LAND USE AND THE HUMAN-ENVIRONMENT INTERACTION ON OLOSEGA ISLAND, MANU'A, AMERICAN SAMOA

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Title

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF SCIENCE

ABSTRACT

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The human-environment relationship has often been characterized as one of human adaptation. This particular view has now come into questions as critiques have shown that the relationship is complex and dynamic. In archaeology, one way of examining this relationship is to study the settlement, subsistence, and land use of a given area. This thesis serves that purpose by providing a case study of a small island in the Samoan archipelago in the central Pacific. The survey of Olosega Island identified over 200 different features distributed across the interior. Although no test excavation was conducted, it is interpreted that these features relate to domestic, subsistence, ceremonial, and political activities that likely occurred in the later prehistoric period. The combination of these features, supplemented by environmental data from the interior and further archaeological work along the coast, indicates that the human population was a member of a complex and dynamic system with its environment. Through time, this system likely evolved in a number of ways, not just adaptive, that often caused changes requiring responses by both the human population and the environment of the area.

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This research would not have been possible without the help of a number of people. I would first like to thank the people of Olosega and Ofu for their help throughout the project, especially Vano who was with us every day. Darren Dodderer and other employees at the National Park of American Samoa provided assistance during the planning stages and the field work. NDSU field school students worked hard under some difficult conditions to ensure the quality of this research. David Herdrich from the American Samoa Preservation Office kindly supplied the available site forms for Olosega and Ofu as well as other information as needed. David Addison and Alex Dinu read various drafts, and their comments improved this work substantially. Finally, I would like to thank my committee, Jeffrey Clark, Thomas Riley, Joy Sather-Wagstaff, and Donald Schwert, for their comments, support, and guidance throughout this project and the master's program in general.

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LIST OF ACRONYMS

ASHPO	American Samoa Historic Preservation Office
CRM	Cultural Resource Management
ENSO	El Niño-Southern Oscillation
GIS	Geographic Information Systems
GPS	Global Positioning System
NDSU	North Dakota State University
NPS	National Park Service
USDA	United States Department of Agriculture
USFS	United States Forest Service

LIST OF SAMOAN TERMS

Fale Aitu	God house
Fale o'o	Common dwelling
Fale Tele	Guest or community house
Fale umu	Cook house
Fo'aga	Grinding stone
Fono	Council
Ili'ili	Pebbles which were used as house floors
Malae	Open area in Samoan village ideally in the center
Malaga	Guests of the village
Mana	Interpersonal force or power
Masi	Fermented breadfruit
Matai	Samoan title holder
Nu'u	Village
Oso	Digging stick
Oso to	Planting stick
Pitonu'u	Subvillage
Tia'ave	Starmound
Umu	Earth oven
Umu ti	Earth oven used to cook ti roots

CHAPTER 1. INTRODUCTION

In 1971, Roy Rappaport wrote that adaptation was "the process by which organisms or groups of organisms maintain homeostasis in and among themselves in the face of both short-term environmental fluctuations and long-term changes in the composition and structure of their environment" (1971:23-24). This statement was written at a time when the environment was thought of by many as a blank canvas used by human populations who were responsible for both environmental developments and catastrophes. Recently, this view has shifted. The environment is now something that is part of a dynamic system along with human populations, each responding to changes within the other, each also responding to pressures posed by external factors. In light of these changes, is it still appropriate to view human-environment relationships in the way that Rappaport suggested, or should we develop another way of viewing these relationships? Through archaeology, there is the possibility of answering these questions by studying the settlement patterns, political systems, land use practices, and settlement distribution of prehistoric peoples.

In particular, the Pacific basin has provided a number of case studies to test this question (e.g., Kirch and Yen 1982; Riley 1972). Many of these studies have illustrated the impact that human populations can have on island environments (e.g., Diamond 1994; Kennett et al. 2006; Kirch 1982b; Rapaport 2006), while others have illustrated the impact that environments have had on human populations (e.g., Allen 1992, 1998; Nunn 2000, 2003a,b, 2007). There is no question that humans have impacts on island environments, which range from organism extinctions (e.g., Steadman 1995) to human landscape modifications (e.g., Kirch 1994). The environment has equally visible impacts on human populations, specifically with respect to subsistence economies and political development. These impacts range from resource depression that may cause competition for those limited resources (e.g., Field 2004), or the environment may just act to constrain or allow certain events such as seafaring (e.g., Anderson et al. 2006). Because of the availability of these comparative cases, further developments can be made as more work is conducted. I will attempt to do just that by examining a case study of the environment-human interaction in the Samoan archipelago.

Environmental Setting

The Samoan Islands are situated at the heart of the central Pacific, around 4,192 km southwest of Hawaii and 2,886 km northeast of New Zealand (Figure 1). The archipelago is split into two separate political entities: the Independent Nation of Samoa (referred to as Samoa) and the unincorporated Territory of American Samoa (referred to as American Samoa). Samoa is comprised of the two largest islands in the group, 'Upolu and Savai'i, as well as two smaller islands that lie between the larger two, Manono and Apolima, and a small number of islets located around the fringing reef of 'Upolu. Tutuila Island, meanwhile, is the largest island within American Samoa with Aunu'u Island situated just off the southeast coast. Farther east, but still within American Samoa, lies the Manu'a group comprised of Ofu, Olosega, and Ta'u islands (Figures 1, 2), the small Swains Island, and the uninhabited Rose Atoll. The research discussed here was conducted on Olosega, which is a small volcanic high island that is roughly five square kilometers in size. Olosega is connected by a small bridge to Ofu Island. These two islands are remnants of a highly eroded, single volcano with only the two steep islands remaining, separated by a small channel. The island of Olosega is composed of mostly pre-caldera volcanics which primarily consist of thin-bedded olivine basalts (Stearns 1944:1313). Later volcanism is responsible for the creation of the north and east ends of Ofu, while marine and stream erosion have further modified the landscape over time. A fringing reef skirts the outside of the island in many areas, supporting a wide variety of marine life (Stearns 1944).

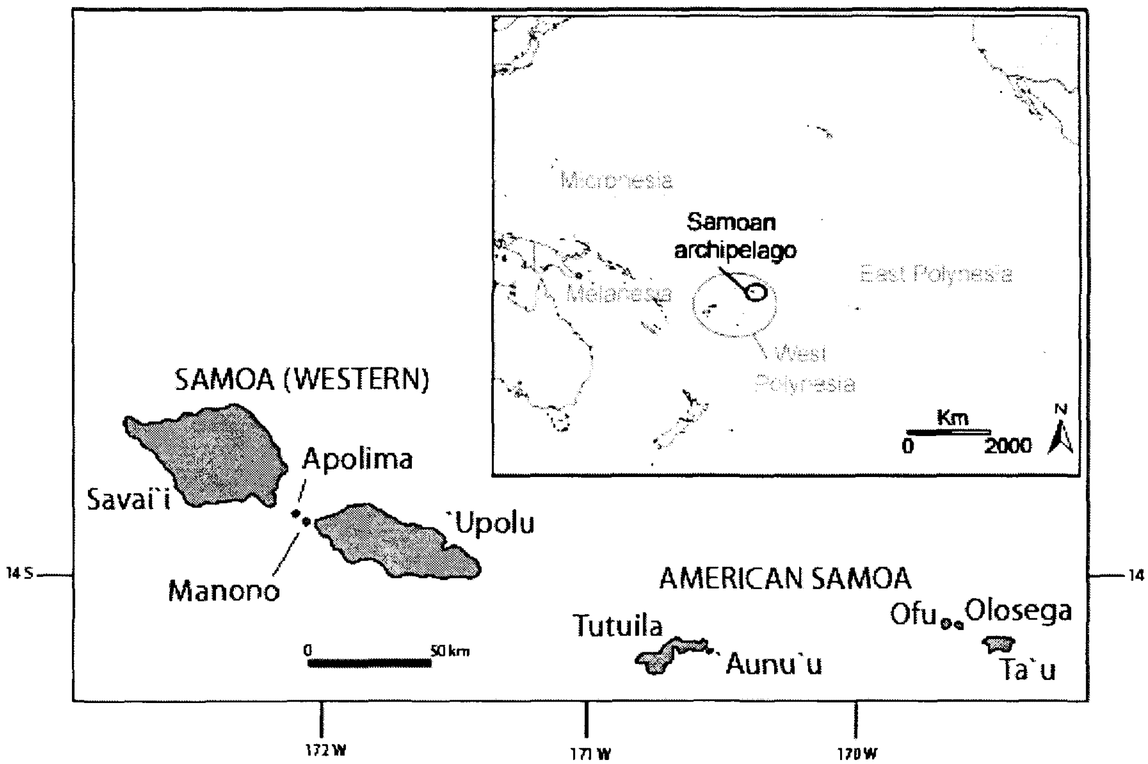

Figure 1. Map of Oceania with Samoa Highlighted. Adapted from Rieth 2007:4 Fig.1.

The majority of the soil, particularly in the interior of Olosega, consists of Fagasa-Ofu silty clays derived from volcanic ash deposits. This type of soil is well-drained and has moderate water capacity usually being found on the steeper slopes (of over 30 percent), but is present on broader slopes on the backside of Olosega. Although this is not prime agricultural land, it has the potential to produce crops, and the vegetation present in these locations lends evidence to that assessment. The coastal areas are composed of Ngedebus cobbly sand and urban land-Ngedebus, while the cliffs and peaks of Olosega are composed of a Fagasa family lithic outcrop, similar to those found on Tutuila (USDA n.d.).

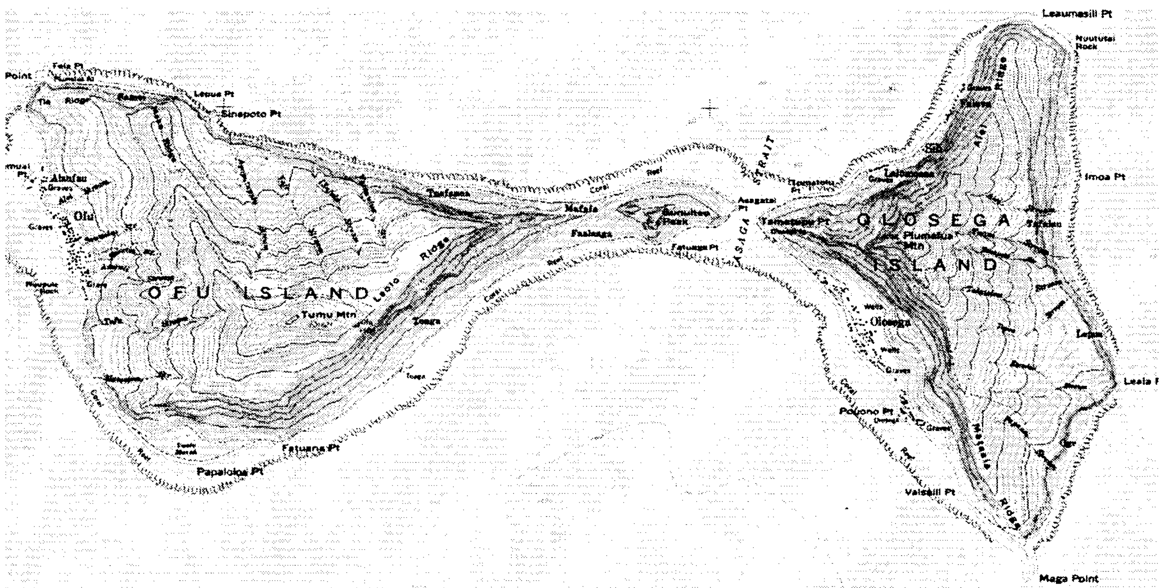

Figure 2. Topographic Map of Ofu/Olosega. From the American Samoa GIS Users Group.

A number of small streams are located on the eastern slopes of Olosega, all of which are intermittent, flowing after heavy rains. The highest point on the island is Piumafua Peak, which is 629 m in elevation with steep cliffs prominent above present day Olosega and Sili villages. The eastern side of the island slopes more gently, but even the majority of this region has over 20 percent slope. Because of this slope, landscape change is common in the form of landslides and slumping, particularly after the removal of vegetation. In addition, a single marsh is located in the back of Olosega village. This marsh is used by the village as an area to grow wet taro, with many of the families having

Brief History of Samoan Archaeology

Modern archaeological research in the Samoan Archipelago began with the survey and excavation undertaken by Jack Golson in the late 1960s. This was then expanded by Roger Green and Janet Davidson (1969a, 1974) providing the basis for a proposed Samoan cultural sequence, which continues to play a large role in any discussion of Samoan cultural history.

The long-lasting influence of that project, which is of interest to the present study, is the role that settlement distributions played in the construction of that cultural history. Throughout his career, Roger Green argued that classification by settlement was the best way to understand the evolution of Samoan culture throughout the archaeological sequence (Green and Davidson 1969a, 1974; Green 2002). A few years after the completion of the Green and Davidson projects, Jesse Jennings directed another large-scale effort focused on the islands of then Western Samoa (Jennings and Holmer 1980; Jennings et al. 1976, 1982).

During this time in American Samoa, William Kikuchi (1963) was conducting limited ethnographic and archaeological investigations. Later, Jeffrey Clark built on the work of Kikuchi by conducting a cultural inventory survey for the Historic Preservation Office of American Samoa (Clark 1980). Since those initial projects were undertaken, numerous contract and academic Cultural Resource Management (CRM) projects have been carried out in American Samoa (see Ayers and Eisler 1987; Best 1993; Best et al. 1992; Clark and Herdrich 1988, 1993; Clark and Michlovic 1996; Eckert and Welsch 2010; Frost 1978; Hunt and Kirch 1988; Kirch and Hunt 1993; Leach and Witter 1987, 1990; Morrison and Addison 2008, 2009; Pearl 2004, 2006; Winteroff 2007).

Although archaeological research was conducted in Manu'a as part of early projects (e.g., Clark 1980, Kikuchi 1963), it has received far less attention than the larger American Samoa island of Tutuila. Although previous research has shown the potential of the area (e.g., Kirch and Hunt 1993), little in the way of archaeology has been conducted and models developed using data collection on other islands in the archipelago are commonly used to explain the prehistory of the three islands of the Manu'a group.

Introduction to this Project

The present study expands on the data collected by the aforementioned projects, contributing new data to the study of prehistoric Samoan settlement and subsistence in the Manu'a Islands and the human-environmental interactions in the Pacific. It specifically explores the land use, settlement distribution, and village layout of Olosega and compares it to data collected from other islands in the archipelago. These data were collected as part of a North Dakota State University (NDSU) field school in the Manu'a Islands, American Samoa, specifically from the archaeological survey conducted in the interior of Olosega. Soon after the start of this work, it became apparent that the project area was unique, allowing for an opportunity to test many of the proposed models of prehistoric settlement and human-environment interaction in Samoa. A total of 251 features was discovered including a number of terraces, ditches, linear depressions, round depressions, star mounds, and a new feature class "ditched terraces." Although it was expected that features were to be discovered in the interior and on the eastern coastal plain, this amount was not anticipated. Data recovered from these features were supplemented by environmental data collected by previous researchers in order to understand the complex interaction between humans and their environment on a small central Pacific island.

Research Questions

In addition to an overriding goal of understanding the nature of the human-environment interaction on Olosega, more specific research questions are examined. These research questions stem from interpretations made as part of ethnographic and other archaeological projects in the Samoan archipelago. More specifically, these questions relate to the pattern of settlement features on Olosega, the distribution of settlement on Olosega, and archaeological evidence of social differentiation. Other research objectives are specific to Olosega, such as the land use history of the project area.

Last Use

A better understanding of the human-environment relationship may be reached by examining the following questions regarding land use:

1. Are there archaeological indicators of past land use activities?
2. Are there environmental indicators of past land use activities?
3. If so, how do these land use activities relate to the settlement pattern as a whole?

Evidence of Social Differentiation

Questions related to archaeological evidence of social differentiation stem from the research of Holmer (1980), specifically the following:

1. Are there individual features on Olosega that may reflect social differentiation?
2. Does the pattern of settlement as a whole reflect social differentiation?

