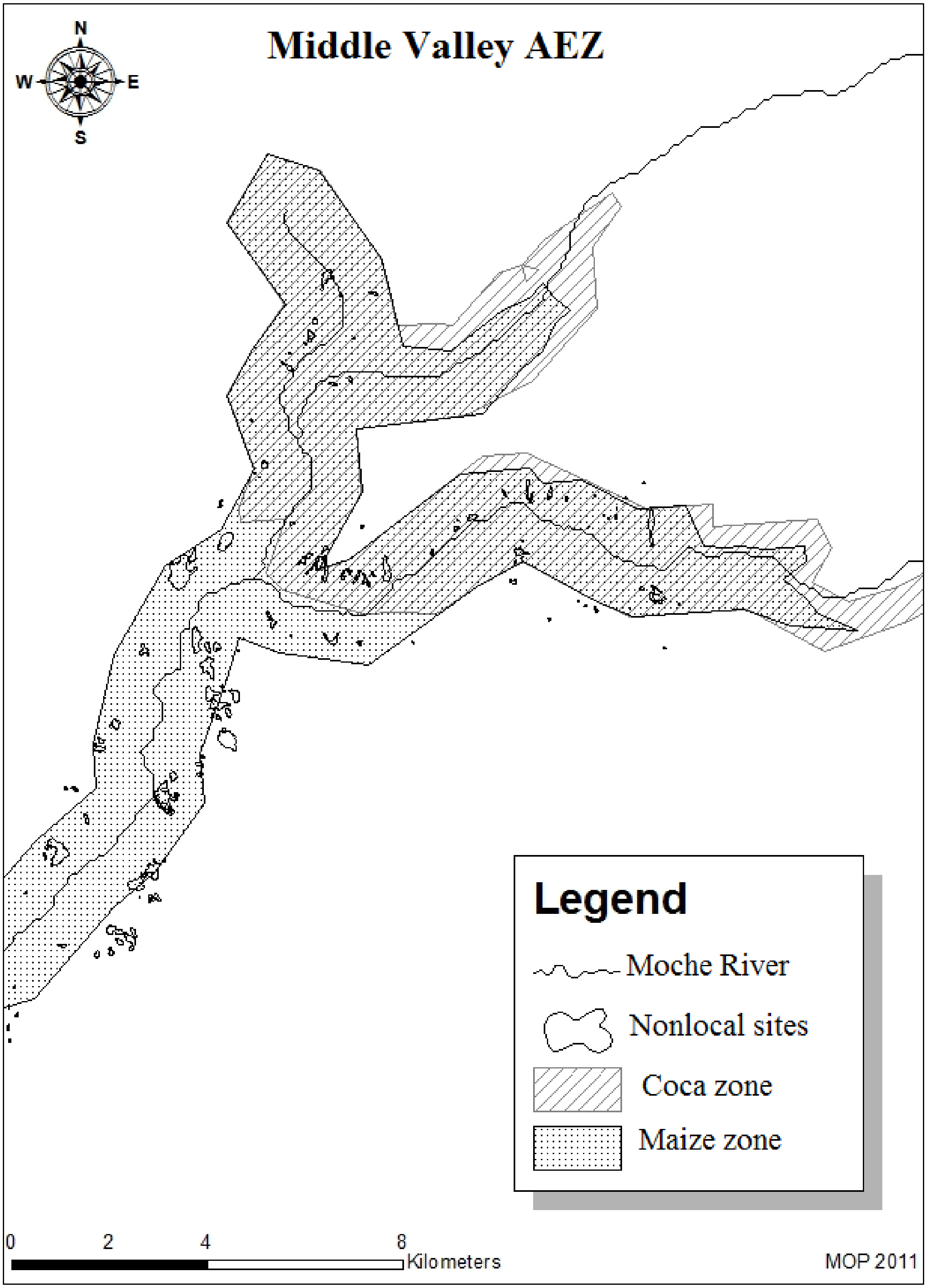


Figure 5-9. Agro-Ecological Zonation of primary production zones for coca and maize in the middle Moche Valley, as compared to highland site locations.

The model indicates that maize could have been grown practically anywhere in the middle valley as long as there was enough water flowing through the canals to sustain the crop. Maize is known to require a considerable amount of water through its life cycle. The volume of water passing through an area at any given time is a question of interest, and manipulating the AEZ with varying degrees of water availability could result in very different patterns. Treating it like a data mining effort, multiple iterations of the model could be run with varying degrees of input from regimes. In addition, there is great analytical potential for coupling the AEZ with evaluation of botanical remains at key sites in the valley.

While maize was a staple in the diet of both nonlocal and local communities, the social significance of maize in the Moche Valley does not take root out of a need for food; it is production of *chicha* (corn beer) that is important. The role of maize changed during the EIP, shifting from a frequent culinary option to a symbolic food transformed culturally through preparation and consumption (Hastorf and Johannessen 1993). Chicha was very important in prehistoric Andean society. Still a common Andean tradition today, men are served copious amounts of alcohol in exchange for their labor. The *mink'a* (work party fueled by food and drink) is often used for various forms of socio-political manipulation. For example, because activities such as brewing chicha are correlated with the presence of corn milling, and considering the very large quantity of batanes at MV225, it is logical to assume that major chicha production was efficiently mobilized by the Cerro León elite (Fariss 2008; Ringberg 2012). The production of chicha at Cerro León was probably a critical aspect of the positive social and political trajectory of the elite family that lived there.

The mink'a (occasionally referred to as *masa* when the work party involves clearing agricultural land) is often conceptualized by anthropologists as a feast, a common way for leaders to attract and maintain followers in situations where political roles are not overtly established through traditional social institutions (Dietler and Hayden 2010:66). With chicha-laden feasts, nonlocal elite could tap the instant sweat equity of laborers from constituent populations who were clustering nearby. The mink'a is not underpinned by balanced reciprocity. While it is a communal event, elite families do not return the favor in kind. They provide food and drink at the time of service. In the highland community where I lived in for two years, there is an understanding among community members that attendance of an elite family's work party is obligatory. Because the mink'a is an ancient Andean tradition, similar asymmetrical power dynamics at play in contemporary communities may have existed among prehistoric communities. With a large workforce, nonlocal elites in the Moche Valley could have expanded irrigation networks and cleared land for new areas of agricultural production. With an increase in available land and water, production of non-food products like coca might have increased. Production and distribution of coca, as a culturally significant, but not a life-sustaining crop, would have been viewed as a symbol of elite power. With more power, elites could clear more land and expand the canals to grow more maize, from which to make more chicha and throw more work parties to clear more land; hence, the wheel of wealth accumulation would spin.

Coca is more finicky than most agricultural products. It is considerably more labor intensive from sprout to harvest and requires a specific climate. According to the United Nations, Peru is the number one producer of coca in the world today. Most plantations are located on the eastern flanks of the Andes Mountains in areas of the cloud forest prepared by slash and burn methods. Both licit and illicit coca production require multiple applications of harsh chemical herbicides and pesticides to retain viable yields at harvest. The jungle harbors many parasitic insects, plants and fungi. Perhaps a benefit of growing coca on the drier, western side of the mountains is that these biological impediments are lessened. On the North Coast, coca grows best below 500 m and requires consistently moist, well-drained soil (Riesco 1995). Like maize, coca can be cultivated just about anywhere in the Moche Valley. In fact, in 8 years of working closely with local residents in the region, I have noticed that coca is present in most every family smallholding throughout the middle and upper valley. Consistent with the model, rarely have I seen it at the higher and lower extremities of the valley. And, in the 2 years I lived in highlands, I never encountered a coca plant anywhere on the western side of the Andes.

Control over the production and distribution of coca was presumably a very important source of wealth and status among prehistoric Andean civilizations and their leaders (Allen 1986; see also, Billman 1999:157). Considering the restricted growing conditions necessary for coca (specifically *Erythroxylum novogranatense*, the variety most common in my study region) "no archaeological coca has been reported from highland contexts [and] it has been inferred that coca probably was cultivated and traded into the Andes once permanent settlements were formed" in the northern and central coastal regions (Hastorf 1989:297-299). Highlanders occupied the prime coca producing zones on the western foothills of the Andes in the upper valley regions of the North Coast (Plowman 1986). Plowman's findings provide more evidence to the inference that nonlocal migrants occupying the prime coca growing zones in the middle valley during the Gallinazo Phase of the EIP were probably highlanders.

Concluding Remarks

In an effort to conceptualize the nonlocal migratory landscape I tested a number of explanatory variables derived from settlement surveys and the MOP-GIS. Many of the variables were decidedly insignificant for predicting nonlocal settlement, but some results of this effort compel us to consider that nonlocal migrants were indeed highland in origin.

While a defining characteristic of migrant settlement, it should not automatically be assumed that building on steep slopes is a strategically defensive posture. There are many small, non-defensive domestic sites built on steep slopes around the valley. Occupational duration at these sites is unknown; yet, we do know that a majority of them are single-component. I do not presume to understand all the reasons why nonlocal sites were built on steep slopes, but this analysis leads me to believe that fear from conflict with local neighbors was not *raison d'être*.

Visibility is considered positively correlated with nonlocal settlement, but it is not a strong predictor. As a result, most 'like' sites during the Gallinazo Phase of the EIP were within view of one another regardless of cultural affiliation. There are other reasons besides fear of conflict why people would choose to build within view of their neighbors. Perhaps it provides one with a sense of community. There may have been extended network or kinship patterns associated with the visible landscape. Yet, the fact that six fortified sites were constructed on the hilltops around the valley, three within clear view of each other at the headwaters of the Moche River and three within clear view of each other at the mouth of the river, suggests some level of strategic maneuvering. It is possible that these forts are related to the corridors between elite clusters and the highlands. If so, this notion gives more credence to the idea nonlocal settlement was highland in origin.

In the context of elite clusters rather than individual sites, mobility does prove to be decidedly correlated with nonlocal settlement. It appears that elite clusters are oriented on the landscape such that mobility between the Carrabamba Plateau and Otuzco Basin was preserved without physical or cultural impedances. If migrants were in fact ethnic-highlanders, in addition to a physical pathway, the conduits may have represented a metaphysical connection with their homeland. There may have been established routes for pilgrimages. Perhaps nonlocal elites maintained connections with highland communities in order to establish networks for trade. If the presence of corrals at elite sites can be archaeologically substantiated, then trade routes might be corroborated using the mobility model. Dried coca is relatively light and presumably very valuable in the highlands at that time. It could have been transported in large quantities with pack animals.

By applying the spatially analytical methods described above to a settlement pattern, it is possible to better understand culture contact and interaction in archaeological contexts. Mobility is not a new area of study for archaeologists, yet it is considered the opposite of settlement studies of sedentary peoples, often referred to as 'complex' society. This opposition is a false dichotomy because the broader paradigm of prehistoric mobility encompasses more than tracing ephemeral campsites of nomadic pastoralists and hunter/gatherers. Multi-generational ethnic migrations are a larger part of the archaeology of mobility. Power, labor, trade, and inequality all have implications for nonlocal and local populations; thus, mobility is an important concept for understanding the social, economic and political complexities of an ethnotone like the one in the Moche Valley during the Gallinazo Phase of the EIP.

Recent bioarchaeological investigations from local households at Cerro Oreja indicate a substantial increase in the consumption of maize and/or consumption of marine resources during the Gallinazo Phase of the EIP (Lambert et al. 2012). I have presented evidence to support that demographics of the Moche Valley changed during the Gallinazo Phase due to an increase in nonlocal migrations. There is reason to believe that migrant households were also engaged in maize farming activities. It is possible that diet changes at Cerro Oreja may be connected to changes in demographics and the shifting settlement pattern at this time. With the available data, it is difficult to ascertain to what extent nonlocal migrations may have affected local diet, hence domestic and political economies at Cerro Oreja. I presented a scenario by which maize production at Cerro León may have led to increased wealth; a comparative study could determine correlations, if any, between nonlocal and local centers.

Analyses described in this chapter indicate that violence at this time in the Moche Valley was diminished. Both nonlocal and local sites were within view of one another all over the valley, and with further investigation to understand duration of occupation, diet, status, and power dynamics at these sites we might be able to infer what level of contact was actually taking place on a daily basis. After all, while a family might not interact with neighbors every day, if the fear of attack consumed their daily practice, they would probably move. It appears that these groups lived in proximity for generations; my investigation only begins to characterize migration and mobility, interpret conflict and complementarity and describe domestic and political economies in the Moche Valley during the Gallinazo Phase of the EIP.

CHAPTER 6

QUANTIFYING VARIATION WITHIN NONLOCAL COMMUNITIES

> Power relations are demonstrably the most complicated and most important aspect of the governance of human societies. It is particularly important to know how power shifts occur and under what conditions various power distributions constitute stable and unstable configurations. The work would have great utility in the study of change and perhaps be able to explain how certain forms of governance can be associated with particular histories of environmental stability and instability. This gives equal value to all social formations, inasmuch as we can learn important lessons from them all.
>
> (Crumley 1995:4)

Who lives with whom and why? This is perhaps the most basic question posed in one form or another by archaeologists concerned with settlement pattern studies. While people independently move in and out of an area, as actors, they interact with other people and construct environments within which they live. Interaction at the household level in my study is predicated upon the idea that there is limited space to fill. Therefore, if a space is occupied by a household, then that space is unavailable to another household. If we take the abundance of sites on a landscape as our basic response variable within a community, then we are forced to work from the understanding that individual responses to social and natural environments are not independent. A rational analysis of the power dynamics associated with prehistoric settlement decisions must take into account this lack of independence. Reaching back to the origin of this idea, human society is not the sum of its parts; it is the product of a social structure by which we are united (Durkheim 1893). In other words, an actor does not act in a vacuum.

When I began graduate school a decade ago, the use of advanced spatial statistics was only recently emerging from the domain of those who are *au fait* with matrix algebra and able to confidently code macro statistical languages for computation, leaving the rest of us waiting for Godot. But a decade later, statistical programs are now readily available and exceedingly user-friendly. Increased power and capability of software programs provide professionals that have the benefit of years of education and practice in traditional archaeological theory and methods access to high-power statistical tools.

As mentioned previously, Billman (1999) notes that the majority of highland sites he surveyed in the middle Moche Valley appear to be located near one of three elite compounds. Visualization in GIS corroborates this observation. It is logical to assume that migrants banded together in a constellation of settlements around elite leaders for protection and access to goods in exchange for their labor and loyalty. Because the empirically observed clustering appears significant, the degree of actual geographic clustering must first be established. The first step in this process is to understand the degree of *spatial autocorrelation* in the data. Spatial autocorrelation is a complex-sounding term with a simple definition. It is based on Waldo Tobler's First Law of Geography, which states that all things in space are related, but closer things are more related (Tobler 1975). Spatial autocorrelation tests whether or not similar attribute values are clustered in geographic space.

In order to evaluate spatially-defined clusters in my data I first calculated a Moran's Index for the entire dataset. Without considering proximity to elite residences, a two-part question put to the data is: are highland sites geographically clustered; and, if they are, what is the percent chance that observed patterns may have occurred randomly? Spatial autocorrelation is most often used to describe randomly sampled data. However, because the settlement survey is a systematic survey of the entire population, it is assumed that there is some degree of autocorrelation in data. The point emphasized is that sites are interdependent.

The Moran's Index (also called Moran's I) evaluates whether a pattern expressed is either clustered or dispersed, and whether or not the resulting pattern is random. In *ArcMap*, Moran's I calculates both a z-score and p-value; the latter evaluates significance of the index score. The z-score is a statistical measure of the mean distribution of values, expressed by standard deviation, such that the z-score of the mean value is zero and the standard deviation is one. In a normal distribution, 68% of values have a z-score plus or minus 1, meaning they are within one standard deviation of the mean, and 95% of values have a z-score of plus or minus 1.96, meaning they are within two standard deviations of the mean, while 99% of values have a z-score of plus or minus 2.58, about two and a half standard deviations from the mean. With a Moran's I score of .47, the null hypothesis, which in this case states that there is no spatial clustering of the values associated with geographic features of interest in the study area, is <u>rejected</u>. Preliminary statistical analysis of strictly locational data indicates, not surprisingly, that highland sites are decidedly clustered within the study area. Furthermore, there is less than a 1% chance that the observed spatial pattern is the result of random chance. The Moran's I indicates that clustering is real and deliberate.