Patterns of Settlement

The questions I will attempt to answer relating to the patterns of settlement on Olosega stem from interpretations made by Buck (1930), Davidson (1969b), Shore (1982), and Holmer (1980). Specifically, I will attempt to answer the following questions:

1. Is the inland settlement on Olosega nucleated or dispersed over the landscape and how does this compare with known archaeological and ethnographic examples?
2. Is it possible to identify archaeological correlates of modern village structures such as the *malae* or *fale tele?*

Settlement Distribution

The questions I will attempt to answer relating to the distribution of settlement on Olosega stem from interpretations made by Davidson (1969b, 1974) and Pearl (2006), while using data from Kirch and Hunt (1993), Moore and Kennedy (1996), Radewagen (2006), Clark (in. prep), and ASPA (American Samoa Power Authority) site files. These questions are:

1. How does settlement change through time and across space?
2. What is the nature of settlement at different periods of time in different areas of the island?
3. If changes are present, what may cause these changes?

Thesis Organization

In Chapter 2, I describe both the research objectives of this thesis and the methodology employed to accomplish those objectives. In the methodology section, comments are made on both field and laboratory methods that were employed in this project. Although mentioned, specific GIS techniques are not discussed in any detail, but, rather, are explained in proceeding chapters where they are utilized.

In Chapter 3, I review literature associated with this thesis, including sections on the theoretical background and orientation of this thesis, landscape studies in the Pacific, and archaeological research on Olosega. These reviews will allow for a better understanding of the data that will be presented in subsequent chapters in order for the reader to better evaluate the models and hypotheses presented.

In Chapter 4, I summarize current interpretations and models in Samoan anthropology that relate to the research questions discussed above. This information will give the reader a better understanding of the arguments presented in this thesis, while also allowing the reader to become familiar with the scientific environment in which this research has been conducted.

In Chapter 5, I provide a summary of the results of the survey and laboratory analyses. Although these summaries cite a number of individual features, this section is meant to provide an overview of results instead of detailed descriptions of individual features, which can be found in the report submitted to the ASHPO (American Samoa Historic Preservation Office). In addition, this chapter provides some working interpretations, many of them functional interpretations, regarding individual features that will feed into wider ranging models and hypotheses. Many of the GIS techniques mentioned in this thesis are discussed and utilized in this chapter as part of those interpretations.

In Chapter 6, I combine all of the data discussed previously in order to create models and interpretations that can be tested by further work. Models exploring land use, village layout, and settlement distribution will be discussed. It is my hope that the models, hypotheses, and interpretations provided will allow for more sophisticated research questions to be drawn to address issues of culture and prehistory in Samoa, and in the wider Pacific region.

I conclude this study in Chapter 7 by exploring broader questions relating to the settlement of humans in Pacific island environments. This chapter discusses future research agendas that can test not only the interpretations and models presented in this thesis, but also test a variety of models of settlement that have been proposed for elsewhere in the Pacific.

Although preliminary in nature, I provide the first major attempt at investigating large-scale settlement patterns in the Manu'a group through this thesis. It not only enhances our understanding of the settlement layout and pattern of prehistoric peoples in Samoa, but also adds to the growing data available regarding the relationship of human beings and their environment in Pacific Island environments. Specifically, these data can potentially aid in addressing questions relating to human adaptation, and more generally cultural evolution, in island environments.

CHAPTER 2. RESEARCH OBJECTIVES AND METHODS

To understand the methods used by any study, an understanding of the research objectives is necessary. The following will first outline what this research was meant to accomplish and then describe in detail the methods employed to reach said objectives.

Research Objectives

In the past, research on prehistoric Samoan settlement relied on few, but influential, archaeological projects undertaken on the larger islands in the archipelago. These data were then applied to other islands in the group, largely because of the lack of archaeological data specific to these islands, even though each island had different environmental characteristics. It is because of this lack of data and the need to evaluate models formulated on the larger islands, though extrapolated for smaller ones, that the present work was undertaken. It was decided to survey the interior of a small island in order to gather information about the distribution of features, the pattern of prehistoric settlement, and the overall land use because the limited land area would constrain settlement making such as survey feasible. Because of this, area survey was chosen over test excavation and sampling. There are obvious drawbacks to this decision as all data collected would be treated as synchronic and, therefore, the temporal relationship between different features and between the features and the changing environment would have to be assumed rather than verified. Nevertheless, it was more important to the success of this project that the distribution of features be known and not their temporal relationships, which will be a goal of a future project. In addition to the survey in the interior, knowledge of the eastern shore of Olosega was desired to address very basic issues of geomorphology, specifically sediment accumulation from erosion, and the relationship between interior and coastal settlements.

Methods

This project has two methodological components. A field work component, specifically survey, was undertaken in the summer of 2010, and a laboratory and technological component undertaken in the fall of 2010. These methods, as previously discussed, were decided upon after considering the research objectives outlined. The following is a detailed summary of the methods used and their applicability to accomplish the research objectives.

Field Methods

This project was carried out in conjunction with the North Dakota State University Archaeology Field School in Manu'a in May of 2010. Because of this, the field crew consisted of a number of participants rotating between excavation and survey activities over a three week period. In addition, at least one local villager accompanied the crew serving as a guide, and trail clearer.

Survey was the primary component to this field work and was undertaken on every possible day. At the outset of the study, the plan was to survey all land on Olosega, but after the first week, and the realization that many more features were present than anticipated, it was decided that a better approach would be a large sample focusing of the southern half of the interior, south of Talaisina Stream, with the addition of Oge beach and coastal plain on the east coast (Figure 3). Because of the nature of the environment and the density of materials, true transects were neither possible nor deemed appropriate. At times, when transects could be used, 10 m was the baseline measurement between individuals, which was reasoned to allow for the identification of most surface structures, even though not every artifact in the survey area would be seen. On two separate days, the crew split into two separate groups to cover more ground in the day, but the groups were always in considerable contact using National Park Service (NPS) radios. Most portions of the project area were systematically surveyed, but toward the end of the project one or two transects were used to identify sites in specific regions, which served as samples for those areas. Thus, the project did not cover the entire island, nor the entire project area as defined before the project commenced. Instead, a large portion of the island was systematically surveyed, a small portion was sampled by a small number of transects, and some areas remain unsurveyed.

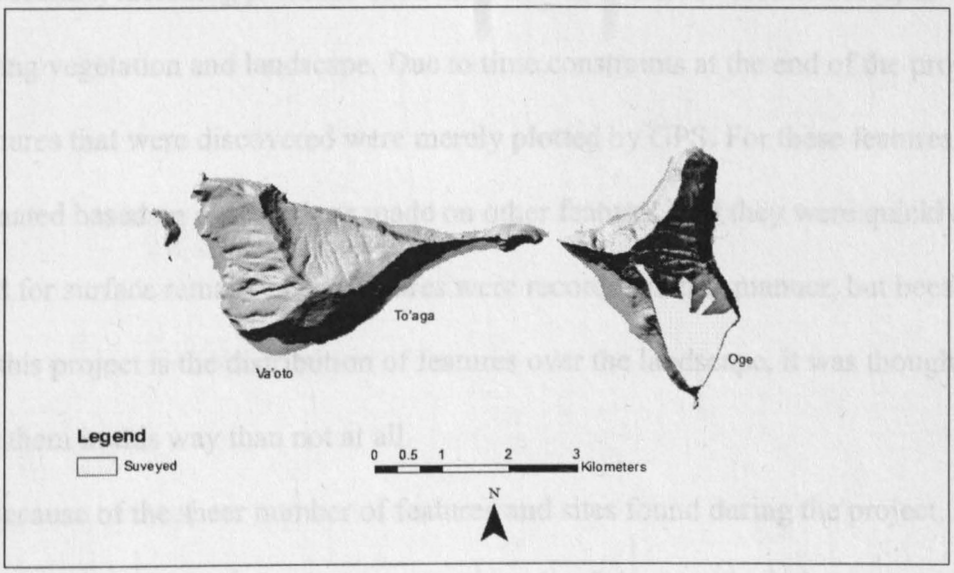

Figure 3. Map of the Surveyed Area.

When features or sites were encountered during the survey, a point was plotted using a Garmin GPSMAP 60 GPS unit near the center of the feature. When large or clearly linear features were discovered, multiple points were taken throughout the extent of the feature or site. The majority of features and sites were plotted only with a single point, largely due to the large accuracy range, ca. 10 m, of the GPS device, which meant that little benefit would be gained by plotting multiple points on smaller features or sites. Maximum length and width measurements were recorded using metric tapes.

Digital photographs were taken of every feature with the number of photos of each dependent on the nature of the feature or site. For instance, only a single picture was taken of terraces with no paving or surface scatters, while multiple photographs were taken when curbing or paving was encountered. In addition, digital video was taken to better understand the layout of features for future analysis. General observations were then noted about the feature, including presence of shell, artifacts, and associated features, as well as surrounding vegetation and landscape. Due to time constraints at the end of the project, some features that were discovered were merely plotted by GPS. For these features, size was estimated based on observations made on other features, and they were quickly examined for surface remains. Few features were recorded in this manner, but because the focus of this project is the distribution of features over the landscape, it was thought better to record them in this way than not at all.

Because of the sheer number of features and sites found during the project, not all of them could be mapped in detail. Instead, a sample of sites, particularly star mounds, were mapped using a tape and compass, while simple sketch maps were drawn to further understand the distribution of features in a given area, specifically the area in the center of the settlement.

Many of the same methods discussed above were also used for the Oge beach and coastal plain survey with the addition of a coring program. Because of the nature of the vegetation and time issues, a simple reconnaissance survey was conducted focusing on the area inland areas of the coastal plain. The cores, with a tube diameter of ca. 2 cm, were taken in a variety of areas to view the subsurface stratigraphy as test excavation was deemed too time consuming and difficult given the access to the area. Cores were not placed in true transects, but were placed in areas thought most likely to provide information on human settlement and past geomorphological processes. The depth of these cores was totally dependent on the nature of the soil and only terminated when sterile sand was reached or when obstructions, such as large pieces of coral or rock, did not allow for the action to continue. At times, an auger bit had to be employed to cut through heavily packed or very rocky soils, but this procedure was kept to a minimum in order to get a clear and undisturbed view of the stratigraphy. Subsurface stratigraphy, as identified by the coring, was mapped on common metric graph paper with soil texture and color noted as well as any inclusion found within the soil matrix. In addition, the location of cores was plotted on the same GPS unit used during the survey.

Laboratory Methods

The vast majority of lab work conducted during this project was on the data collected on the location of surface structures recorded during the interior survey. The classification of features and sites identified was accomplished by creating a morphological typology using information gathered by previous research (i.e., Davidson 1969b, 1974;

Clark and Herdrich 1988, 1993) and identifying new patterns within the recently collected data. After classification was accomplished, the information was then entered into a Microsoft Excel spreadsheet that included site locations along with data regarding size and other applicable comments. Points were transferred from the GPS unit to MapSource software. These data were then exported out of MapSource to a Microsoft Excel spreadsheet, and then imported into a GIS. Within the GIS, they were converted to traditional shape files for further manipulation and analysis. Basic statistics were obtained for each type of feature so that outliers could be identified. Specifically, size categories were created for both terrace and ditched terrace feature classes to better understand the observed distribution. This project utilized both ArcGIS 9.3 and ArcGIS 10, specifically the ArcMap application, but also ArcScene to a lesser extent.

The spatial analysis was conducted using various tools available through ArcGIS. The specific analyses performed will be discussed later in this thesis, but these included techniques such as nearest neighbor analysis, kringing, point density analysis, viewshed analysis, hydrology, and cluster and outlier analysis. Such tools are an important component of any GIS software.

GIS is a set of interrelated computer programs designed for handling and processing spatially referenced data (Kvamme 1999:154). The key component of any GIS is its capabilities to allow one to visualize their data in a variety of ways based on any number of definable attributes. Although visualization is the most common and most widely identified aspect of GIS, it is only one aspect of the complex system which also includes ways of entering data, storing spatially referenced data, and conducting various analyses on those data (Wheatley and Gillings 2002:8-9).

Spatial distribution studies, such as the nearest neighbor analysis, are another application of GIS software and are the main analytic techniques utilized in this thesis. Because of its visualization and spatial statistical analyses capabilities, a number of archaeologists have utilized GIS to understand the layout of prehistoric settlements in a given area or features within individual sites (intra-site spatial analysis).

Despite GIS's potential benefits, its use in archaeology is not without problems (see discussion by Kvamme 1999; Lock and Stancic 1995; Wheatley and Gillings 2002). Research choices, such as the inclusion or exclusion of certain data, are made throughout the analysis process and, therefore, may bias the results. The decision of what analysis is used can also influence the interpretation of your data because different techniques of analysis will focus on different attributes of the data. Other problems exist because certain definitions in archaeology do not translate well into a GIS, specifically the concept of site, causing potential misinterpretations of results. Archaeologists can counteract these issues by explicitly describing decisions made so that other researchers can determine if the decisions introduced a bias. Concepts of what a "site" or "feature" exactly is, and how one can incorporate such definitions into a GIS system are decisions that will always have to be made by the researcher, and there will always be a degree of bias because of it; it is then up to the researcher to understand and attempt to correct those biases when making interpretations so that mistakes can be avoided.

Maps of the survey area were created using ArcGIS software and templates. These were then exported out of the GIS program as .jpeg files for use as illustrations. Aerial photography and a 10 m digital elevation model (DEM) used during the GIS analysis were provided by Alex Morrison of the University of Hawaii, while all tables and most graphs were created using Microsoft Excel.

Although this project focused on the distribution of surface structures, a small number of artifacts were collected from the project area. All of these are stone artifacts, most of which are formal tools. These were catalogued and given a unique specimen number with details regarding site, features, and any further comments on location listed. In the case of formal tools, a typology (Green and Davidson 1969b) was used to sort the artifacts, while no further classification of flakes and non-formal tools was undertaken. Measurements and weight were determined and the data were entered into an Excel spreadsheet.

CHAPTER 3. LITERATURE REVIEW

This literature review includes the theoretical background and orientation of this thesis, a summary of past settlement research in Polynesia, and a summary of past archaeological work on Olosega.

Theoretical Background and Orientations

Settlement or landscape perspective approaches have had a long history in archaeology beginning with the pioneering work of Willey (1953) in South America. Since the 1950s, this approach has grown to include a wide variety of theoretical perspectives and methods that emphasize either the environment (e.g., Butzer 1982), the social perceptions of landscape (e.g., Tilley 1994), or a combination of both. Much of this variation, but not all, stems from the modern movement away from the processual (Binford 1968; Binford and Binford 1968) or "new" archaeology and into a post-processual or "interpretive" archaeology (Hodder 1986). Although these two perspectives are very distinct, they are not mutually exclusive. For example, it is possible to study both the land use history of an area as well as the symbolic and sacred landscape of that same place. Thus, in practice, most scholars do not fall into the broad categories of processual or post-processual. Instead, they utilize concepts and methods of each. But, because this thesis utilizes aspects of both approaches, each will be described.

The Processual Approach to Prehistoric Settlement

From their inception, processual archaeology approaches have been modeled on the physical sciences (see Binford 1962, 1965; Binford and Binford 1968). By examining human culture change and development as a set of processes, researchers have thought that overarching laws may be deduced from empirical data to explain culture. Rossignol summarized the objectives of processual archaeology well by stating that "archaeologists wanted to investigate methods of inference that ultimately lead to knowing the past, rather than to speculating about it" (1992:5). Because processual archaeology is claimed to be more scientific, the methodology employed by them was also considered more scientific and objective, with many studies being quantitative. With the advent of new computer applications, such complex statistical applications and GIS which were once thought to allow for such as objectivity, processual methodology flourished. Many processual archaeologists utilize methods from other scientific disciplines, particularly statistics, economics, geology, and ecology, to better understand the processes of both humans and their environment.