Calculating the Moran's I requires that spatial relationships are conceptualized using Euclidean distance, whereby all features influence all other features, but the farther away a feature is from another, the lesser the impact it has on that feature. *Inverse Distance Weighted* (IDW) interpolation relies on the assumption that things closer to one another are more alike than those things farther apart (Tobler 1975). For IDW analysis, a value near 1 indicates clustering while a value near -1 indicates dispersion; a value of 0 is completely random. To predict an unmeasured location, IDW interpolates a prediction location, and values nearest the prediction location are assumed to have more influence on a given point than those farther away (Watson 1992). In the process of creating an IDW surface raster for the level of spatial autocorrelation in my dataset, each measured point has a local influence that diminishes with distance. The interpolation applies greater weight to the points nearer a predicted location than those with increasing distance, thus 'inverse' and 'weighted' modify the distance interpolation between highland sites. A graphical representation of this is presented below [Figure 6-1].

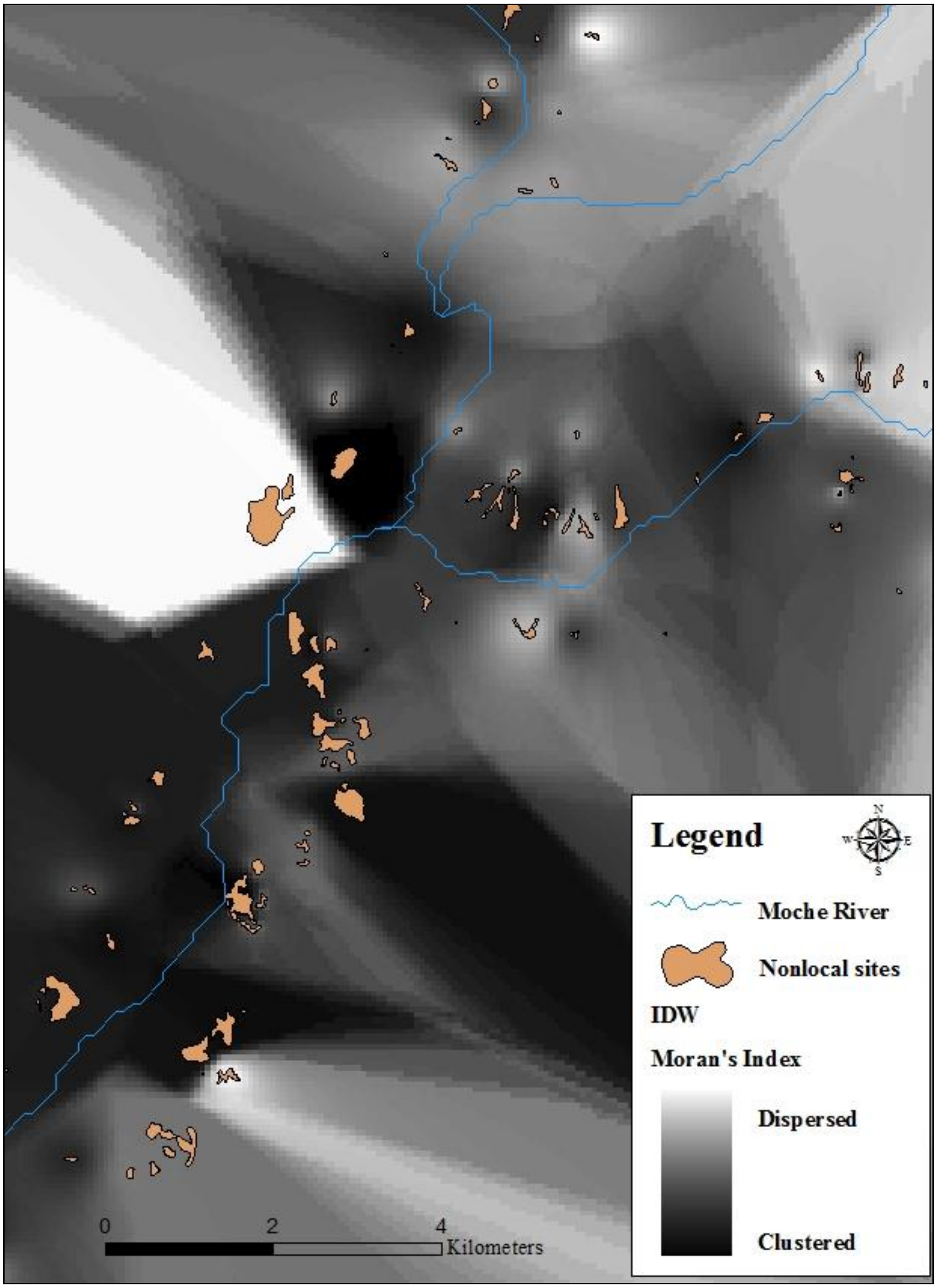


Figure 6-1. Inverse Distance Weighted Interpolation of spatial autocorrelation in the nonlocal settlement data.

Further exploration of the inherent spatiality of the data with *Nearest Neighbor Analysis* (NNA) corroborates the findings of the Moran's I test. Also a distance interpolator, it functions slightly differently. The NNA index is expressed as a ratio of the observed distance divided by the expected distance of highland sites, where the expected distance is an average distance between neighbors in a hypothetical random distribution (Watson 1992). If the average nearest neighbor index is less than 1, then the pattern exhibits clustering. If the index is greater than 1, then the trend is toward dispersion. The NNA index for highland sites is .59, which exhibits clustering. Perhaps this statistic is underwhelming (and redundant) at this stage, but NNA is the predecessor of *Natural Neighbor* (NN) interpolation, which is another useful way to visualize clustering.

NN works by identifying the nearest subset of samples to a query point, then applying weight to each that is based on proportionate areas of a value (Sibson 1981). Also known as an area-stealing interpolation, NN uses only a subset of samples in the immediate area of a query point, such that interpolated weights are never outside the range of samples and it does not infer trends not already represented by the input (Sibson 1981). One other difference is that the interpolated surface is smooth, and most importantly, it adapts locally to the structure of the input data, which means there is no requirement for a user-defined search radius or area-shape. NN has been shown to work equally well with regularly and irregularly distributed data (Watson 1992).

The 'natural neighbors' of any point are those associated with neighboring Thiessen polygons. Initially, a Voronoi diagram is constructed of all given points (represented by the polygons), then a new Voronoi polygon is created around the interpolation point (Sibson

1981). The proportion of overlap between polygons generates the assigned weight. Recall for comparison that a distance based interpolator such as IDW assigns weight based on Euclidean distance between points. Where: *G(x,y)* is the NN estimation at *(x,y)*; *n* is the number of nearest neighbors used for interpolation; *f(xi,yi)* is the observed value at *(xi,yi)*; and, *wi* is the weight associated with *f(xi,yi)* (Sibson 1981). Below is a 3d visualization of highland settlement clusters with the Natural Neighbor interpolation [Figure 6-2].

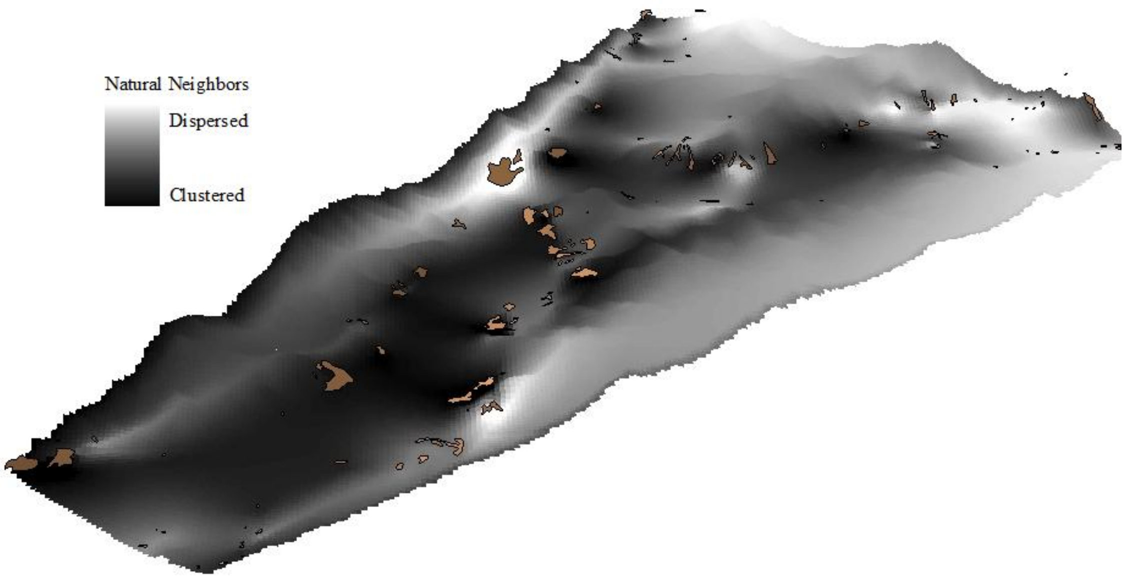


Figure 6-2. A 3d visualization of the Natural Neighbors interpolation with nonlocal sites indicated. Note the distinct pattern of linearity, as represented by shaded relief. There is a high degree of clustering indicated by the black and gray coloration.