Processual settlement studies are aligned with this general theoretical orientation. All seek to understand the science of human settlement in an objective and deductive way. The modeling of prehistoric economic systems has been a major objective, specifically identifying both patterns of land use and adaptations to a given environment. During the early stages of this movement, most researchers viewed humans as an entity distinct from nature. Because of this perceived patterning, many studies emphasize the predictability of site location due to the presence of some environmental feature, such as soil type, vegetation pattern, or availability of water, now employing GIS software to accomplish this goal. The modification and "degradation" of the natural landscape have also been important themes, which have led researchers to employ ecological and geological techniques to explore soil nutrient losses and geomorphological change (e.g., Butzer 1982;

Vitousek et al. 2004). In addition to concern about the natural environment, human cultural systems, such as agricultural systems and village layout, were also addressed using actualistic studies (e.g., Binford 1978, 1980; Kirch 1976, 1994; Yellen 1977). These studies seek to understand prehistoric human behavior by using analogical methods such as ethnoarchaeology and experimental archaeology.

Although processual studies have greatly enhanced our knowledge of past settlement distribution in variable environments, there have been many critiques of this orientation, especially in last 25 years. For example, many note that the individual and the symbolism of the landscape are removed from culture when culture is viewed as a set of processes and systems (e.g., Bender 1993; Hodder 1986; Tilley 1994). In studying landscape in this way, the researcher is not taking into account major evidence that may affect further interpretations. For instance, if a certain resource exploitation site has more social significance, the population may choose to settle near it because of that social significance, and not because of the resource itself or any other environmental factor in the area. In a sense, because the human element remains unconsidered, the research objective can never be reached. Furthermore, many of the methods once considered to allow for the objective research of prehistoric culture have now been shown to be biased. For instance, choices are always made by the archaeologist such as what analytical technique to choose or what data to include (see GIS discussion above).

The Post-Processual Landscape

As settlement archaeology became more "scientific," those that did not view archaeology as a science became dissatisfied. As part of the post-processual movement dating to the late 1980s and through the 1990s (see Hodder 1986, 1992; Shanks and Hodder

1995; Shanks and Tilley 1987), a new, humanistic perspective in the study of prehistoric settlement developed: one centered primarily on the social constructions of the environment and "landscape." This movement was a response to the empirical nature of processual settlement approaches that utilized mathematical modeling and computer technology to understand the processes and systems behind human cultural behaviors. Although largely born out of the marriage between field archaeology and history, modern landscape studies have also been concerned with prehistoric peoples. The main goal of such studies has been to integrate of the individual player into the systems of the processualists, hoping to provide more robust interpretations that include various aspects of the human nature.

The development of what is generally termed "landscape archaeology" occurred primarily within the British school of thought and spread from there. Although the concepts of this approach were mentioned by Hodder (1986, 1992), it was not until Bender (1993, 1998) and Tilley (1994) that humanized space was first described. Although Bender's (1993) work was multidisciplinary in nature, she provides theoretical answers to various questions, specifically those regarding landscape perception, posed by the post-processual archaeologists, providing a methodology that displayed the subjective nature of landscape as shaped by human experience. Tilley (1994), more specifically, argues that the human perception of space, place, and landscape were unstable entities with different meanings proscribed on them by different individuals and groups both synchronically and diachronically. Landscape was then entirely socially constructed, important to people because of context and not because of any physical properties.

Unlike processual settlement archaeology, most post-processual landscape studies involve an aspect of the non-economic human-environment relationship (Ashmore and Knapp 1999). Landscape and human culture are seen as a single entity; one cannot exist without the other, and if one changes the other will change as well. Furthermore, because landscape archaeology addresses the cognition of space as well as the behavior of past peoples, historical and ethnographic texts provide to these researchers a key resource, without which viable interpretations would be difficult to create. In addition, GIS technology is becoming an important tool for these studies, specifically for viewshed and line-of-site analysis (see Lock 2000).

Methodology, then, does not generally differ from traditional settlement archaeology and post-processual landscape studies — although feelings, perceptions, and bodily senses have been suggested as viable research tools, which clearly do not mesh well with processual archaeology — the primary difference lies in the perspective used and the nature of the interpretations presented. Specifically, the testability of these interpretations is questionable. Because most conclusions include aspects of human cognition and perceptions, it is difficult to distinguish between useful and bad models. This particular critique remains the most common (e.g., Flemming 2006), and it is the primary reason that many researchers do not utilize a post-processual landscape approach. For instance, Flemming (2006) draws attention to the post-processual principle of "going beyond the evidence" and states that it is difficult to understand the argument in support of specific interpretations because the interpretation is beyond the evidence. Hyper-interpretative styles, according to Flemming, do not allow for the true understanding of the archaeological data and argument of the actual archaeologist. Instead, it is a literary device aimed to provide entertainment, and not actual information.

Orientation of the Present Study

Because the two perspectives discussed above are considered to be extremes in each of the respective schools of the thought, some archaeologists tend to use various ideas from each of the two and combine them for a more holistic approach to the study of settlement. The following will provide a summary of the theoretical orientations that have guided this thesis and the reasons for choosing those particular orientations.

This thesis falls under the theoretical orientation termed "human ecodynamics" (Kirch 2007a; McGlade 1995), but also socioecosystems (Barton et al. 2004). Although still in its relative infancy, this perspective has gained acceptance by archaeologists who frequently study ecological and environmental change through time as it relates to humans. In simple terms, human ecodynamics is concerned with the interrelationship of humans and their environment viewed within a non-linear dynamic system. This approach is comparable to a human ecology for the most part, although human ecodynamics stresses the concept that humans and their environment cannot be separated with the environment taking an active, but not deterministic, role in shaping the culture. Human ecology, on the other hand, tends to view the environment as a canvas of human activity. Human ecodynamics is a way to quantitatively study the human-environmental interaction through time with the understanding that landscapes are social constructs, which can change as a result of the environment. Environment is always a perception with a pristine nature being impossible. Temporality is a key component within this perspective; not only does space affect how humans interact with their environment, but time does as well, specifically due to different technologies, ideologies, and individuals. Although not specifically employing a human ecodynamic orientation, Barton et al. (2004:254) sums this view of non-linear development by suggesting that "the state of a socioecosystem at any particular place is equally a product of spatial-dependant as well as time-dependant processes." Therefore, within this perspective, the archaeological landscape recorded and described by the archaeologists is just the last step in a very complex interaction between humans and the environment and it should be realized that changes were common in the past. These changes, however, may no longer be reflected in surface remains.

Because this approach views the relationship between humans and the environment as non-linear and dynamic, it views the human-environment relationship as self-organizing and able to incorporate change into the system, some changes perhaps being detrimental. Furthermore, because this particular orientation stresses the view that humans and nature are inseparable, the relationship is coevolutionary. As a result, the evolutionary path cannot be predicted because no two areas will ever have the same spatial and temporal attributes. Disturbances and non-stable situations are also common within the system, but the complexity of the relationship enables these deleterious events, in many cases, to be absorbed. The archaeological landscape, therefore, is considered to be evidence of long-term changes caused by social and natural processes (Kirch 2007a:9-10). Because of the nature of archaeological research, historical ecology and human ecodynamics are natural compliments. As Kirch has stated, "archaeologists, in other words, are well situated to act as interlocutors between the concepts and languages of social and natural sciences" (2007a:9).

In addition to an overriding theoretical orientation of human ecodynamics, aspects of the research are directed by other approaches. Methodologically, this research employs a technique referred to as siteless, off-site, or distributional archaeology (Dunnel 1992; Ebert 1992; Foley 1981). The basic concepts of this approach emphasize the ambiguity of site designations for archaeological research, especially research focused on prehistoric settlement. It argues that because no culture or group would have recognized their own distribution in terms of sites, the term site should not be used in archaeological research and discussions. Although I use a siteless methodology as part of this research, features discovered during the course of this project were grouped into separate "sites" for the classification and administrative ease of the American Samoa Historic Preservation Office (ASHPO). As a result, even though the concept of a site is not specifically referred to within the discussion of this research, these features have been assigned site number by the ASHPO.

Finally, the interpretation of the data follows the orientation of Clark and Terrell (1978). This perspective emphasizes that archaeological interpretations are merely models of prehistory and are always simpler than the actual events. Because these are models, a verified prehistory is never the primary goal of any research project. Rather, models should be used as research tools for scholars to reach a better understanding of the data. As part of this procedure, and because different perspectives generate different ideas, multiple working models are emphasized. In other words, multiple models are needed for a given phenomenon so that research questions can be derived from those models and hypotheses can be generated for testing that allow one to assess the usefulness of the models, eventually leading to a better understanding of the data. Because much of the research presented in this thesis is preliminary, many interpretations and models will be suggested for the same phenomenon in order for them to be tested in the future, although this thesis may favor one model over the other given the present data.

These various theoretical orientations were chosen to guide this thesis for a variety of reasons. Since there was a need to understand the relationship between a human population and its environment, an ecologically strong approach was necessary, an approach that allows for the socially constructed environment to be taken into account because of the nature of the culture that inhabited this area. In addition, a more scientific, objective approach was favorable because of the inclusion of various GIS techniques within the research as well as the desire to test many of the models presented in this research in the future. In short, the specific theoretical orientations of this thesis were not chosen because it was believed that one perspective was clearly better than the other. Instead, the research objectives and methodology utilized during this research guided the choice of theory as much as my original theoretical orientations guided the choice of research objectives and methodology.

Settlement Studies in Polynesia

The development of settlement studies in Polynesia mirrors that of settlement pattern studies in general. The potential for these studies within Oceania has long been realized, especially when islands are considered as "natural laboratories" with a plethora of natural boundaries (MacArthur and Wilson 1967). Sahlins (1958), for instance, utilized this perspective in his landmark work *Social Stratification in Polynesia* to explore the development of social complexity in Polynesia. The difference between Oceania and many other parts of the world is that the physical, terrestrial landscape is not the only entity that needs to be studied. Instead, the perception and utilization of seascapes has been a popular topic, particularly in regards to island colonization (e.g., Irwin 1992, 2008). But, because the topic of this thesis is related to landscapes, the following discussion will only pertain to said landscape studies without any further reference to seascapes, even though it is an important aspect of the Polynesian settlement system in general.

Archaeologically, this approach was originally pioneered by Green et al. (1967) for the island of Mo'orea in the Society Islands, but the methodology and concept quickly spread to research conducted on other island groups (e.g., Burley 1994; Clark and Herdrich 1988, 1993; Dickinson et al. 1998; Green and Davidson 1969a, 1974; Kirch 1975, 1976, 1982a, b; Kirch and Sahlins 1992; Riley 1973; Rosendaul 1972; Tuggle and Tomonari-Tuggle 1980; Weisler and Kirch 1985). These early studies focused primarily on the recording and description of archaeological features within the environment, with the goals being the documentation of cultural sequences based on settlement change and the reconstruction of past subsistence strategies. All were clearly influenced by the theoretical orientation and methodology of the time, focusing on the environment as a natural canvas for human activity that may constrain or enable different human activities. Many of these studies used scientific approaches including geological, biological, and geographical techniques that enabled the quantification of settlement. Nevertheless, many of these studies do consider the perceived and sacred landscape, utilizing ethnographic resources to develop sophisticated behavioral models and functional interpretations.

Recently, much more research has been conducted explicitly under the name of landscape or settlement archaeology. Many of these have focused on island agricultural systems utilizing what Dunnel (1992) considers siteless archaeology (e.g., Allen 2004; Kirch 1994; Kirch et al. 2004, 2005; Ladefoged et al. 2003, Ladefoged and Graves 2008; McCoy 2005). Although these studies do not differ in terms of research design from previous studies, new insights and perspectives were employed to explain change, intensification, social perceptions, and other aspects of prehistoric and historic settlement. Like other regions of the world, GIS and other quantitative methods are still being employed (e.g., Field 2002, 2004; Morrison 2006; Rieth et al. 2008). Hawaii, in particular, has been cited as being a model system for human ecodynamics as interdisciplinary research is needed to understand and model the archipelago's complex socio-environmental history (Kirch 2007a). In addition to these new developments, themes such as the human impact on the environment and human adaptability to certain environments continue to be an important part of archaeological research in the region (e.g., Allen and Addison 2002; Kirch 2007b; Ladefoged et al. 2009; Meyer et al. 2007; Summerhayes et al. 2009; Vitousek et al. 2004)

Landscape archaeology is very diverse in the Pacific, ranging from studies using purely economic perspectives to ones based on the social and sacred landscapes. This is evident in the edited volume Pacific Landscapes: Archaeological Approaches (Ladefoged and Graves 2002), which contains a number of different research topics from all over the Pacific region that utilize both the British and American schools of thought. This led the editors of that volume to suggest that landscape archaeology in the Pacific is "a particularly robust approach for researchers working in different paradigms" (Ladefoged and Graves 2002:8).

Archaeological Research on Olosega

Compared to other volcanic high islands in the Samoan Archipelago, Olosega has received the least amount of archaeological examination with only a handful of projects undertaken and a very low number of publications mentioning it. In 1963, Kikuchi conducted the first archaeological survey on the island of Olosega. Although he did not visit every site that he recorded, he interviewed local informants to gain information on prehistoric remains. On Olosega, Kikuchi identified a few sites on the coastal plains near the modern villages of Olosega and Sili as well as noting an abandoned village and a fortification located in the interior of the island. Although he does not give a time period for the habitation of these inland sites, he did state that most informants indicate that these sites were inhabited during the "Tongan Occupation" of the islands (Kikuchi 1963:42). Following Kikuchi, Clark conducted a territory-wide survey of archaeological remains in 1980 under the newly formed American Samoan Historic Preservation Office, which oversaw the formal recording of sites on Olosega and the establishment of the site numbering system still used by the ASHPO. In this preliminary survey, he listed a total of eight sites, which included the inland village and fortification noted by Kikuchi, but they remained unvisited (Clark 1980:39-42).

After another notable absence of archaeology in the islands of Manu'a, Hunt and Kirch undertook a large survey and excavation project in the islands with the primary goals of better understanding both the prehistoric cultural sequence and the geomorphological factors that affected these islands. As part of this undertaking, survey and excavation were carried out on all islands in Manu'a, including Olosega. This included the first true investigation conducted in the interior regions of the island in which Hunt found and recorded in better detail the fortification described by Kikuchi (1963) and Clark (1980). Hunt, however, did not interpret this settlement as a fortification and instead concluded that it was an inland village, the extent of which was unknown (Hunt and Kirch 1987). Specifically, Hunt mentions two features that he discovered at site AS-12-2 including a large terrace and a depression, but he remarks that many more features are likely to be found. Excavation on Olosega was carried out at Olosega village, but no cultural material was reported. The majority of further investigations were carried out on the island on Ofu, specifically the To'aga site, which has provided cultural sequence for Manu'a (Kirch and Hunt 1993).

Additional archaeological work was undertaken as part of cultural resource management. In 1992, Simon Best undertook a reconnaissance survey of a proposed road corridor in which he recorded two additional sites on Olosega near the modern village of Sili (Best 1992). In addition, Moore and Kennedy (1996) continued work on the road corridor as well as surveying and testing additional areas on Olosega. There test excavations and surveys provided numerous artifacts, while the survey recorded a number of habitation and possible agricultural features on the Sili side of the island.

In 1997 and 1999, as part of a NDSU archaeological field school, Clark and NPS archaeologist Epi Suafo'a conducted a short reconnaissance survey along the ridges of the island. This led to the discovery of 31 star mounds, 46 terraces, 14 *fale* (house) alignments, 7 ditches, and numerous stone tools (NPS 1999) over the course of three surveys over the whole island. Although this survey did cover areas over the entire island, it was not intensive in nature (Jeffrey Clark per. comm.). It did, however, indicate the wealth of archaeological remains in the area and the need for further archaeological investigations.

In summary, although archaeological information is lacking, the available information indicates that sites with the potential to reveal information pertinent to Samoan prehistory are present in the interior of Olosega. The chronology of Ofu and Ta'u islands can surely serve as a proxy for Olosega given their proximity to one another until further excavation can be carried out. It is within this framework that this project was undertaken.

CHAPTER 4. SAMOAN CULTURAL HISTORY

The Samoan archaeological sequence is complex, containing gaps in spots reflecting differential preservation and choices in research projects. The knowledge of the Samoan past, however, has developed very nicely over the last 10 years allowing for a summary of the consensus view of the Samoan archaeological sequence to be compiled. Examples of these complete summaries have been provided by Clark (1996), Green (2002), and Martinsson-Walin (2007), while others have provided summaries on different topics and time periods of Samoan archaeology (e.g., Addison and Asaua 2006; Rieth 2007).

Subsistence

Although subsistence is known to be a factor in social complexity and settlement, it has not received much attention in Samoa. In part this is due to the presumed absence of surface architecture associated with agriculture that is so common in some parts of the Pacific (Kirch 1994, 2000), as well as preservation issues associated with the soils of these very wet volcanic high islands. Generally, subsistence in Samoa is a mix of both wild and domesticated terrestrial and marine resources, the amount of each consumed depending on environmental factors and overall availability of a particular resource.

Marine Resources

Buck (1930:418) and Herdrich and Armstrong (2008) describe a number of different techniques for the acquisition of marine resources including netting, angling, gleaning, and poisoning, which were primarily practices in the reef zone. Archaeologically, the majority of data are from three sites, Lotofaga on ‘Upolu (Davidson 1969a), To’aga on

Ofu (Nagaoka 1993), and Fatu-ma-Futi on Tutuila (Addison, Walter, and Morrison 2008; Morrison and Addison 2008, 2009). The data recovered from the coastal midden site of Lotofaga suggest little variability over time with only a few species of shell acting as substantial parts of the diet. Davidson (1969a:242) noted the difficulty in distinguishing between food and natural shell within this deposit, which may have skewed some of the results slightly. Meanwhile, at To'aga, Nagaoka (1993) suggests that little change occurred in subsistence over the entire sequence, and few dominant taxa are present over time and space. She goes on to suggest reasons for this including the stability of the natural environment, or the lack of change in subsistence practices. In addition, the fish remains of To'aga suggest reliance on near shore and reef fish, with little evidence of pelagic fishing, which is also reflected by the abundance of small fishhooks that are unlikely to be used when catching larger fish. The Fatu-ma-Futi site on Tutuila seems to correlate with this general pattern as Morrison and Addison (2008, 2009) do not note any type of resource depression in their analysis of shellfish remains until just before the contact period. *Turbo* appears to have been the taxon of choice, similar to the patterns seen at To'aga, probably reflecting its natural abundance, while other taxa, such as *Tridanca*, provide minor supplements. Morrison and Addison (2008:31) consider the lack of resource depression as compared to other regions in the Pacific Basin to differences in the local climatic and environmental conditions such as ENSO frequency.

In short, the general pattern observed in marine resource exploitation is one of stability and little change over time. Janetski (1980:122) does suggest some resource depression for Manono, but provides little evidence to back this suggestion other than a decreased relative abundance, which could be caused by a variety of cultural and environmental factors (Morrison and Addison 2008).

Horticulture

It is often assumed that the colonizers of Samoa brought with them the "transported landscape" popularized by Kirch (1982b, 2000) that included many of the crops and animals historically known for the islands. This is now, however, becoming subject to some debate because the appearance of horticulture is difficult to detect archaeologically. Its appearance is usually inferred from indirect evidence such as interpreted vegetable peelers. Nevertheless, plant and animal domesticates did eventually reach Samoa. In his opening statement on Samoan horticultural practices, Buck (1930:544) states that Samoan horticulture is not very intensive, and then goes on to state that the household, in terms of horticultural production, is autonomous, providing food for others only during special occasions. Kirch (1994), meanwhile, in a discussion of the importance of water control devices, notes that their use was only minor in Samoa.

Like many islands in the Pacific, taro (*Colocasia esculenta)* is an important crop in Samoa. Today, it is grown on cleared slopes, some steep, in individual garden plots and in natural marshes where taro is often grown on naturally occurring raised beds that drain well (Buck 1930; Carson 2006). Addison and Gurr (2008) suggest that this activity began during prehistoric times and was widely used, specifically on Tutuila, but also on the islands in the Manu'a group. Also on Tutuila, Adam Thompson reported a small set of irrigated terraces in Malaeloa (Addison and Gurr 2008), while on 'Upolu, Ishikura reports water control devices and raised, drained plots in the Falefa Valley (Ishikura 1974). In addition to raised beds, crops are also commonly planted near streams to produce similar, but not the same, effects as raised beds.

Although water control has been documented, the majority of horticulture in Samoa utilized rain-fed slash-and-burn techniques. These gardens can include a number of crops such as taro, banana (*Musa* sp.), kava (*Piper methysticum)*, and *ti* (*Cordyline terminalis)*, which are grown in plots usually located near the village, but Buck (1930:545) states that people would, at times, travel a distance to get to their plots. Specifically, Buck (1930:545) noted Olosega as an example where people would travel into the interior to the tableland above the village. The primary tools utilized were the digging stick, or *oso*, and the planting stick, or *oso to* (Buck 1930:545). At times, plots are fertilized with mulch of different plants to improve soil fertility and crop yields as well as reduce fallow periods.

Archaeologically, such a system is difficult to detect. Carson (2006:13, 19) has reported circular planting beds for the planting of tree crops such as coconut and breadfruit and retaining walls on Tutuila to protect against erosion problems. For eastern Tutuila, Clark and Herdrich (1993:168) raised the possibility of some terraces being used for cultivation instead of habitation, but they suggest the more likely explanation is that these were used as temporary housing for people cultivating the slopes. Nevertheless, the presence of these terraces does in fact mark the cultivation of the area, be it on the terrace itself or the slope near the terrace.

Animal Domesticates

Domesticated animals are also part of the "transported landscape" proposed by Kirch. Within this model, pigs, dogs, and chickens were brought along with crops with the original colonizers. Archaeologically, however, chicken is present early, but pig and dog come in later, which seems to suggest different introduction events into Samoa (Addison and Matisoo-Smith 2010). Exploitation of wild terrestrial animals, specifically bird, has been documented archaeologically, specifically at To'aga, where Kirch and Hunt (1993) suggest human predation as a reason for extinction of a few species.

Surface Structures and Patterns of Settlement

To understand the settlement of a certain area, the ideal units of settlement must also be understood and defined. A number of authors, most notably Davidson (1969b, 1974), Buck (1930), Holmer (1980) and Shore (1982), have examined in detail the different levels of settlement within a traditional Samoan system using archaeological and ethnographic evidence.

The largest recognizable unit of settlement within this system is the *nu'u*, or, roughly, village. This particular concept is much debated but, by definition, it is a set of title-holding families that form a grouping. This unit encompasses a large area of land, sometimes from the coast up to the interior of the island, and each with its own *fono,* or council of *matai,* (title holders) (often glossed as chiefs). Within each *nu'u* are smaller units called *pitonu'u.* Davidson (1969b:56) considers these entities as spatially distinct portions of a *nu'u*, which have been referred to as subvillages. Because of this distinction and because of the confusion of terms, Davidson (1969b:56-57) suggests that some settlements seen at contact termed as villages were likely *pitonu'u* and not true *nu'u*. Although these two units were recognized and defined in traditional Samoan society, the ideal may rarely have existed. Shore (1982:51), for instance, suggests that a *pitonu'u* is little more than a clustered group of more than one household that is within a larger settlement unit.

Participation is the basis of *nu'u* membership, which could mean that households living within the geographical area of a particular *nu'u* may not actually belong to that *nu'u*. Because of these problems, the identification of specific *nu'u* has been very difficult both archaeologically and ethnographically. Within the different missionary and explorer accounts of Samoa, different interpretations of Samoan settlement were reached, even when analyzing the same area of the same island (see discussion in Davidson 1969b:55-57).

Archaeologically, large units such as *nu'u*, or even *pitonu'u*, cannot be identified during the course of fieldwork. Therefore, smaller remains of past structures within a village must be relied upon in order to understand the overall settlement of the region. Davidson (1969b:62) recognized three types of features that may help in the identification of the organization of settlement: the *malae*, the *fale tele*, and the *fale aitu*.

The *malae* is in essence the central open area of the settlement that has other surface architecture surrounding it, ideally in a concentric pattern (Shore 1982). Archaeologically, this particular feature is yet to be confidently identified as it is described in ethnographic and historical literature. Nevertheless, Jackmond and Holmer (1980:149-151) identified a number of smaller open areas as *malae*, and Best (1993) identifies what he considers *malae* associated with fortifications.

Historically, off the edges of the *malae* are the *fale tele* (guest houses) of the 'aiga (family units). These houses were utilized as both meeting place of the *fono* (council) and/or the *malaga* (guests of the village). According to Davidson (1969b:63-65), through her study of historical text, the *fale tele* were the largest houses of the village and, therefore, should be recognized as such in the archaeologically record. According to Buck

(1930), the construction of a *fale tele* was a family event requiring a large amount of local resources and, at times, help from the village. In addition, only the best building materials were used for this feature, specifically, wood from the breadfruit tree. The *fale tele* would have served as a source of pride and prestige for the family, so the expense was seen to be justified. The chief of the family was responsible for all costs associated with building, including the acquisition of all materials and the feeding of the laborers (Buck 1930:19-20).

Also near the *malae* was the *fale aitu* (god-house). This structure was the center of religious life within the traditional Samoan system. Buck (1930:70) and Stair (1897:226) state that little distinguishes *fale aitu* from other structures, other than that they were known to the residents of the area as being sacred, and perhaps had some sort of boundary. Buck does give some details as to their specific function, specifically noting that most of these structures were dedicated to war gods. Unlike other traditional structures, very little is known of these structures from the accounts of missionaries and explorers other than ones mentioned above and a few others, as these god houses were one of the first aspects of traditional culture to be abolished, obviously because they were counterproductive to the missionaries' efforts.

Behind the *fale tele* and the *fale aitu* are the *fale o'o* (dwelling houses). These houses were constructed in similar ways and used similar materials as the *fale tele* and *fale aitu*, but they were differentiated by their location, size, and degree of skill in construction (Buck 1930:16-19). A debate does exist concerning the size differentiation of chief's houses compared to the *fale tele* and common dwellings. Holmer (1980:93) proposes that a statistically significant difference in platform volume can be used to differentiate between the structures, specifically the chiefs house having a volume of 250-400 m^3, the *fale tele* having volumes of 200 m^3, and common dwelling houses having a volume of between 100 and 200 m^3. Later, Jennings et al. (1982) found that in modern villages, chiefly houses were in fact, on average, larger than commoner's houses, while Davidson (1969b:71) also indicates that chief houses were situated on larger mounds. Davidson (1969b:65), however, does suggest that the lack of reference to such chiefly houses by historic texts indicates that a division between chiefly houses may not have been that obvious during the early historic period.

As for the construction of common dwellings, Turner (1884:152) compares them to a beehive in which the floors are raised six to eight inches off the ground on rough rocks, and then an upper layer of smooth pebbles. Buck (1930:67-69), referring to the same structures, states that the material used for paving is a reflection of available resources with some using angular rocks while others used water-worn stone or coral. Archaeologically, these common dwellings are identified by the presence of a curbing made of either or stone or coral, or by a paving of coral or water-worn pebbles (Hunt and Kirch 1988; Clark and Herdrich 1993). These are the most abundant features of any previously described in this section and it is these features that are likely to inform us about various aspects of a settlement system in the interior of Olosega.

Just behind the dwelling houses are the *fale umu* (cooking houses). The sole purpose of these structures is to house the *umu* (earth oven) and provide an area to store food. Buck (1930:13) remarks that these structures are roughly built with no aesthetic purpose in mind. Irregularity in construction was common and so some variability is expected, although the general shape was always kept. At times, the cook house may be moved to a slope where a terrace had been built with the actual structure being similar to that constructed on the flat ground.

Connecting many of these areas within residential complexes were paths. For the islands of 'Upolu and Savai'i, Davidson (1974:238-240) notes paths in the form of single ditches on ridges, markers of stone laid throughout a village or to a particularly important site, paved paths, raised earthen or stone paths, and stepping stone paths over recent lava flows on Savai'i. Holmer (1980) correlated many paths in the Mt. Olo tract with high status habitations and inclusion within wards and household units. Paths have been recorded in Manu'a only along the coasts (Kikuchi 1963; Hunt and Kirch 1988).

The orientation and layout of the village itself is complex, and research on this topic has been debated. The most complete analysis of a Samoan village layout comes from Shore (1982), who uses a structuralist perspective. According to Shore, the layout of a traditional village on Savai'i relies on both a linear and concentric pattern based on various binary oppositions with a binary opposition of seaward:landward driving the linear alignment. Specifically within this model, the *malae* serves as the central location and by moving further inland of the village, one steps into the realm of the ghosts, and away from the overall order of the village. Within a traditional village, then, the more prestigious structures of the village should be more seaward than the structures of less prestige. For example, a cookhouse will be further inland than a guest house. The second dichotomy discussed by Shore relies on the center:periphery opposition in which the center represents order and stability, while the periphery represents chaos and the unknown. The *malae* of the village is again the focal point of this model. The same basic principles used in the linear model are used in this model except, obviously, that within the concentric model, if one moves in any direction away from the *malae*, order and stability are lost.

Others, however, are in disagreement with Shore. Herdrich and Clark (n.d.) suggest a point field approach to village layout. This layout is much like the center: periphery opposition suggested by Shore, but it does not utilize concentric circles and is able to incorporate units larger than a village or even a district. The only layout that matters is how far a particular structure is away from the center of the settlement, the *malae*. These borders can shift as political ties shift. Land tenure, then, is not a static division, but is quite dynamic.

Holmer (1980), using statistical methods, was able to demonstrate that the distribution of archaeological sites and features in the Mt. Olo tract was not random and that some form of clustering was present. Furthermore, again using statistical methods, he suggested that each of these wards had a high status platform, on which the chief had his house. All structures, if they are in the same ward and especially if they are in the same HHU, are connected via sunken or raised paths. Although aspects of his work have been criticized (Clark and Herdrich 1993:170-171), many would agree with his proposal that the settlement is the material evidence of a stratified society.

Along with sites largely associated with domestic and residential activities, many features which have been interpreted to have a specialized function have been documented and recorded in the archipelago. The most well known of this group are the *tia'ave* (star mounds) (Herdrich 1991). Star mounds have been found throughout the archipelago with the majority found on Tutuila, but this is probably a reflection of the amount of archaeological investigation undertaken in the interior of this smaller island in comparison to the larger islands of 'Upolu and Savai'i (Clark and Herdrich 1993). Their name comes from their general shape, a raised mound with distinctive rays, arms, or projections around the periphery. Although all features classified as star mounds exhibit these general characteristics, great variation in form exists. For instance, the number of arms, or rays, size of the mound, height of the mound, and material used in construction are dependant on external factors such as availability of construction materials or environmental constraints.

Structurally, Herdrich (1991) has suggested that star mounds may be a type of effigy, most often an octopus (8 rays) or a turtle (6 rays), depending on the group responsible for construction. On Tutuila, many of the mounds recorded by Clark and Herdrich (1988) were constructed of earthen fill with stone facing, but some are of stacked stone, which is perhaps a reflection of the natural abundance of stone in some areas. Size, specifically height, is also likely a function of environment. Mounds on the ridgelines are typically elongated and lower in height, while those on flatter surfaces are rounded and high (Herdrich 1991). The few dates that have been obtained in association with these features suggest that they were built and used in the last few hundred years before contact (Clark 1996).