While not a monumental discovery, knowing that spatial clusters actually exist is important. By looking at the settlement distribution maps it is obvious that sites are clustered, the analyses described above confirm that observation. In order to understand the interaction between clusters, one must understand the true nature of attraction. At this point, we can tell who lives with whom, but the second part of my leading question still remains . . . why? The following sections outline tests I used to evaluate the interaction between identifiable clusters of nonlocal sites, including cluster analysis and ordination.

Data Transformations

As a reminder, the information that makes up the survey database is drawn from three primary sources: Brian Billman's research in the early 1990s, the Chan Chan-Moche Valley Project carried out a decade before Billman's project; and my own fieldwork taking place in the decade since. My research includes GIS data layer production from archaeological and land surveys in the middle and upper Moche Valley conducted over the last eight years. Discussed in Chapters 4 and 5, I use data from surveys and the MOP-GIS to describe nonlocal architecture and settlement.

The settlement dataset is quite large, and 'noisy'. As such, it requires data transformation in order to extract a meaningful number of composite variables that will express the information contained therein. Data transformation often improves assumptions made about normality and variance (Kintigh 1990). Data transformation is usually a prerequisite for cluster analysis and ordination, such as Principal Component Analysis (PCA). The importance of data transformation for large multivariate datasets cannot be understated. Transformations are useful for analysis of settlement communities because they compress high values and spread out lower ones, conveying an order of magnitude in the data that makes multidimensional information more tractable (Kintigh 1990). Data transformations can be extremely effective, but each comes with its own set of rules and requires a firm grasp of the end effects on the data. Most important for understanding any potential benefits and pitfalls of data transformation is a clear understanding of the intended results. In my case, I intend to make compatible multiple attributes that are measured on different scales.

K-means

K-means is a non-hierarchical method of defining clusters. It is an iterative analysis of the dataset, whereby each step of the process identifies individual membership within a cluster, which is then reevaluated based on the current centers of each existing cluster, and repeated until the user-defined number of cluster solutions is reached (Peebles 2011). As a non-hierarchical method of defining clusters, an individual data point can be assigned to a cluster and then reassigned at a later step in the process as many times as necessary. This method of defining clusters is much better for preparing the data for ordination because groups are based on Euclidean distances, as to reduce the variability of individuals within a cluster, while at the same time, maximize the variability between clusters (Peebles 2011).

One common method of defining clusters is to compare the *sum of squared error* (SSE) for a number of user-defined cluster solutions. The SSE is defined as the sum of the squared distance between individual data points in a cluster and that cluster's centroid, thus representing a global measure of error (Peebles 2011). As the number of clusters increase, SSE typically decreases, because each cluster gets smaller and distances within each cluster get shorter. A plot of the SSE by sequential clusters can be a useful way to choose an appropriate cluster solution for factor analysis. Interpreted much like a *scree plot*, the appropriate cluster solution is defined as the solution at which the reduction in SSE slows dramatically (Peebles 2011). Graphically, this slowing produces an elbow in the plot, suggesting that solutions beyond the point at which the curve bends should not have a substantial impact on the total SSE. Scree plots function by plotting data components on the X axis and corresponding eigenvalues[2] on the Y axis. As the line moves toward the latter components eigenvalues drop. When the slope of the drop changes, making an elbow toward a less steep decline, then the test indicates one should disregard all further components after the elbow as insignificant. Granted, some bias is introduced due to researcher subjectivity when selecting the elbow of significance because the curve almost always has multiple elbows. However, a cut-off is often obviated by a dramatic change in slope at an elbow. In the plot below the slope between the first three cluster solutions is steep, whereas after three it nearly flattens [Figure 6-3].

[2]Eigenvectors are a special set of vectors associated with a linear system of equations in matrix algebra that are sometimes also known as characteristic vectors, proper vectors, or latent vectors. The eigenvectors of a square matrix are the non-zero vectors that remain parallel to the original vector after being multiplied by the matrix. For each eigenvector, the corresponding ***eigenvalue*** is the factor by which the eigenvector is scaled when multiplied by the matrix (Marcus and Minc 1988).

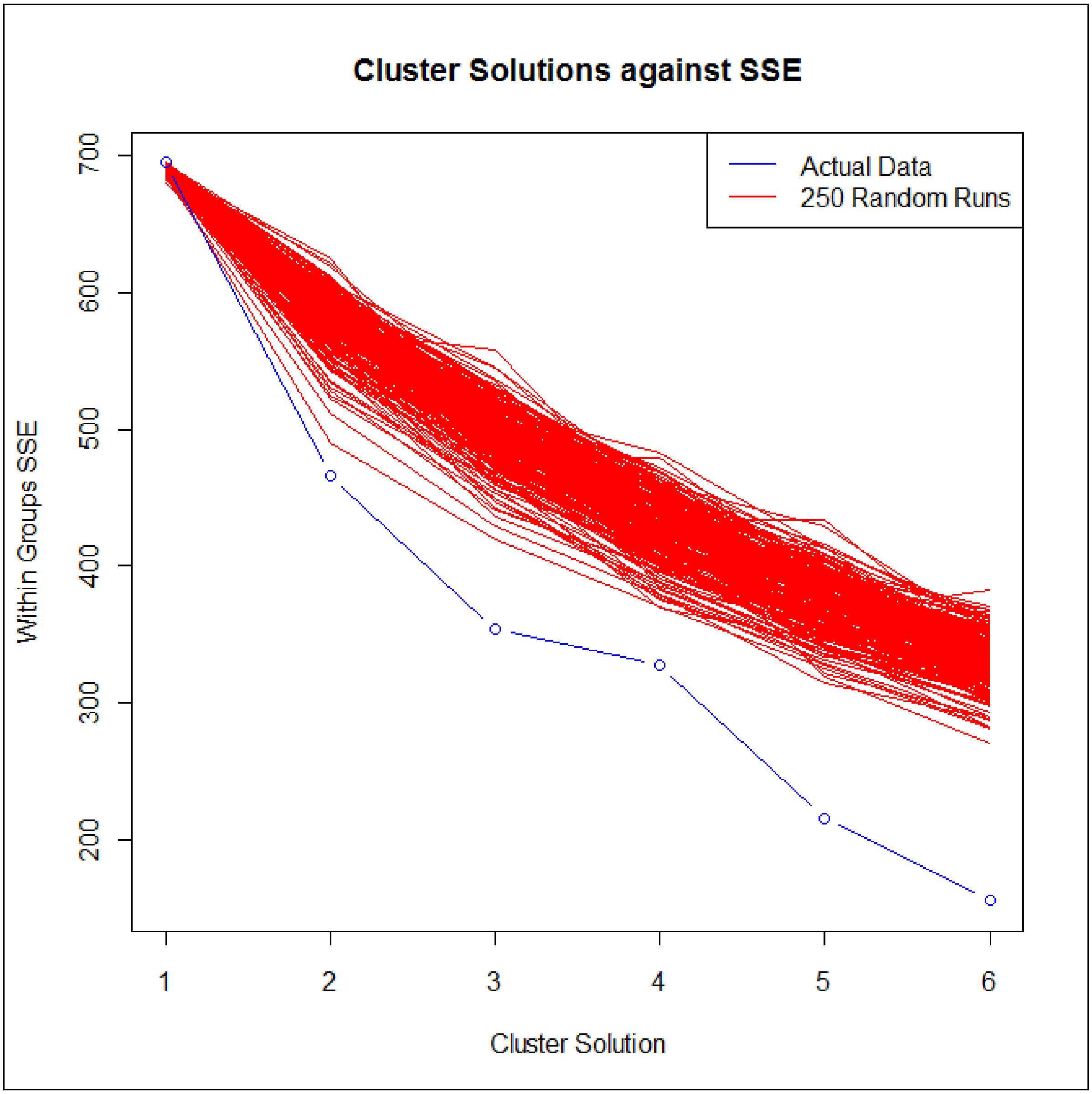


Figure 6-3. Plot of the SSE indicates 3 solutions are appropriate for factor analysis.