Many scholars would agree that these mounds represent the Samoan version of pigeon catching features known in other regions of the Pacific (Davidson 1974; Clark and Herdrich 1988, 1993; Herdrich 1991; Herdrich and Clark 1993, but see Best 1993:431 for an interpretation of star mounds as parts of a fortification system). Herdrich and Clark (1993:58), however, point out that function can change through time; a kind of exaptation, common in evolutionary biology (Gould and Vrba 1982), in that the behavioral purpose and their symbolic function may have changed over time. The action of catching pigeon was never intended for subsistence, although some may have been eaten. The primary reason for this behavior was competition, as pigeon catching was known as a chiefly sport during the prehistoric era. This competition allowed for the showcase of *mana* (see Shore 1989), and the possibility of status enhancement. Herdrich and Clark (1993:60-62) conclude that these features may have once served to enforce the social hierarchy, but changed in late prehistory, becoming a medium for junior chiefs to usurp power from their more senior colleagues. It is important to keep in mind the utilitarian functions of star mounds as pigeon catching and competitive arenas, as well as the symbolic consequences of monumental architecture on social complexity.

Fortifications have also been recorded both in the ethnohistoric record and the archaeological record. Most fortifications in Samoa appear to have been single features on ridges, commonly ditches, while complexes of ditches and banks have also been recorded (Davidson 1969b, 1974; Scott and Green 1969). Fortifications on Tutuila and in the Manu'a group are less understood. Best (1993), citing Krämer (1902-03), notes a possible fortification on Olosega, but this actually refers to an inland village that Krämer states has to be located in the interior for the purpose of defense. Others found on Tutuila appear in the form of stone lined trenches (Clark 1980), inland defensive features (Best 1993; Clark and Herdrich 1993; Frost 1978), and resource defense areas (Best 1993; Leach and Witter 1987, 1990). It appears that the classic ditch and bank fortifications recorded on 'Upolu have not been found in American Samoa although a large portion of western Tutuila, the interior of Ta'u, and the interior of Ofu remain unsurveyed.

Resource exploitation areas are also known in the archipelago. Although geochemical evidence may suggest quarries on multiple islands (Weisler 1993), they have only been found on Tutuila where they are distributed unequally across the landscape reflecting the distribution of high quality basalts. The largest of these is Tataga Matau located inland of Leone Village toward the west end of the island. Along with the basalt outcroppings, terraces, defensive ditches, star mounds, and other features form the quarry complex (Leach and Witter 1987, 1990). At small exploitation sites of Alega and Maloata, both Clark (1993) and Ayres and Eisler (1987) recorded numerous lithic activity and possible residential terraces associated with the exploitation of the basalt. These sites, then, represent much more than a single outcropping that people would exploit from time to time. Instead, they represent a complex system of resource acquisition that forms an integral part of the archaeological landscape on Tutuila.

Settlement Distribution

The extent and distribution of prehistoric settlement remains in the archipelago is only now beginning to be understood. Large scale projects that specifically examined this question are few (e.g., Green and Davidson 1969, 1974; Jennings et al. 1980; Clark 1989; Clark and Herdrich 1988, 1993; Hunt and Kirch 1988; Kirch and Hunt 1993; Pearl 2004, 2006), but a large amount of data has come from them. Specifically, knowledge of site formation processes and of the complex geomorphological history of the islands has been gained (Dickinson and Green 1988; Clark and Michlovic 1996; Kirch and Hunt 1993), which has resulted in a better understanding of why a particular distribution of settlement exists while also identifying areas that are likely to yield sites of a particular age. This section is a summary of interpretations of the prehistoric settlement distribution in Samoa, born largely out of the work of the previously cited scholars.

All islands are considered as one in the discussion of initial settlement due to the fact that so few sites have been found. A division will be made between Independent Samoa, Tutuila, and the Manu'a group when discussing the later periods as environmental differences have affected settlement distribution. Because of the small amount of habitable space available on these islands, many late prehistoric features have been built over older features. This obviously causes a problem for anyone studying the distribution of surface features from a period, as it is the most recent structural remains that are most visible. Because of this, much more can be interpreted about the distribution of sites across the landscape and the distribution of features within particular sites from the later periods of settlement.

The Lapita Period

Initial settlement, ca. 2900 B.P. of the islands appears to have occurred primarily along the coast (Clark and Herdrich 1993; Clark and Michlovic 1996; Davidson 1974; Green 2002). The lone Lapita site, Mulifanua (Green 1974), and the sites of To'aga (Kirch and Hunt 1993) and 'Aoa (Clark and Michlovic 1996) in American Samoa, which are nearly contemporaneous with Mulifanua (see Rieth 2007 for discussion on the issues of dating initial colonization), have been drastically affected by geomorphological change, which makes the modeling of the prehistoric environment more difficult. It does appear, however, that they are all situated on coastal flats with access to very productive marine environments. Although there is some debate as to the density of sites from this period (i.e. Clark 1996 vs. Green 2002), it is likely that at least a few undiscovered sites that have been hidden by the complex geomorphological processes.

The Polynesian Plainware Period.

Over the next 1,500 years after initial Lapita settlement (see discussion regarding discontinuous settlement in Addison and Morrison 2010), settlement may have expanded over the coastlines and inland areas throughout the archipelago. Specifically, work in Manu'a (e.g., Clark et al. in prep; Hunt and Kirch 1988), Manono (e.g., Jennings et al. 1980), 'Upolu (e.g., Green and Davidson 1974; Wallin et al. 2007), and Tutuila (e.g., Addison, Walter, and Morrison 2008; Clark 1996; Clark and Michlovic 1996; Eckert and Welsch 2010) have all yielded sites that date to this period. Like the previous period, their distribution is still not well understood because so few sites have actually been found, and field work examining their distribution has not been conducted. It is likely, though, that inland settlement began at this time, evidenced by deposits from Pava'ai'i and Vainu'u on Tutuila (Addison and Asaua 2006; Eckert and Welch 2010) and the Falefa Valley on 'Upolu (Davidson 1974). In regards to evidence of land use between colonization and ca. A.D. 500, Addison and Matisoo-Smith (2010:6) argue that evidence from this period is consistent with "a relatively small and dispersed population practicing low-intensity agriculture."

In Independent Samoa specifically, it appears that a pattern of dispersed settlement ranging from coast to the interior was beginning to form (Davidson 1974; Green 2002), although not as developed as subsequent periods. This pattern is typified in the Falefa valley, but Green (2002:137-138) and Davidson (1974:161) argue that it has parallels elsewhere. To the contrary, Clark (1996:453) argues that this pattern may be unique to Falefa due to the optimal environmental conditions suitable to human occupation that it possesses. Furthermore, Clark points out that only one location in the valley has evidence of habitation at this time, thus making the actual nature of settlement within Falefa unclear.

Although inland settlement does occur on Tutuila at this time, the pattern is different than what has been observed in Samoa. Specifically, Addison, Toloa, Tago, and Vaueli (2008) suggest that inland use was occurring and widespread, but not intensive. As stated previously, only a few sites of this period have actually been recorded in sufficient detail to be included in an analysis of settlement distribution (Addison and Asaua 2006; Clark and Michlovic 1996; Eckert and Welch 2010; Moore and Kennedy 1999). Although sites are found on both the coast and inland regions of Tutuila, the small size of the island does not allow settlement to be truly isolated, and there is little doubt that people from the inland areas traveled down to the coast for marine resources, and that people living on the coast traveled to the interior for terrestrial resources.

The situation is even more unclear in the Manu'a group. The To'aga site is clearly still occupied at this time (Kirch and Hunt 1993). The Va'oto site appears to have been occupied at least through the beginning of the period, although the top layers of the site have been stripped by bulldozer activity so it is unclear how late the site dates (Clark et al. in prep). In addition, cultural layers dating to this period have been found in Ofu Village on Ofu and Ta'u Village on Ta'u, although these have not been thoroughly excavated (Hunt and Kirch 1988). Plainware pottery has also been discovered along the Ta'u road corridor (Clark 1990) and inland of Ta'u village (Herdirch et al. 1996). Before this study, only limited survey and fact checking had occurred in the interior of these islands, so the age of inland settlement is not known (Hunt and Kirch 1988; NPS 1999).

The "Dark Ages" Period

After A.D. 500 until the beginning of the 2nd millennium A.D., the archaeological record is not well understood on any of the islands, and is sometimes referred to as the "Dark Ages" of Samoan archaeology due to the lack of sites that have been found dating to this period (Davidson 1979). Most argue that this lack of sites is due to the lack of an artifact that can be used to identify a deposit that dates to this period (Rieth and Addison 2008; Green 2002), and some undated deposits are likely representative of this period. In Samoa, Green (2002:140) suggests that settlement expanded and "much of the landscape came under use." As an example of this expansion, Davidson (1974) notes that modern villages have been moving farther and farther inland due to the lack of suitable land for horticulture near the village. She sees this as history repeating itself, and at earlier times, specifically during the period in question and the earlier period, this is what may have forced the move into previously uninhabited lands. Although sites at Mt. Olo and Pulemelei were being inhabited, no large mounds were built until later (Holmer 1980; Wallin et al. 2007).

On Tutuila, inland settlement was probably sustained and expanded as suggested by deposits from Faleniu and Malaeimi (Rieth and Addison 2008) inland of the Tafuna Plain and from Vaipito (Addison and Asaua 2006) inland of Pago Pago Bay. Most sites from this period tend to yield some lithic debitage (Rieth and Addison 2008), and it is likely the basalt industry on Tutuila had its start during the end of this period, and flourished after. A large number of architectural forms are present, as well, with alignments, pavings, post holes, and terraces being directly dated to this period (Rieth and Addison 2008). By this time, slopes in the back of valleys were probably being utilized and there is evidence that suggests substantial clearing of vegetation and major erosion (Clark and Michlovic 1996; Carson 2006; Pearl 2006).

In Manu'a, little is known of inland settlement, and settlements on the coast that date to this time are few, represented by To'aga on Ofu (Kirch and Hunt 1993) and Faga on Ta'u (Cleghorn and Shapiro 2000; Shapiro and Cleghorn 2002). A large amount of lithics were discovered at Faga, while both sites yielded abundant shell midden and artifacts.

The Late Prehistoric Period

The last one thousand years of settlement is the best represented period due to the presence of field monuments, which have allowed for easier identification of sites. It is generally argued that this is the time in which traditional Samoan culture developed, specifically as a house society (Green 2002:138). These developments can be observed in the archaeological distribution of sites over the landscape and the intrasite distribution of features on 'Upolu, particularly in the Mt. Olo tract survey area, which Holmer (1980) suggests can be grouped in what he calls "wards" and "household units" that reflect a stratified society

In other areas of Independent Samoa, dispersed settlement continued into the interior on both large islands of 'Upolu and Savai'i, but little is known of Manono and Apolima other than the presence of some surface remains (Jennings et al. 1980). Fortifications appear on the landscape during this period in the form of large ditch and bank structures, at times appearing to protect a particular resource (Davidson 1974), but this is unclear. Star mounds also are clearly present at this time, and the few that have been dated date to within the last 500 years (Hewitt 1980a,b; Holmer 1976). These structures are primarily distributed in the bush but have also been found among residential structures

(Holmer 1980). During this time period, occupation at the Pulemelei mound site, a monumental feature that indicates increased social complexity, also flourished (Wallin et al. 2007).

On Tutuila, many of the same patterns can be observed, but differences exist. It is clear that the utilization of the interior expanded at this time, and substantial slope cultivation is indicated by erosion into the valleys (Clark and Herdrich 1988, 1993; Clark and Michlovic 1996; Pearl 2006). Interior residential sites also date to this time period, but the extent of former settlement is unknown (Clark and Herdrich 1993). Coastal settlement continued through this time and probably expanded (Addison and Asaua 2006), including sites that are associated with lithic manufacturing. These sites are found throughout the island, and can be quite small or very large (Clark 1993; Addison 2010; Addison et al. 2010; Winteroff 2007). Although field monuments are known on Tutuila, the large platform mounds and raised rim ovens of Samoa seem to be absent (Clark 1996). Nevertheless, it is clear that some form of social stratification was present especially in relation to resource control (Winterhoff 2007). Fortifications are found in the interior of the island on large, prominent points but they are also found near basalt quarries, the most well known of these is the defensive features of Tataga Matau (Best 1993; Leach and Witter 1987, 1990). The construction of star mounds also appears to develop during this time period (Clark 1996; Herdrich 1991; Herdrich and Clark 1993).

Partially because of the lack of habitation markers on the surface, no study on the distribution of features within a site has been undertaken, and because a large portion of the island has not been surveyed, or reported beyond gray literature, site distributions over the landscape have not been considered, although portions of the island have been systematically surveyed (Addison et al. 2010; Ayres and Eisler 1987; Clark 1989; Clark and Herdrich 1988, 1993; Pearl 2004, 2006).

The situation in Manu'a is different, and even the last 1000 years remains vastly understudied. The archaeological sequence of To'aga disappears in the middle of this period, but some surface remains probably date to this time (Kirch and Hunt 1993). In addition, little is known about other areas, although a few CRM projects have been conducted studies near Sili Village on Olosega and on the northeast coast of Ofu (Best 1992; Moore and Kennedy 1996; Radewagen 2006). The surface remains that have been found in the interior of Olosega probably date to sometime during this period as indicated by the presence of star mounds and information from oral history. On Ta'u, settlement is indicated on the coast (Hunt and Kirch 1987, 1988), but little survey has been conducted in the interior (Clark 1990; Herdrich et al. 1996; Herdrich and Clark 1993). Some surface remains have been found, but no study of their distribution has been undertaken. In addition, as mentioned before, star mounds have been discovered on all islands, but only their distribution on Olosega is known (NPS 1999).

The Historic Period

At the end of the previous period, specifically just after European contact, the settlement pattern may have changed drastically. According to one model, people moved down to the coast into clustered villages and population density may have plummeted (Davidson 1969b), although actual figures are unavailable. This is the settlement pattern seen by visitors and anthropologists who first studied the Samoan archipelago, and little has changed since with most settlement still occurring on the coast.

As the previous discussion has shown, settlement in Samoa is diverse and, in ways, dependant on the environment. Much work is yet to be undertaken on all the islands in the group and it is hoped that this study contributes to the knowledge base collected over the past 50 years. The modeling of cultural evolution has always been a part of Samoan archaeology (Green and Davidson 1969a), having been very beneficial to this point, and will surely continue to be beneficial in the future.

CHAPTER 5. RESULTS

In this section, I will summarize the results of the Olosega survey project. The bulk of the section is related to surface features identified during the survey in the interior which included star mounds, terraces, ditches, ditched terraces, depressions, and miscellaneous features. At the end, however, results from a small reconnaissance survey conducted over Oge coastal plain are presented as well as a summary of the artifacts collected from the interior of the island. For more information on the features referred to within this thesis, see the appendix at the end or the report on file at the ASHPO offices.

Inland Survey

As was stated in the previous chapter, the accomplishment of the major goals of this project relies on a substantial survey of the interior of the island. This survey identified and documented 24 sites distributed over the southern half of Olosega, with one of those sites consisting of 227 features. Although some of these features exhibited unique characteristics, all but a few features were grouped into a feature type which included star mounds, terraces, ditched terraces, linear depressions and ditches, and depressions. The following is a summary of these feature types.

Star Mounds

As discussed above, star mounds are one of the few features in the Samoan landscape that can be considered as monumental architecture. Because of this, these structures may hold important information regarding the social and political atmosphere of prehistoric Samoa. These features have been found on nearly all of the main islands in the archipelago (only Apolima excluded) with the largest number discovered on the island of Tutuila (Herdrich and Clark 1993). Hunt and Kirch (1988) suggested that these features were not present on the small islands of Ofu and Olosega. A couple of years later, however, Clark and Herdrich found star mounds on Ta'u, Herdrich located a mound on Ofu, and in 1997, Epi Suafo'a, with the National Park Service and Jeffrey Clark of North Dakota State University found a total of 31 star mounds distributed on the two ridges leading up to the summit of Olosega (NPS 1999; Clark field notes)(the star mounds documented in this study were only found on the southern ridge of Olosega while the total of 31 reflects both the noth and south ridges) . Thus, one of the goals of this project was to relocate these features, record them in more detail, and establish their location using the GPS device.

Because of the work of the NPS in this area, previously identified star mounds have been designated site numbers by the ASHPO office, and these numbers will be used to describe the features. Although all star mounds are considered separate sites for administrative purposes, these site designations were ignored during the analysis of the material and the settlement was analyzed as a single group. Because of the nature of the vegetation in the area, some features received much more detailed survey than others.

General Characteristics

Although variation was discovered in some of these structures, general statements can be made about the group as a whole, with the most striking variations described one at a time. A total of 23 star mounds was found, all located on Mata'ala Ridge overlooking the present day village of Olosega. All are constructed of earthen fill with very little stone present on the structure itself. In addition, all appear to be raised structures built off the ground by adding material both to elevate and widen the ridge on which these structures lay, being more pronounced at the front of the structure. The back of many, on the other hand, have large, steep banks that serve as a boundary, the size of the banks depending on the slope of the ridge. This portion of the structure appears to have been dug out to level the area.

The height of these structures appears to increase as one ascends farther up the ridge, but all are raised at least half a meter off the ground surface at the front. The average length is 25.0 m, while the average width is 13.1 m. The shape of most of the structures is elongated with projections present on front and sides (slope side and cliff side), but absent on the back. Unfortunately, however, many of the projections on the cliff side of the structure have slumped off to such a degree that identification of projection form was very difficult, sometimes impossible. Thus, the number of projections on each structure should be viewed with caution, and it is likely that, for at least a few, the actual number of projections was different when the structure was in use. Nevertheless, the number of projections recorded during this survey ranged from three to ten, with six being the median and just under six being the mean. All but one of these star mounds exhibited some sort of facing on the projections and, in a few cases, between the projections. The number of courses and the size of rocks utilized varied greatly, but most had just a few courses of medium-sized boulders. Furthermore, this facing seemed to become more sophisticated as one ascended the ridge which may be either related to the increase in height of the structure, the increase in slope of the surrounding area, or perhaps a combination of the two.

Surface remains on these structures were rare, but some scatters of angular stone were noted on a few mounds. The few alignments and depressions that were found will be described below. Vegetation was variable depending on where one was on the ridge. *Ti* plants, however, were common on and around the star mounds, but other than *ti*, few economic plants were identified.

Coral in Facing

In addition to stone, pieces of coral have also been found in the facing of star mounds (Clark and Herdrich 1988). Although rare, examples of this are present in the survey area. For instance, the star mounds of sites AS-12-029, AS-12-031, and AS-12-042 all appear to have some coral included in the facing, but the majority of this facing was still stone with just one piece of coral included (Figure 4). During the fieldwork, it was difficult to identify coral in the facing rocks because in a rainforest environment coral and stone look somewhat similar in certain lighting situations. Consequently, in some instances the identification of coral was done from photographs after the field work was completed. With that stated, coral is definitely present only on site AS-12-029 and is likely present on the other two.

The function of this coral is unknown. One possibility is that it was merely a convenient material at the time of construction, but, more likely is the suggestion that the coral had social significance and would have been brought up into the interior for a reason in the place of stone. Perhaps, as Clark (1989:142) suggests, it was to further identify these structures with the sea creature with which they have been interpreted to signify (see also Herdrich 1991).

Negative Projections

Like Tutuila (see Clark and Herdrich 1988; Clark 1989), only one definitive example of negative projections was found during this project. Negative projections are projections that do not appear to be raised, but rather are carved out of the back bank of the mound. These projections are approximately the same length of the other projections, but do appear to be somewhat wider. Between the two negative projections is a flat area of raised earth that is much lower than the bank, which appears to have been made to differentiate the two projections, making them separate entities.

Figure 4. Coral in the Facing of AS-12-029.

Because only one structure has clear negative projections, interpretations are difficult to propose, especially when considering that other mounds had the same number of projections and none were negative. It could merely be a product of environmental constraints of that particular area or perhaps personal preferences of the builders. Another possibility is that the builders merely wanted to make the structure look visually pleasing, and thought that would not be possible if they added additional projections on either the slope or cliff side.

Causeways, Ditches, and Terrace Skirting

In eastern Tutuila, Clark and Herdrich (1988, 1993; Clark 1989) recorded a number of star mounds with ditches in the vicinity, which they either interpreted as being boundaries of the structure or defensive in function. On Olosega, however, few such ditches were identified. For example, the back of the star mound at site AS-12-042 is bordered by a small ditch, and it appears that this ditch serves only as a border and not a defensive feature. Although a few additional ditches or sunken paths were discovered in proximity to star mounds, these were not related to the actual structure.

Instead of ditches, some star mounds were surrounded by flat terrace-like structures. These terraces, however, do not completely surround the structure, but are only present in specific areas, possibly built to better define the structure. For instance, a 2-m wide terrace skirts the entire slope side of the star mound at AS-12-022, while a small terrace-like flat area was identified between two projections on the cliff side of the star mound at site AS-12-041.

In addition to terracing and ditches, a causeway was discovered that connects sites AS-12-044 and AS-12-045, measuring 4.2 m in length and 0.5 m in width. To date, this is the only such causeway found between two star mounds (Figure 5). This suggests that the structures were contemporaneous, but why a causeway was needed is unclear. Potentially, the number of competitors competing at this time was greater than the number of projections on either mound due to constraints posed by the environment or society and, because of this, two mounds were needed for the same competitive event.

Figure 5. Causeway between AS-12-044 and AS-12-045.

Variation in Morphology

Although the vast majority of star mounds in this area have an elongated, oval shape, a few are more circular in shape and have positive projections present on all sides. These were located in areas of high points in the landscape, specifically between two eroded stream banks. The star mounds, therefore, were located at an apex of sorts, making them appear even more raised than they actually were. Because of their shape and the presence of arms all around the structure, they had more projections than the other mounds in the area. Although it is possible that social factors influenced the location of this type of mound, the environment allowed for it.

Stone Alignments and Depressions

Evidence of surface structures is rarely, if ever, found on star mounds. It is because of this that they were originally interpreted as being a specialized site (Davidson 1974), and the star mounds in the study area were no different, exhibiting few signs of surface features. Some surface structures, however, were present in the form of rock piles and small depressions, the most impressive of which was a rock pile that measures 2.2 m in length, 1.5 m in width, and 0.25 m in height, recorded on star mound AS-12-028 (Figure 6). It is located near the cliff-side of the structure. The function of this structure is unclear, but the local Samoan guide that accompanied the crew that day noted that it may be a burial. Stone piles were also noted on other star mounds, these were merely collections of a few rocks; not as impressive as the one on AS-12-028.

The depressions found on the star mounds were all quite small, none being over 50 cm in diameter or more than 30 cm deep. The locations of these depression were variable on each star mound, with some being toward the middle and others being on projections. Although it is possible that these were manmade, it is likely that at least some of these were related to vegetation activity.

Interpretations

Although a small number of differences were observed between star mounds found on Olosega and those found on other islands in the archipelago, it appears that this feature class is fairly homogenous throughout its geographic expanse. On Olosega, the primary purpose of the star mounds does not appear to be defense, as Best (1993:431) has suggested, given the lack of defensive advantage these structures would have provided to either the residential areas or cultivated land. No evidence was found, however, that would either support or deny any interpretations proposed by Herdrich and Clark (1993) or Herdrich (1991).

Figure 6. Rock Pile on AS-12-028.

Although additional comments on the function of these features cannot be made, the star mounds on Olosega do provide some additional information about this feature class. First, it appears that more than one star mound could be used for the same competitive event as evidenced by the causeway connecting sites AS-12-044 and AS-12-045. Although this does not necessarily prove that they were used at the same time, it suggests they were because no other sites were connected in such a way, and the environment around the sites did not make a causeway necessary. In other words, it would not have necessarily been more difficult to travel between AS-12-043 to AS-12-044 than it would be between two other star mound sites on the ridge.

The sheer number of star mounds in this area is also unique and begs the question why there was a need for so many. Clark and Herdrich (1986, 1993) have suggested that pigeon catching, which is interpreted as being the dominant function of star mounds, may be a surrogate for warfare; it was the peaceful means to settle conflict that avoided loss of life. Although competition was the important aspect of pigeon catching, evidence suggests their use in divination and healing (Moyle 1974:165; see also Herdrich and Clark 1993:57-58). The primary purpose for the construction of these structures was religious, not necessarily for competition alone, although competition was always part of the activities. Herdrich and Clark (1993:61) have proposed, however, that over time, the mounds and the activities associated with them evolved so that competition was the primary purpose of the activities with titles being wagered at times.

Terraces

Terraces were by far the most numerous feature type discovered during the survey. Although found on other islands, discussion regarding their function and morphology has been limited (e.g., Clark and Herdrich 1988, 1993; Davidson 1974). This section will summarize the data collected and provide interpretation of that data.

Morphology

A total of 196 terraces was recorded using a GPS while four, Features 3, 21, 140, and 227, were described in detail but not plotted. As with all other feature classes, a large amount of variation exists in the morphology of terraces. The majority of structures were constructed by the cutting out and flattening of an area of the landscape (Figure 7). A few, however, were constructed using a classic cut and fill technique with a retaining wall (e.g., Feature 11). Generally, these features exhibit a steep bank, some having what appears to be stone facing, to the upslope and unmodified slope to the downslope, which made height an unusable dimension. Instead, it would have been beneficial to measure how large the back banks were, but only estimations were actually made in some circumstances, with height merely dependant on the degree of slope of the area on which the terrace was constructed. The sides, like the fronts, were not well defined as they gradually graded into the surrounding slope, although banks or ditches were noted in some instances that served as a boundary. Features 86 and 138 may exhibit evidence of a retaining wall on the sides in the form of a boulder alignment to protect from slumping into a stream bed, but this is a unique situation given the location of the terraces.

During the spatial analysis, the terraces were divided into six size classes based on surface area with size six being the largest. This distinction between size classes, however, was arbitrary as few natural breaks could be identified in the data except for size class six. Instead, divisions were made at arbitrary intervals to divide the data and identify potential differences. Although rare, morphological differences were noted in two size classes. In size class one, some terrace appear to be constructed in the same way as others but are bowl-shape and measure between 5 m and 15 m (Features, or parts of Features, 22, 29, 44, 63, 69, 91, 95, 101, and 183). Terraces classified within size six were all morphologically different and are described below.

Figure 7. Overview of Terrace 82. Note the Coconut and *Ti.*

These differences are one reason why size class six, which includes Features 86, 93, 188, and potentially 82 and/or 30 through 32, was differentiated from the rest of the terraces. For instance, Features 93 and 188 are both very long, with length measurements of 200 m and 180 m respectively, in addition to being banked on the downslope side, giving the impression of a linear depression. Although these are very similar for the most part, Feature 93 widens in areas, creating terrace-like areas. Feature 188, on the other hand, continues to be the same width throughout its extent. Although different than the previous two, Feature 82 and the combination of Features 30 through 32 could also represent a terrace of this sort. Both examples are much smaller than either of the previously mentioned features, but are long and thin, making it unclear whether or not one or both of these features should be classified with Features 93 and 188. Features 30 through 32 were given separate feature numbers because small linear depressions appear to mark boundaries between the three features, but it may have been used as one structure with divisions.

Also within this area is Feature 19, which was originally classified as a star mound, but was later reevaluated. This feature is quite large at 52 m long and 16 m wide, and is located amongst a number of smaller terraces. It is possible that this terrace also supported a significant structure, but further mapping will aid in interpretation.

Feature 86 is another large terrace, wider than, but not as long as, Features 93 and 188 at 74 m long and 27.5 m wide. Along with a variety of surface remains, this feature also exhibited a path, which appears to lead past two platforms to two other terraces. These platforms are small, built on the stream bank to the north of the actual terrace, with no surface remains identified. During the survey it became clear that this feature was something unique on Olosega.

Although not unique in terms of size or general morphology, Feature 48 exhibited a smaller terrace positioned on a larger terrace. Both had many of the same characteristics as other terraces in the area, including coral and stone scatters as well as a large bank to the upslope. It is likely that a specific activity took place on the upper terrace, but what that activity was is unknown as no testing was conducted.

Surface Remains

Many terraces exhibit structural remains, which include evidence of coral or stone paving (Figure 8) as well as stone alignments (Figure 9), many of which appear to represent house curbing. In total, 14 terraces have stone alignments, 108 terraces have both coral and stone scatters (does not include terraces on which only a single piece of coral was found), 42 have just stone scatters, 4 have just coral scatters, 38 have no surface remains, and 4 remain unevaluated (note: these numbers do not add to the total number of terraces for reasons described below and because only those features that were both plotted and evaluated were included). All terraces with curbing have both stone and coral paving except one, Feature 102, which only exhibits stone paving. This curbing is predominantly arcing in shape and constructed using medium-sized basalt boulders. Few whole curbing alignments were found, but the few that were observed measured over 10 m in maximum length. Terraces with coral and stone scatters exhibit varying amounts of each; some were completely covered by coral and stone while other terraces merely exhibit a small scatter. In addition, the stone in the scatters on many of the terraces is angular and not representative of paving, while in other cases the stone was *ili'ili*, (pebbles often used as house floors) (Figure 8). The terraces exhibiting just coral are all located near the slopes overlooking Oge coastal plain, which would make the transport of this material for these terraces more feasible. Nevertheless, it is possible that stone was present but overlooked during surface examination.

Distribution

After the terraces were classified into the different size grades and the different structural types described above, GIS analysis was conducted to search for patterns in the data, including such methods as nearest neighbor analysis, central feature analysis, geostatistical analysis, and basic visualization, which provided the bulk of analytical information (Figure 10). A large majority of terraces with surface structure are located downslope of Feature 38, which is a large ditch cut across the survey area (see below discussion on ditches). More specifically, all terraces with curbing stone and all but four terraces with coral scatters are located downslope of the feature. The majority of terraces exhibit stone scatters with no coral, on the other hand, are located either upslope of Feature 38 or on the peripheries of the settlement (Figure 11). This distribution is similar to that of terraces with neither stone nor coral scatters, while the four terraces with coral but no stone scatters are located near the slopes leading down to Oge coastal plain.

Figure 8. *Ili'ili* Paving on Feature 35.

Figure 9. Curbing on Feature 86.

A nearest neighbor analysis was then run on the terraces to understand the nature of the distribution. The first analysis considered only the location of the features and not any of the attributes associated with the particular terraces, such as size. This analysis indicates that the distribution is clustered with a less than one percent likelihood of the distribution being random. Size classes were then taken into account, specifically size class six. This analysis indicated their distribution was dispersed with a less than one percent likelihood of that distribution being random. Although it indicates the type of distribution, the nearest neighbor tool in ArcGIS does not identify those clusters and, thus, another method needed to be utilized.

A geostatistical method, namely inverse weight distance, was used to explore general trends in the distribution of the terraces based on terrace area and to pinpoint locations of clusters identified by the nearest neighbor analysis (Figure 10). Because this technique is designed to be a predictive model, the patterns identified can be difficult to interpret. Nevertheless, the method did appear to identify two, possibly three, groups separated by stream channels, which roughly correlate with the long, banked terraces described above. The final analysis of the distribution of terraces focused on the central feature. This method simply explores the data and identifies the central most features in the distribution, in this case Feature 86 (Figure 12).

Interpretation

Terraces, although fairly abundant in Samoa, have never received considerable functional interpretation. Both Clark and Herdrich (1986, 1993) and Davidson (1974) suggest that such features may have served a residential purpose, but the extent of that settlement is short term, which does not appear to be the case on Olosega. The surface structures found on the terraces, the morphology of the terraces themselves, and the distribution of those terraces all suggest that many of these features were inhabited permanently. The few that exhibit no surface remains of any kind, however, may have had a different function. Because of the lack of structural remains, and because of their location upslope of Feature 38, it is possible that these may have been used by those cultivating crops as workshop areas.