Another useful way to visualize the appropriate cut-off is to examine the absolute difference between the actual and the random SSE, where the cluster solution between the actual SSE differs most from the mean of the random SSE (Peebles 2011). To facilitate this comparison, the *kmeans* analysis is graphically represented below as an absolute difference between the actual and random (mean of 250 runs) SSE against the cluster solutions [Figure

6-4]. One standard deviation above and below the mean absolute difference is represented in this test. The point at which line direction first shifts negatively represents the widest gap between the actual and the random SSE, thus indicating clusters solutions following this shift should be disregarded. Once again, the appropriate cluster solution for my data is three.

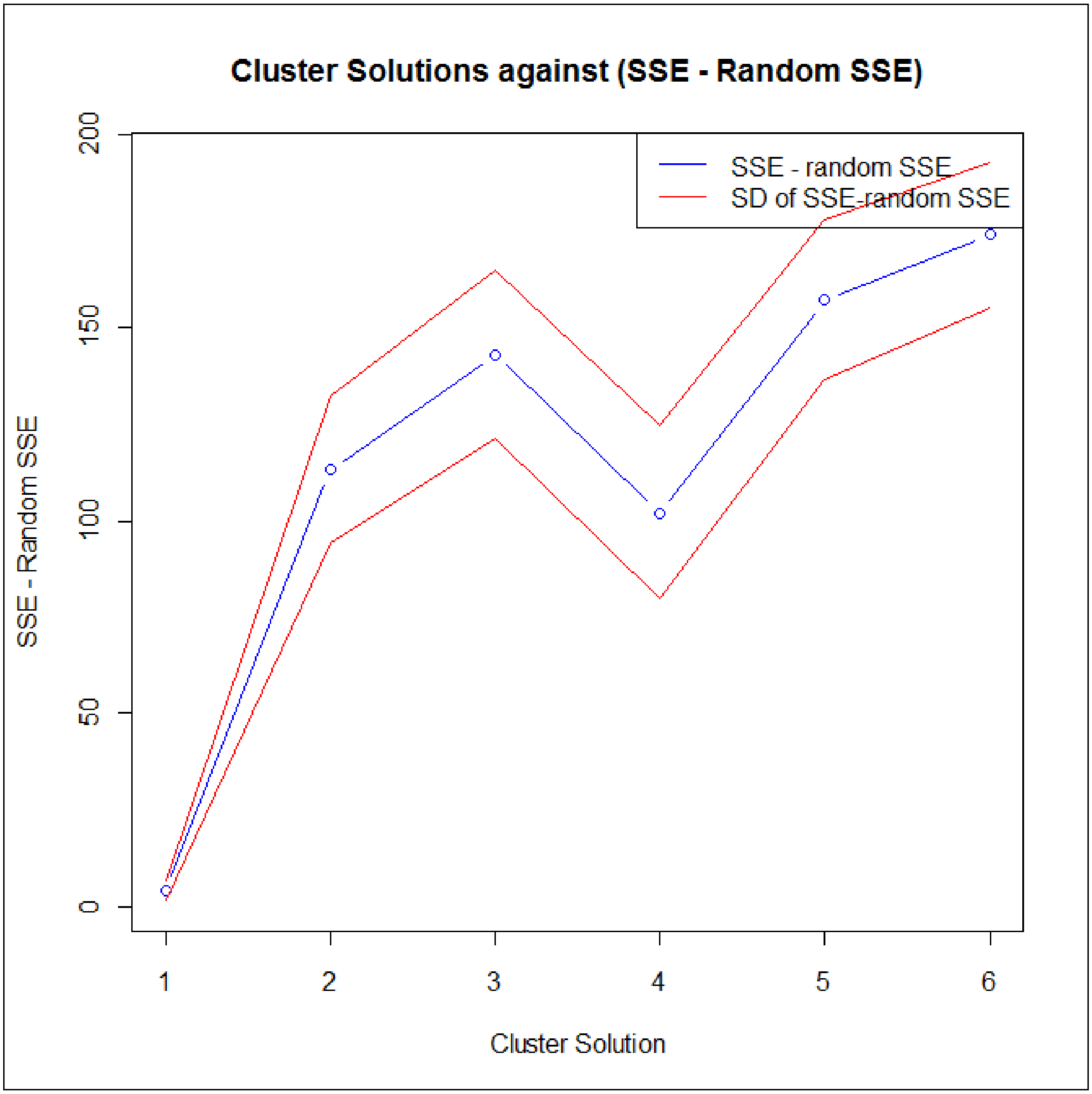


Figure 6-4. This plot of the SSE against the random SSE also indicates that 3 cluster solutions are appropriate for factor analysis.

Ordination

In this analysis, the *K-means* clusters are given in terms of data variance through Principal Component Analysis (PCA). It has been shown that the PCA subspace is identical to the cluster centroid subspace (Zha et al. 2001). The ubiquitous K-means clustering algorithm uses a sum of squared error objective function (Ding and He 2004). A detailed analysis indicates a very close relationship between K-means and PCA (Ding and He 2004).

PCA is a type of ordination technique. Ordination is defined simply as the arrangement of data points along a scale (axis) or scales (multiple axes). Ordination can be useful to archaeologists in many ways. Archaeologists often have large, multivariate datasets derived from a complex network of interaction. Ordination is a powerful tool for evaluating complex networks of interaction, the type of data that can make regression analysis difficult (Ammerman and Kintigh 1983). The most common reason to employ ordination is so that data can be arranged in such a way as to graphically summarize complex relationships by extracting one (or a few) dominant patterns from a potentially infinite number of possibilities; the process of extracting those axes is called ordination (McCune et al. 2002). Ordination is often used to mine data for hypothesis generation. Data mining is an iterative process of exploring quantitative information in order to identify meaningful and logical relationships among variables in a dataset. In the field of archaeology, data mining is often used to uncover patterns and/or predict events; however, it can also be used to test an existing hypothesis (Ammerman and Kintigh 1983). My hypothesis is that because nonlocal sites are geospatially clustered, they are also clustered in other meaningful ways. The nature of attraction between sites begets their interaction.

McCune (2002) stresses that ordination helps select the most important factors from multiple factors imagined or hypothesized, separate strong patterns from weak ones and reveal unforeseen patterns that might suggest unforeseen processes. Among many ordination techniques, one of the most common is Principal Component Analysis. PCA is frequently used for exploratory research, employed when observations lack a clear causal interpretation (McCune 2002). In my case, I need to interpret information contained within a large number of data fields by evaluating a smaller number of underlying latent dimensions of that information. PCA is more accurately defined as a *components analysis*, but is often recognized as a form of *factor analysis*. The defining characteristic that distinguishes the two factor analytics is that components analysis assumes that all variability should be used, while factor analysis only uses the variability in common with other items (McCune 2002). A useful, but non-technical analogy for understanding how factor analysis works, is presented on *Statnotes: Topics in Multivariate Analysis*, published online by Dr. G. David Garson (2011):

> A mother sees various bumps and shapes under a blanket at the bottom of a bed. When one shape moves toward the top of the bed, all the other bumps and shapes move toward the top also, so the mother concludes that what is under the blanket is a single thing - her child. Similarly, factor analysis takes as input a number of measures and tests, analogous to the bumps and shapes. Those that move together are considered a single thing, which it labels a factor. That is, in factor analysis the researcher is assuming that there is a "child" out there in the form of an underlying factor, and he or she takes simultaneous movement (correlation) as evidence of its existence.

Factor analysis was developed from *field theory*. Field theory involves places and their attributes, and the interaction between them. A matrix is developed from n places and a attributes, and describes spatial association and variation over n places (Garson 2011). The matrix is defined by independent factors and variation in places is identified in the structure of a matrix. Simply put, PCA explains the total variance of variables. Factors (components) describe the common, as well as the unique, variance of variables. The obvious variables are considered to express both the total variance explained by components and the error variance not explained by components (Garson 2011). Components are meant to reproduce the total variance, in addition to the correlations. PCA is a variance-focused approach to ordination. If I could visualize all variables for nonlocal settlement and all nonlocal sites simultaneously, then there would be little need to use ordination to describe variation in site variables. That is impossible. Therefore, PCA takes a cloud of data points and rotates it such that the maximum variability is visible and identifies the most important patterns. Technically speaking, PCA is an iterative process through which the first component is basically a linear equation created to extract the maximum total variance from the variables; for the second component, PCA then removes the variance explained by the first and creates a second linear equation to extract the maximum remaining variance; and so on, until the resulting components explain both the total variance and correlative structure (Garson 2011).

The first Principal Component (PC1) depicts the greatest variation. The direction of PC1 is the eigenvector, and its magnitude is the eigenvalue. To better define exactly what an eigenvalue is, first let $\boldsymbol{A}$ be a p by p matrix and w a p-element vector; if it is true that Aw = l w for some scalar l, then w is an eigenvector of $\boldsymbol{A}$ and l is the corresponding eigenvalue (Cliff 1987). That is, an eigenvector of a matrix is a vector such that when we multiply the matrix by the vector we get the vector back again, except that it has been multiplied by a particular constant called the eigenvalue (Cliff 1987). This process is called *eigenanalysis*. For a square matrix, eigenvectors and eigenvalues match the rows and columns of a table, respectively. The eigenvalues (also called latent roots) are almost always ranked from highest to lowest and numerical (Marcus and Minc 1988). PCA is based on eigenanalysis of correlative structure, whereby sample scores are the eigenvectors of a square matrix; such that. the eigenvalues are the latent root of an ordination axis and the strength of each component represented as a percentage of the variability (Cliff 1987).

In the figure below, each site is displayed on a scatter plot of the first two principal axes of the PCA [Figure 6-5]. The K-means clusters are outlined. For this type of visualization, there should not be significant overlap in the distributions of outlines (Peebles 2011). The axes percentages are based on eigenvalues of a matrix.

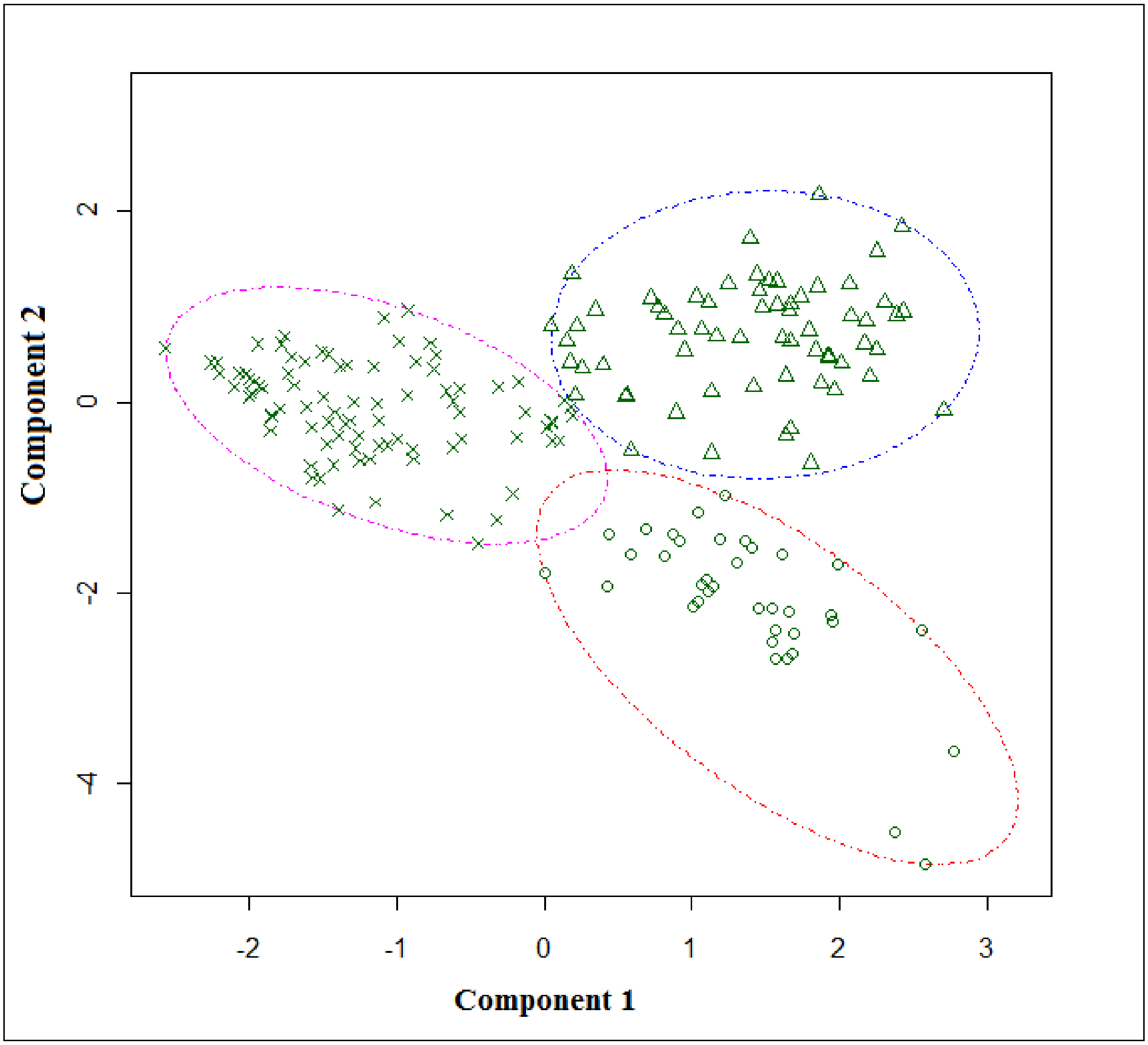


Figure 6-5. PCA with K-means clusters outlined relative to corresponding eigenvectors.

Generally speaking, at least half of the point variability within a dataset should be explained by the first two (or sometimes three) components in order to validate the analytical approach. The first two components in my analysis explain slightly more than half of the total variability. In the table below you can see that the first component accounts for approximately 29% of the variation, while the second accounts for 23%, a total of about 52% [Table 4]. The third and fourth also have a moderately significant proportion variance, but the standard deviation of the latter three components falls below 1. Thus, the appropriate cutoff for interpreting the importance of these components should be at the second. However, looking a bit deeper into the results of the PCA raises questions about the potential importance of the third component.

Table 4. Importance of principal components.

	Component 1	Component 2	Component 3	Component 4	Component 5
Standard Deviation	1.1972078	1.0614987	0.9725489	0.9464261	0.7735246
Proportion of Variance	0.2866613	0.2253559	0.1891703	0.1791445	0.1196681
Cumulative Proportion	0.2866613	0.5120172	0.7011875	0.8803319	1

Accurately interpreting the results of PCA with regard to variables of interest within a dataset requires factor loadings (correlations) for variables that contribute to corresponding axes (components). Factor loadings, also called component loadings, are the correlation coefficients between variables (rows) and factors (columns). Similar to *Pearson's r*, the squared factor loading is a variance percentage that indicates which variable is explained by what factor (Raubenheimer 2004). In order to arrive at the percent of variance across all variables accounted for, one must divide the factor's eigenvalue by the number of variables. Standard practice is that loadings should be .7 or higher to confirm that a specific factor is representative of independent variables identified *a priori*, such that the .7 level should correspond to at least half of the variance in the indicator being explained by the factor (Hair et al. 1998). Yet, this standard is considered by some to be unrealistic for real world data, which is why a .4 level is acceptable (Raubenheimer 2004). That being said, Hair et al. (1998) still call loadings above .6 “high” and those below .4 “low”.

For Component 1, the variable that most contributes to variance among nonlocal sites is *distance to agricultural fields*, with a highest factor loading of .5. In fact, .5 is the only positive result in the first principal component. Therefore, in my analysis, a .5 level is the natural cutoff. Interestingly, the reader will recall that distance to agricultural fields was not indicated to be a good predictor of nonlocal sites when compared to local sites. Yet, regarding nonlocal site variance it appears to be important. This result alone validates the use of PCA for analysis of nonlocal settlement patterns.

Component 2 is most indicated by the *degree of slope* that a site is built upon. With a level of .7, this is a high correlation value. Components 3 and 4 are loaded by *proximity to elite residences* and *use of area*, respectively. Theoretically, these are very significant factors; this is where theory and arbitrary cutoff levels are at odds in my analysis [Table 5].

Table 5. Component loadings.