Analyses suggest that three levels of settlement are present on Olosega. Feature 86, with its unique morphological characteristics and its central location, is suggestive of a high-status residential area, in the form of either a chiefly household or perhaps a large *fale* *tele* (community/guest house). The second level of settlement is represented by Features 93 and 188, the long and narrow terraces. These two examples appear to be associated with two clustered groups identified by the geostatistical and nearest neighbor analyses, although a third may be represented by Feature 82 and/or the combination of Feature 30 through 32. The final settlement class is of common dwellings represented by the bulk of the terraces on Olosega. Although these terraces range in size and distribution, there is no indication that they were internally differentiated. For instance, although it was initially thought that terraces with curbing may represent internal differentiations, the nearest neighbor analysis indicates that their placement is random. Consequently, further interpretations are not possible. Further interpretation may be possible among size class five terraces, such as Feature 19, but more precise data are required to better understand their distribution within specific clusters. It is possible that each potential cluster also has a high status terrace.

Although no testing was conducted, it is possible that the bowl-shaped terraces discovered represent cooking houses or specific activity areas given their shape and location. A number of these were either found directly behind, on, or to the side of other terraces, which is the location of cook houses suggested in the literature described above. Specifically, Feature 22 appears to be associated with Features 23 and 24 by a sunken path, which may signify what Homer (1980) refers to as household units. In addition, what appears to be fire-cracked rock that may reflect heat from cooking was discovered on an example of this type of terrace (e.g., Feature 29).

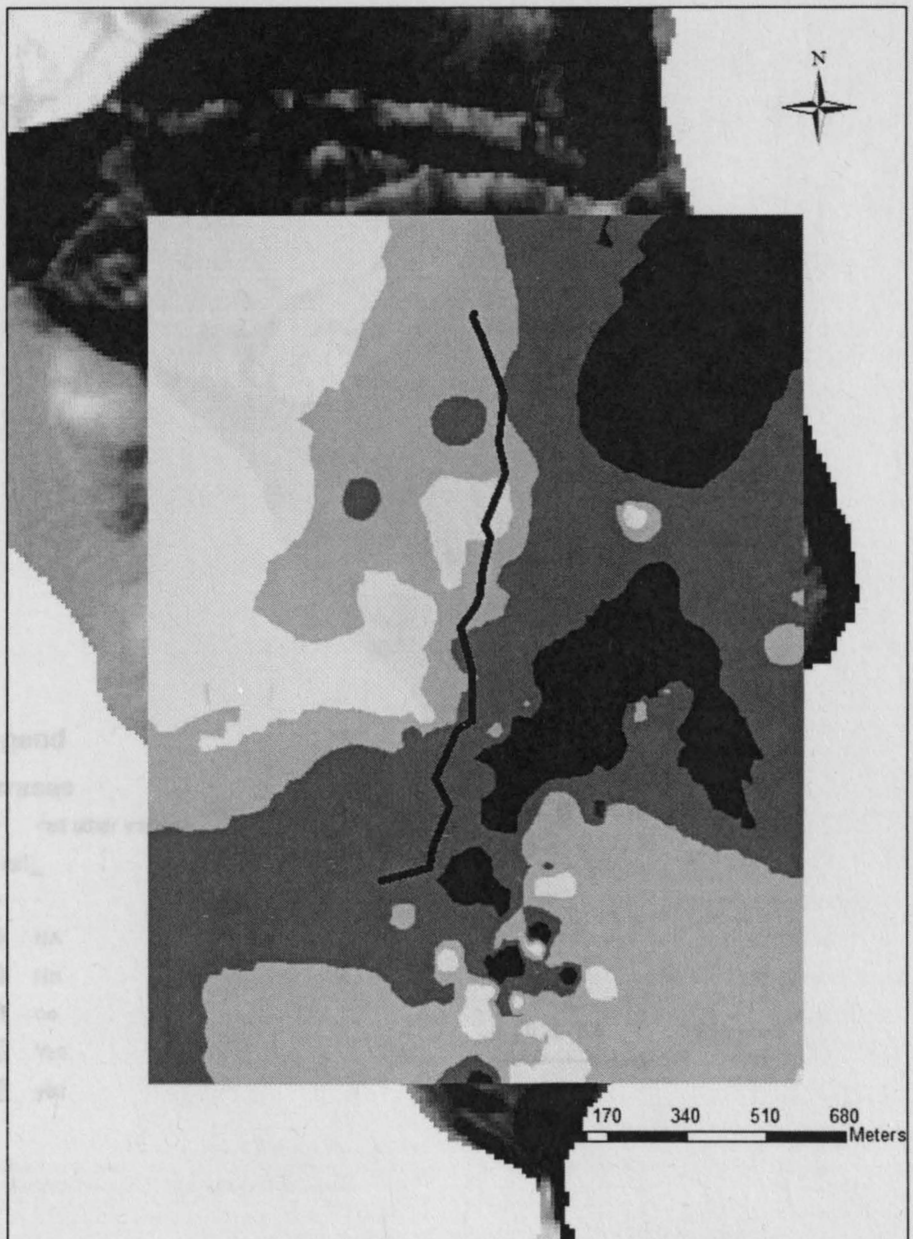

Figure 10. Clusters Identified by Inverse Weighted Geostatisitcal Analysis.

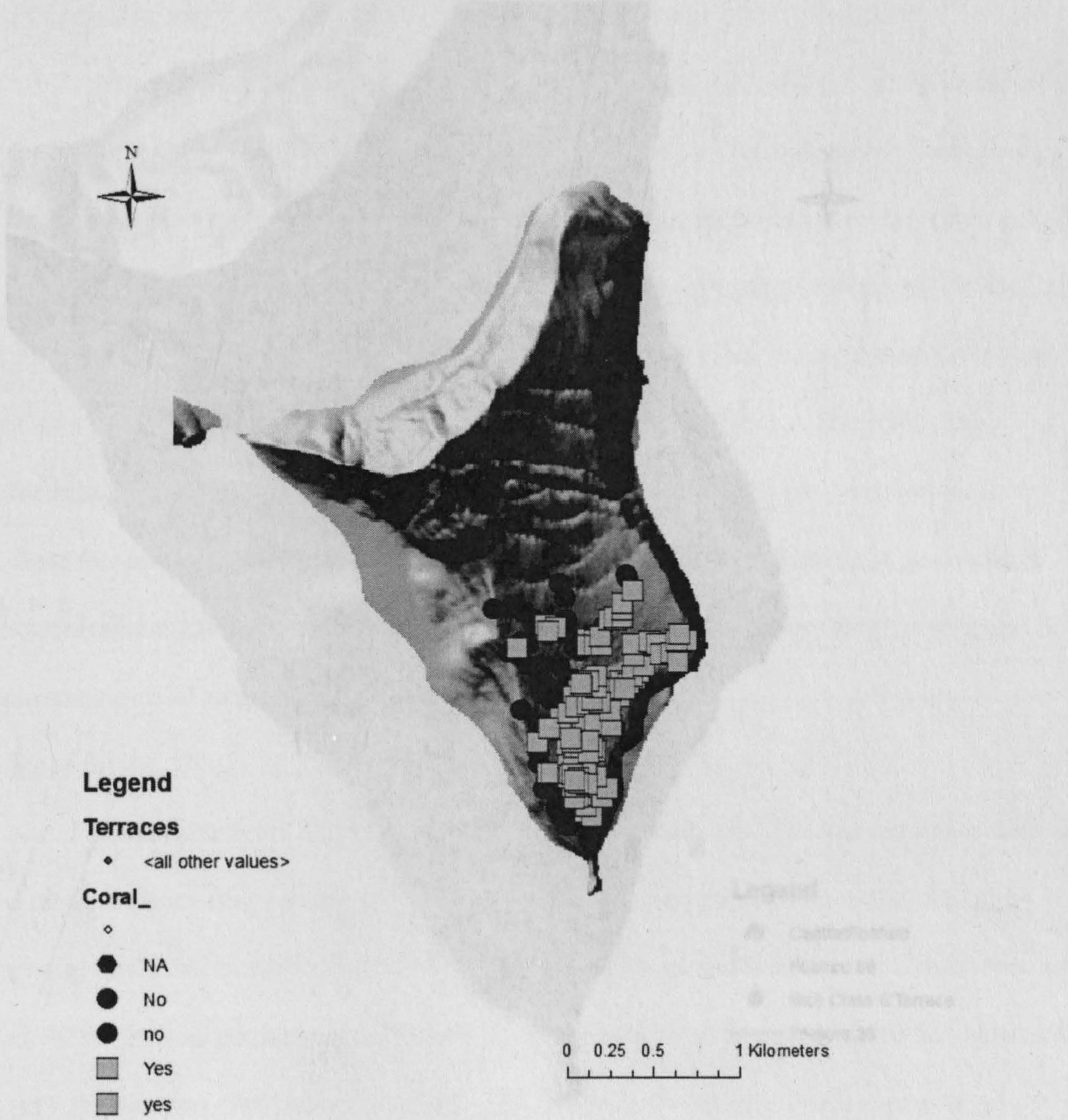

Figure 11. Distribution of Terraces with Coral. Duplicates in the Legend are an Artifact of the Software and do not Represent a Distinction that I am Making.

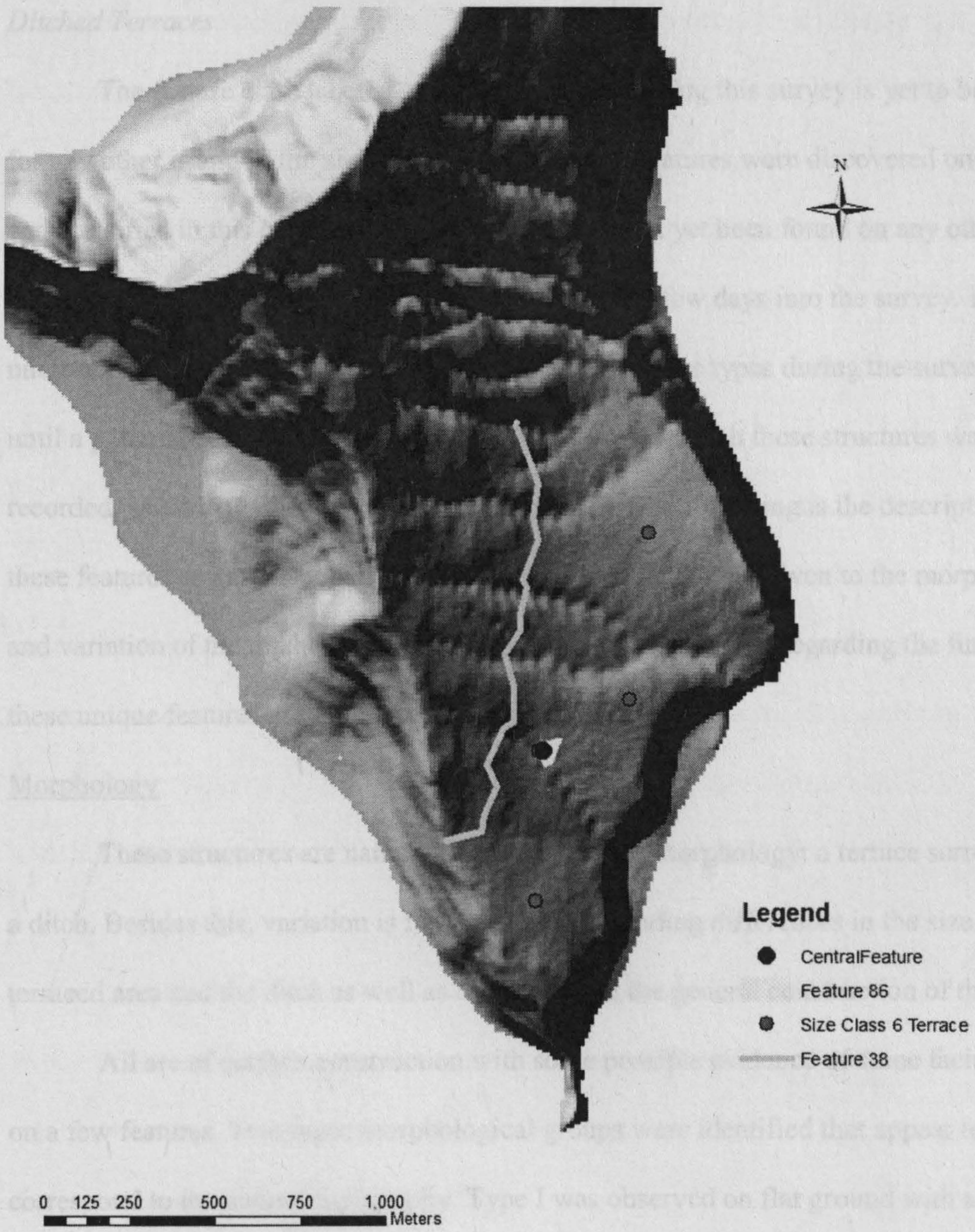

Figure 12. Size Class Six Terraces and the Central Feature (Feature 86).

Ditched Terraces

The feature class labeled as ditched terraces during this survey is yet to be reported for any other island in the archipelago. A total of 22 features were discovered on Olosega and classified in this category. Because these have not yet been found on any other island, they were not recognized as a new feature type until a few days into the survey. In fact, a number of these structures were classified as other feature types during the survey process until a pattern became clear, which affected the way in which these structures were recorded, specifically how each was photographed. The following is the description of these features as understood at this time, with special attention given to the morphology and variation of the ditched terraces. In addition, interpretations regarding the function of these unique features are proposed at the end of this section.

Morphology

These structures are named after their general morphology: a terrace surrounded by a ditch. Besides this, variation is fairly common including differences in the size of the terraced area and the ditch as well as differences in the general construction of the feature.

All are of earthen construction with some possible evidence of stone facing present on a few features. Two basic morphological groups were identified that appear to correspond to the natural topography. Type I was observed on flat ground with a deep ditch surrounding the feature giving it a raised appearance. A mere two examples of this type, Features 1 and 193, were recorded and both appear to have been raised with earthen fill alone. The rest of these features are built on heavily sloping land. These ditched terraces, Type II, exhibit a flattened area on the downslope side of the feature with a steep bank to the upslope, which is partially or completely surrounded by a ditch. Thus, if one were to walk downslope onto one of these features, one would encounter a ditch first, then a steep bank, a flat area, and finally the ditch that surrounds the feature again (Figure 13). The opposite pattern, with the flat area upslope of the steep bank, was only found on one ditched terrace, Feature 17. The average size of a ditched terrace in the project area is less than 23 m in length and just over 17 m in width, while they range between 12 m and 35 m in length and between 8 m and 26 m in width (see Appendix for more detailed metric data). A complete ditch was observed to surround 18 of these features with a partial ditch bordering four other features on three sides (Figure 14). These ditches were variable in size, but many of the features near the center of the research area had ditches that measured near 0.5 m deep, while those toward the peripheries had ditches closer to 1 m in depth. Ditch width followed a similar pattern with those near the center all possessing ditches near 1 m in width, while the ditches of the features on the periphery were commonly 2-3 m wide. In addition, a causeway of earthen construction was identified only on Feature 83, even though the ditch was less than 0.5 m deep in that spot. In addition, some ditches contained come coral and stone, but this may have been displaced from the actual terrace itself. Feature 108 is of unique construction. The north half of the feature is elevated ca. 20 cm, with the elevated area bounded on three sides by the ditch, and the fourth side dropping down to a common terrace with coral and stone paving. Thus, the feature displays characteristics of both a ditched terrace and a common terrace.

Surface Remains

Surface remains constructed of stone, coral, or both were recorded on all but five of the ditched terraces (Figure 15). Although almost all ditched terraces had some evidence of surface remains, these remains were variable with no true patterns being identified through the survey area.

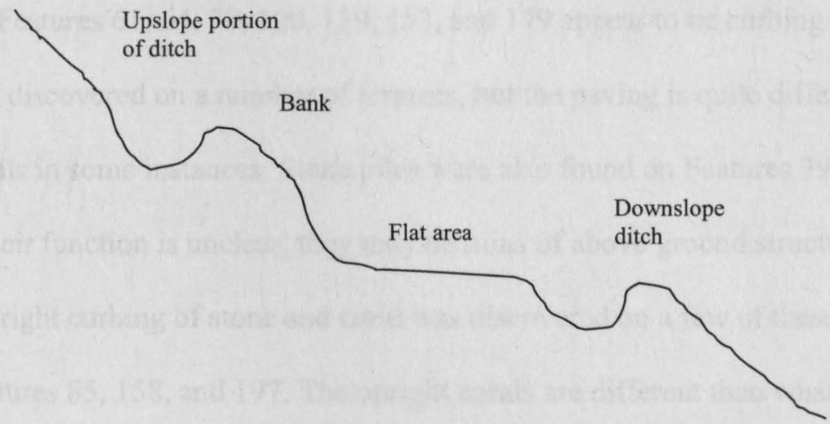

Figure 13. Profile View of a Type II Ditched Terrace. Not to Scale.