	Component 1	Component 2	Component 3	Component 4	Component 5
ELITE	-0.455	0.276	0.623	0.645	0.338
USE	-0.207	-0.575	0.433	-0.435	0.222
AREA	-0.671	-0.197	-0.114	0	-0.704
FIELD	0.548	-0.198	0.474	0.42	-0.51
SLOPE	0	0.717	0.432	-0.465	-0.286

Perhaps PCA is most easily visualized using the dimensionality of the matrix. Below is a figure that illustrates data used by PCA with the direction gradients of variables indicated [Figure 6-6]. The reader should note the density of the variance cloud and its position relative to the directionality of gradients in 2-dimensional space.

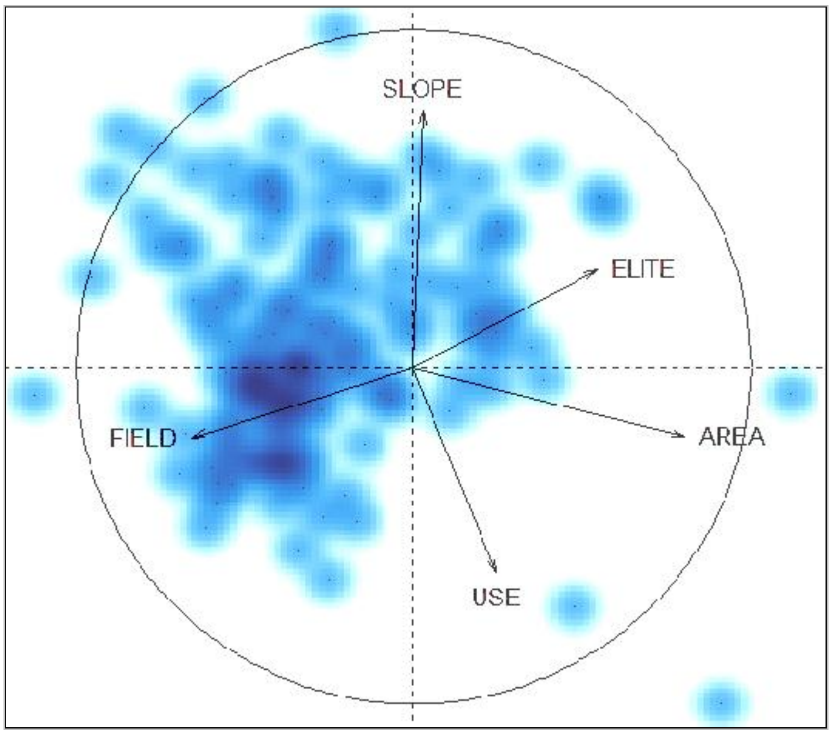


Figure 6-6. Variables factor map with data variance cloud.

Distance to agricultural fields and slope of construction are important factors for variance in the nonlocal site data. However, the variance cloud also moves along the gradient for proximity to elites. Therefore, one final interpretation is considered. If I include the third component and visualize the matrix in 3-dimensional space, then a somewhat different pattern emerges. The plot below illustrates a strong variance among data points relative to the pairing of Components 1 and 2, as well as 2 and 3 [Figure 6-7].

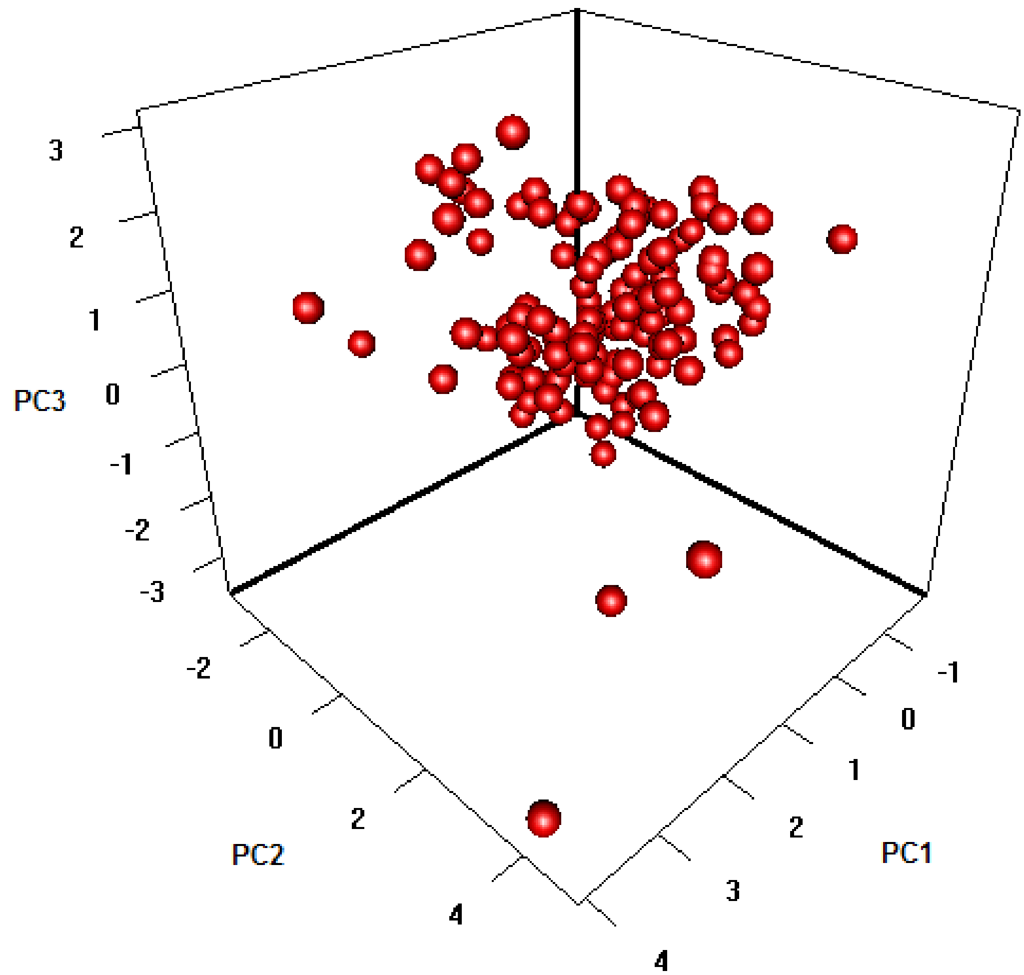


Figure 6-7. 3d scatter plot for Principal Components 1-3 and corresponding eigenvectors.

Concluding Remarks

Who lives with whom and why? It appears that the most significant factors for describing variance among nonlocal sites are distance to agricultural fields and degree of slope, and to a certain extent, proximity to elites. This analysis identifies which attributes explain more than half of the total variance among nearly two dozen fields of data recorded for 114 nonlocal sites. In the last chapter, I discuss the finding that one-to-one logistical regression indicates distance to agricultural fields was not a significant predictor for nonlocal sites. Evidenced by the clustering and ordination techniques described above, distance to agricultural fields is an important distinguishing factor of nonlocal sites. Living on steep slope distinguishes between nonlocal and local settlement, as well as among nonlocal sites.

The main reason to transform data in a principal component analysis is to compress data by eliminating redundancy. I confront interdependence among migrant settlement by analyzing the correlative structure of nonlocal sites, and in doing so reduce the multivariate dataset to produce classifications of continuous variables such that the combined variation among all response variables is synthesized. Particularly relevant for settlement pattern archaeology, these analytical methods illustrate the utility of multivariate statistics when ‘spatiality’ is inherently significant (Ammerman and Kintigh 1983). Ordination is a robust tool for exploration of data and is instrumental in this case for developing a model of migratory settlement in the Moche Valley during the Gallinazo Phase of the Early Intermediate Period.

CHAPTER 7

CONCLUSION

On the North Coast of Peru approximately 2,000 years ago, nonlocal migrants established multiple colonies among indigenous coastal groups prior to the formation of the Southern Moche polity, one of the most well studied, politically complex, and enduring ancient societies. Although many decades of archaeological research have come to pass, questions still remain about the nature of interaction between communities living together in the Moche Valley at a critical time of Andean socio-political development. Dating to the Gallinazo Phase of the Early Intermediate Period, highland-style ceramics have been found at 114 sites in the Moche Valley; yet, by the following Early Moche Phase of the EIP, only a couple hundred years later, very little material evidence for nonlocal occupation remains.

My dissertation research was motivated by two questions:

1. What is the 'signature' of highland migrant settlements in the Moche Valley during the Early Intermediate Period?

2. What was the nature of interaction between highland and coastal groups that once occupied the Moche Valley?

And, the two principal objectives of my research were:

1. To quantify the aspects of architecture, spatial organization and settlement pattern unique to highland settlements in the Moche Valley during the EIP by combining GIS and statistical modeling with traditional archaeological fieldwork.

2. To address issues of culture contact between highland and coastal ethnicities, as well as explore the nature of interaction between highland groups that migrated into the valley, presumably as separate cohorts.

As one of the most prolific early Andean scholars, Kroeber (1927:649-650) states "the explanation that most readily comes to mind for the mixture or fluctuation of habit within one population is that of a meeting of Highland and Coast customs." If we are to truly understand culture contact and the ensuing interaction of communities living in a pluralistic society, we must go beyond descriptions of traditions to investigate the archaeology of space in prehistoric peoples' everyday lives. For nearly a century, Andean scholars have defined the ethnicity of these cultures by geographic origin of their ceramic styles. My research explores what it may have meant to be a 'highlander', migrating down the mountain into a coastal river valley, and living among a community with whom there had been a long history of conflict.

Highland and coastal groups interacted in the Moche Valley for many generations prior to the Gallinazo Phase of the EIP. Through archaeological indicators of warfare, it appears that these interactions were most often violent. Highland raiding was probably the source of conflict in the Moche Valley during the Salinar Phase of the EIP (Billman 1996). Steven LeBlanc (2003) sees prehistoric warfare as driven by competition, often triggered by climate change, and believes that warfare is a pervasive and rational socially sanctioned institution. While the irrigation network expanded over many generations during the Salinar Phase, highlanders saw an opportunity to forcibly take resources from the many weaker, dispersed and politically autonomous coastal communities below.

However, a continuity-model would suggest that as coastal communities consolidated and grew stronger it became more difficult and unnecessary for highlanders to raid small coastal villages. As the irrigation network expanded, it became more productive to migrate into the valley, occupy niches opened up by expanding irrigation, and build complementary relationships with the coastal population. It is not unreasonable to assume that highlanders sought to colonize these agriculturally productive niches, and through manipulating the technological advancements of farming, they also manipulated relationships within the agrarian society. Human relationships necessarily implicate technology because our species always makes use of 'material resources and symbols' to create enduring and consistent social systems (Strum and Latour 2000). In evaluating the dynamics of a prehistoric social system we cannot neglect to consider the importance of technology as a causal factor for change. The more technologically sophisticated a society is, the more overlap there is in essential connections between groups within that social system (Crumley 1976). Connections between ethnic groups living within a pluralistic society are a complicated set of interdependent linkages that organize many parameters of society (Scarborough 2003). These vital connections of society are often materialized by visible symbols like architecture and nonvisible symbols like spatial distancing. During this interval of the Gallinazo Phase, the organization of nonlocal sites and migrant settlement patterns are characterized by asymmetrical power dynamics that functioned to maintain social order inside an ethnotone.

Models like those described in my dissertation are useful because they allow us to see patterns in space and time that might otherwise be intractable (Winterhalder 2002). The conventional wisdom was that sites associated with nonlocal ceramics were built on steep slopes out of fear of conflict with local populations, but my model provides evidence to the contrary. I infer from my results that building on hillsides was a choice, not a necessity. I also used site-level and landscape-level variables to build a model of nonlocal settlement that indicates access to agricultural fields is the starting point for understanding interaction among nonlocal groups.

Mathematical models such as those discussed in this dissertation, in their most pure form, are only expressions of human behavior related to spatial interaction. The effectiveness of similar models in archaeology was first discussed more than three decades ago by many prominent researchers (Crumley 1979; Flannery and Winter 1976; Hodder 1974; Renfrew 1975). Early on, geographers devised a number of transformation methods (see Tobler 1975; Rushton 1972) that reduced distortions in locational models resulting from environmental variation, the 'lag effects' of spatial patterning like temporal longevity and site occupancy. Similar transformations were considered by economic anthropologists such as Smith (1976) and Chisholm (1975), and they note that these transformations are not meant to be taken as explanatory theory (positivistic); rather, transformations are designed to be used as "normative devices that isolate and identify deviations from an ideal ordering model to pose problems of specific interest for examination and explanation" (Butzer 1982:214). Researchers using mathematical models of human behavior should be mindful of this distinction.

Smith (2003:77) submits that "spatial relationships are the sinews of archaeological research". In keeping with this notion, we might expect that spatial relationships are fundamentally present across all scales of archaeological investigation. Yet, space is often treated unevenly within our discipline, sometimes there is an assumed equivalence between physical environments and constructed environments. In order to advance archaeology beyond this notion, we must start our investigations of spatial relationships in prehistory from a two-fold position: 1) humans create space through social practices; but, 2) physical realities of the world around us are not obsolete in this process.

Prehistoric human settlements are often believed to have locally emerged; hence most interactions with neighboring settlements are considered subsequent and/or peripheral. When archaeological sites are thought of in this way, important connections in prehistoric society are represented as static and are simplified, or ignored completely. It is more likely that human interaction at the community level contributes to the size and status of all groups in the broader social system (Sindbaek 2007). We should be compelled to find ways in which social interactions and physical locations are given equal status in the archaeology of space.

In this dissertation, I have described nonlocal architecture at specific sites, predicted aspects of differentiation between nonlocal and local communities and identified important factors for variation among nonlocal sites. I have provided a compelling argument that nonlocal material culture belonged to highlanders. I established that clustering around elites was significant; but more importantly, that those clusters represent corridors to the highlands, which could be important for understanding what became of nonlocal migrants during the Early Moche Phase. I speculate that perhaps the ethnic-highland population was gradually assimilated into Mochica culture, rather than victim of genocide or forced removal. I have provided evidence for nonviolent interaction among populations living in an ethnotone. I am confident my project supports the advancement of modeling in archaeology and will have a direct influence on current and future research on events surrounding the migration of nonlocal (presumably highland) groups to the Moche Valley during the Gallinazo Phase of the Early Intermediate Period.

Future Directions

For every question I answered in this research, there were two or more new questions posed. I have a number of ideas about how best to address those questions. The first step is to expand the MOP-GIS. Since I began constructing the database in 2003, there have been new technologies developed for data collection. There are better, more detailed and higher resolution information products available. There are still large areas in the watershed left to survey. I will continue to build the MOP-GIS by finishing the upper valley survey with as many new, high-quality information products as possible. I also recently gained access to archaeological and geospatial data from other river valleys on the North Coast. I intend to incorporate those data with the MOP-GIS and construct a multi-valley social network model.

Mentioned multiple times throughout this dissertation, two very important types of archaeological data are missing from nonlocal contexts in the Moche Valley: bioarchaeological and paleoethnobotanical data. Considering that substantial mortuary and bioarchaeological studies have been done on local human remains, particularly Moche, the analysis of nonlocal burials and human remains would go a long way toward confirming ethnicity and origin of the nonlocal population. Also, skeletal trauma is the best way to track interpersonal violence. A narrative of highland/coastal conflict (or the lack thereof) is written on the bones of individuals that lived in the Moche Valley during the Early Intermediate Period. More bioarchaeological study is needed to understand nonlocal migration and interaction with coastal communities. For example, at MV225 (Cerro León) we have found material and biological evidence for the use of marine resources. A diet rich in marine resources in addition to terrestrial foods would imply that these nonlocal elite individuals had access to resources other than locally grown agricultural products. If substantiated, this pattern would illustrate complementarity between nonlocal migrants and their coastal neighbors.

The other missing piece of the puzzle is paleoethnobotanical data. In order to understand nonlocal culture we must have information about the interrelationships of people and plants from evidence in archaeological contexts. Once processed, flotation samples available from multiple years of excavation at MV225 will document the trajectory of the site from construction to abandonment. We also have material from coastal Gallinazo Phase and Early Moche Phase contexts. I conducted a complete survey of milling stones at MV225 and mapped all of the architecture at Cerro León. The combination of data from the milling stone and architectural surveys with paleoethnobotanical data will yield descriptions of highland household-level practice and render finer distinctions of status and stratification in highland migrant society.

Lastly, I will continue to be a part of MOCHE, Inc. (Mobilizing Opportunity through Cultural Heritage Empowerment), a nonprofit organization that helps preserve Andean cultural heritage and works to improve the quality of life for descendent communities in Peru. I am excited about the prospect of working with our local partners to build a research center and cultural heritage museum at Ciudad de Dios, in the middle Moche Valley, where cultural heritage preservation, scholarly research, and education will merge.

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