Figure 14. Upslope Portion of Ditch on Feature 104.

The majority of remains were simple pavings and alignments, but a few were more elaborate, being constructed of a series of alignments and pavings. Specifically, the surface remains on Features 61, 64, 70, 100, 119, 153, and 179 appear to be curbing stones, similar to what was discovered on a number of terraces, but the paving is quite different, consisting of plate corals in some instances. Stone piles were also found on Features 79 and 83. Although their function is unclear, they may be ruins of above ground structures. In addition, upright curbing of stone and coral was discovered on a few of these structures, notably Features 85, 158, and 197. The upright corals are different than what is commonly recorded in East Polynesia, being only ca. 20 cm above the ground surface. Nevertheless, upright coral is rare in any circumstance in West Polynesia, but they are still be interpreted as curbing stones. Plate coral and groupings of common coral were also found on ditched terraces, specifically Features 37, 79, 191, and 199. The density of coral on these features was marked with much more coral discovered on Feature 191. Although no specific patterns could be identified in the placement of coral on these structures, these likely represent either pavings for a structure or graves.

Although the majority of ditched terraces followed the general patterns described above, four features exhibited unique surface remains. Feature 193 is a large Type I ditched terrace with three alignments present on the surface. One alignment is made of a curved pattern of large boulders measuring roughly 2 m long. Although these rocks are quite large, it is possible that this alignment is the remains of stone curbing for a foundation. The other two alignments on the feature consist of both coral and stone. One is a rectangular alignment of stone, with coral paving in the middle, which measures 2.5 m in length and

1.5 m in width. The other is a rectangular grouping of coral and a few stones that is smaller than the other two features. The most probable function of these is grave makers.

Figure 15. Structural Remains of Feature 100.

Meanwhile, six alignments or groupings were identified on Feature 7 including four piles of stone and/or coral, a stone and coral alignment, and a stone-lined depression. The majority of the coral observed in the piles was large plate corals, but regular coral was also found. In addition, much of the stone that was used was large slabs measuring ca. 40 cm in length. The function of these piles is unknown, but it is possible that the stone and coral alignment was curbing for a standing structure. The final alignment, the stone-lined depression, is also difficult to interpret without further testing. It is quite large with the majority of the stone clustering on one side. Although no charcoal and fire-cracked rock were observed at the base of it and no raised rim was present, the size, nature, and location of the structure suggest that it may have been an *umu ti* (earth oven used to cook *ti* roots). Such features have been interpreted in Western Samoa based on the presence of a raised rim (Davidson 1974), but none have been recorded on Tutuila or Manu'a. However, Cox (1982:395) argues that a raised rim is not necessarily indicative of an *umu ti.*

A similar depression was discovered near Feature 158, just off the south side of the ditch that was smaller, with rocks located only on the outside of the depression, not within. In addition to this depression, a platform-like structure with upright stone and coral plates is located near the upslope end of this ditched terrace, which has altered the morphology of the feature. The flat area of ditched terraces typically located on the downslope end is actually located on the upslope of this feature. This platform includes two tiers of stone alignments and plate coral pavings extending out from those alignments and measuring 7 m by 3 m. Because of this, I interpret this as the remains of a structure, but it could potentially be a grave—a multiple internment grave given the size.

Feature 104 exhibits no sign of a standing structure. Instead, a small *fo'aga* with two facets was situated near the center of the feature. Although many Samoans interpret these artifacts to be bowls used in the preparation of kava, archaeological evidence indicates their use in the final steps of the adze manufacturing process to polish and sharpen the stone. The facets on this specific *fo'aga* were quite deep, meaning that it had been used as a grinding stone in the past, but it could not function as one given its present condition. It is possible, given the location of the find, that it had once functioned as a grindstone, but was then placed on the ditched terrace and utilized as a kava bowl.

Spatial Distribution

As noted before, a general trend was observed in the distribution of ditched terraces in the project area, specifically that the larger ditched terraces cluster on the periphery of the settlement while the smaller ones are toward the center. This particular hypothesis was tested using a Kringing technique in ArcGIS. Kringing is a predictive modeling technique that utilizes a set of known samples to predict certain values for an unknown area, in this case the value being the area of the feature. For this particular test, the Kringing was not used to predict the area of an unknown ditched terrace, but, instead, was used to discover the general trend in the data. In other words, the Kringing technique will show the area in which different values, in this case the size of the surface area, are most likely to be located. The results of this analysis suggest the general trend that was previously observed: smaller ditched terraces located toward the center while larger ones commonly located on the periphery of the surveyed area (Figure 16). It should be noted, however, that this is merely a trend. In fact, some larger ditched terraces are located toward the center and some smaller ones toward the periphery, but this is clearly not the general pattern. When one considers all the ditched terraces together as one group and analyzed using a nearest neighbor analysis, the distribution is random. Therefore, it appears that size may be an important characteristic in the distribution of these structures.

In addition, all the ditched terraces were found downslope of Feature 38, mixed in among the interpreted residential terraces. Although space was often found between these features and others in the same area, ditched terraces were found connected to either terraces or, in some instances, other ditched terraces. When this occurred, the features were usually separated from each other by the ditch itself, with the lone exception being Feature 108 (already discussed). These double ditched terraces or ditched terrace/terrace combinations possess the same characteristics of other ditched terraces, so it is unclear why they were built in such a way, or if there was any meaningful distinction at all.

Functional Interpretations

The question of what ditched terraces were used for is intriguing. Clearly, they are different than the many terraces that were recorded during the survey, and even highly variable as a group. Because of this variability, it should be asked whether there existed a singular function. Different structures have been found on each feature and no clear pattern exists, other than the general trend discussed above. Compounding the issue is the fact that this particular feature has yet to be found on any other island in the group and is not specifically mentioned in any ethnographic texts. Thus, in order to better understand the function(s) of these features, we must begin this discussion with what we do know about these features.

A large number of ditched terraces have some surface remains, specifically surface structure remains. Coral is commonly used and at least some coral is present on all but four of these features. The surrounding ditch also gives the features a raised appearance, which makes them stand out from the surrounding landscape. Additionally, they are dispersed east of Feature 38 and among terraces, while a general trend indicates that the smaller ditched terraces cluster near the center of the distribution, the larger ones being on the periphery. From this discussion of characteristics, three functional options can be suggested at this time: that of the *fale tele*, the *fale aitu*, or the house of a high-status individual. The *fale tele* has already been described in detail in an earlier chapter. In historic times, they tended to be near the center of the village and larger than common dwelling houses. It is in this regard that the interpretation of ditched terraces as *fale tele* loses its appeal. Specifically, the fact that small ditched terraces are the ones close to the center seems to contradict the historic layout of a *fale tele*.

An interpretation of high status housing experiences the same problems. Given the prestige of a central location in Samoan culture, reason suggests that high-status individuals would inhabit that area. Thus, the remaining interpretation is that of a *fale aitu*. Historically, as has already been discussed, these structures were not differentiated from other common dwellings other than a fence or another border surrounding the feature, or the structure was situated on a raised platform. As one can observe from the previous discussion, ditched terraces have many characteristics of regular habitations, other than the surrounding ditch, which seems to correlate well with descriptions of possible *fale aitu* as similar to other structures other than a bordered area. In addition, an interpretation a *fale aitu* can fit with their distribution. The central ditched terraces are located near the majority of terraces, which serve as local, individual god houses. Meanwhile, the larger ditched terraces on the periphery could have served as community god houses or territorial markers. Clearly, more work needs to be conducted to test these hypotheses, but at present the most likely interpretation is that they are some type of specialized sites, namely religious/ceremonial structures.

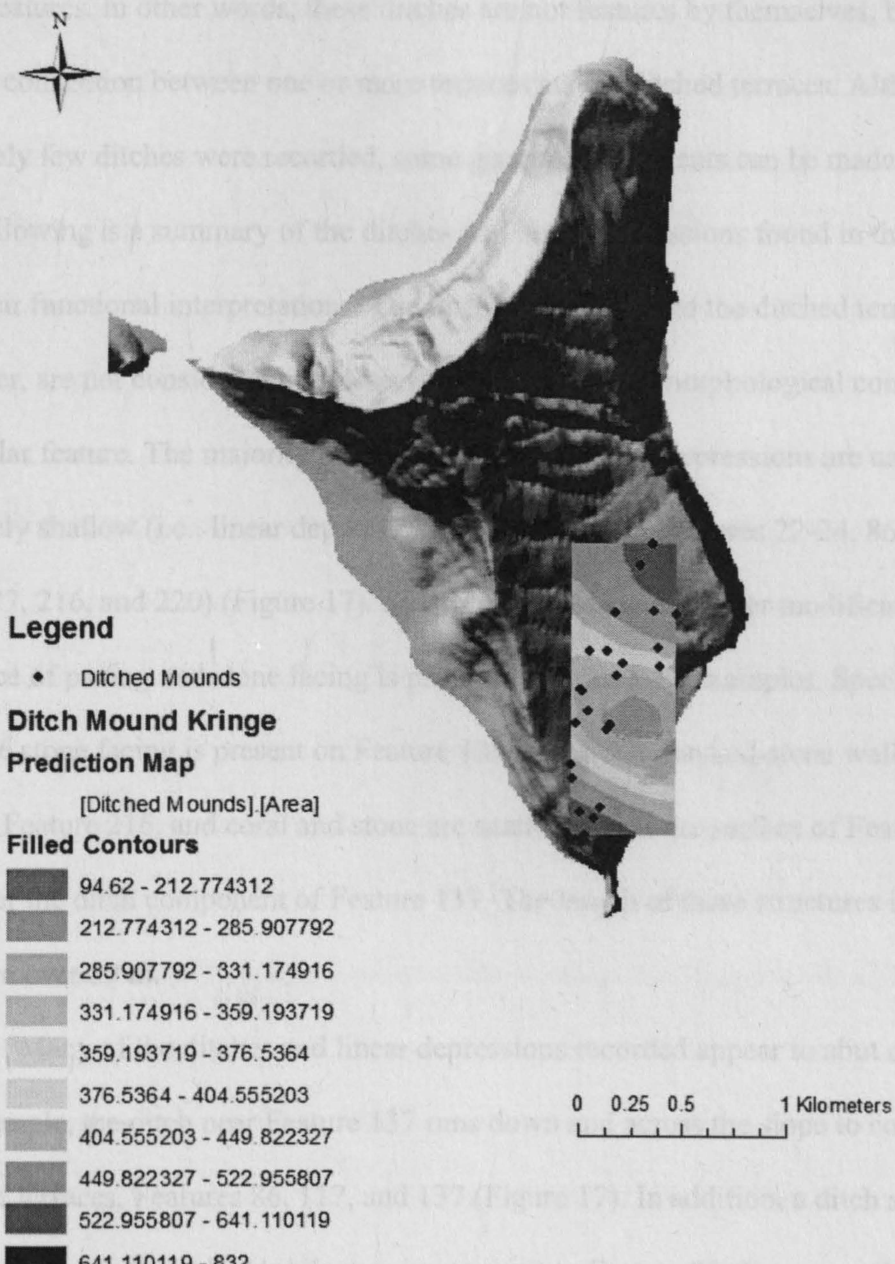

Figure 16. Ditched Terrace Distribution.

Ditches and Linear Depressions

Many of the ditches discovered during this survey appear to serve as constituents to other features. In other words, these ditches are not features by themselves, but rather act to form a connection between one or more terraces and/or ditched terraces. Although relatively few ditches were recorded, some general assessments can be made about them. The following is a summary of the ditches and linear depressions found in the study area, and their functional interpretations. The ditches that surround the ditched terraces, however, are not considered in this section as they were a morphological component of that particular feature. The majority of these ditches and linear depressions are narrow and relatively shallow (i.e., linear depressions associated with Features 22-24, 86, 93, 117, 135, 176, 177, 216, and 220) (Figure 17). Most show no signs of further modification; however, evidence of paving and stone facing is present in a couple of examples. Specifically, possible stone facing is present on Feature 135, a possible stacked-stone wall is located next to Feature 216, and coral and stone are scattered over the surface of Features 135, 216, and over the ditch component of Feature 137. The length of these structures is variable, but most are over 50 m.

Many of the ditches and linear depressions recorded appear to abut other features. For example, the ditch near Feature 137 runs down and across the slope to connect three separate terraces, Features 86, 117, and 137 (Figure 17). In addition, a ditch appears to connect Features 23 and 24 while running tangent to Feature 22. It appears that these ditches were used as paths and, because of the nature and location of the structures, few other interpretations could be suggested at this time.

Along with a linear depression, Feature 216 also exhibits what appears to be a wall. This wall is constructed 1-3 courses of poorly-stacked basalt boulders and is only on one side of the linear depression. This feature is likely a walled path similar to those found on Upolu (Davidson 1974:239), although it is less than 9 m in length. Other possible interpretations for this feature include its use as some sort of boundary.

Feature 38

Feature 38 is a unique in both its size and morphology. This feature stretches across the entire southern half of the island, running parallel to the mountain slope. At Mata'ala ridge, this feature runs downslope on both the cliff and slope side, measuring approximately 3 m in width and 1.5 m in depth (Figure 19), although it quickly disappears on the cliff side after descending ca. 30 m. The degree of erosion observed on the upslope bank indicates that water has moved through the feature, but no sitting water was observed within it. Although this feature is morphologically a ditch in most areas, it is not in a few areas. Instead, the downslope bank disappears, usually at topographic high points, the morphology quickly reverting back after these high points. In addition, the feature becomes very narrow and deep in certain sections while in others the ditch is quite wide and fairly shallow, although always over 0.5 m deep. Moreover, at certain intervals along the feature, small channels, measuring 1-3 m wide, are cut into the downslope side of the ditch, many of them located within stream banks (Figures 20 and 21). One of these channels, however, is located on the upslope side of the feature running next to a number of terraces in the area. Along the length of the feature are small areas that exhibit possible stone facing, although it appears to be very rudimentary and not well stacked other than at the northern end of the ditch where there is a nicely stacked stone retaining wall (Figure 18).

This feature appears to be located near the division between slope grades as well as between the division of modified and secondary forest (Liu and Fischer 2007). Specifically, downslope of the ditch, the slope is less than 40 percent and the forest is heavily modified with a mix of various economic plants, while upslope of the ditch the slope is greater than 40 percent and the vegetation is secondary forest with a small number of economic plants. Although the ditch does not match the border of these zones perfectly, the accuracy is still very striking.

Feature 38 is clearly a unique part of the cultural landscape of Olosega, and its importance in understanding the human-environment relationship is apparent. The dating of the ditch is problematic because no historic or prehistoric artifacts were found that could directly be related to the ditch, and no ethnographic or historic sources explicitly cite this feature. The only temporal evidence, therefore, is the ditch's association with other features in the area. The ditch abuts a number of different features, but never bisects a terrace. If the ditch was built in the historic period after the area was abandoned, it would be reasonable to suggest that the ditch would bisect at least some terraces. Features are commonly built over older features and modified for the present need, and only culturally significant areas are preserved, not whole settlements. On the other hand, the path of the ditch appears to avoid or go around terraces, which suggests the ditch was built after many of the terraces. Because of this, I suggest that the terraces were still in use at the time, and continued to be in use after, this ditch was made. Although this does not provide a specific date for the construction or use of the feature, it was likely built sometime after the construction of many of the terraces and before the abandonment of the settlement in the protohistoric period. As for a primary function of the ditch, a few possibilities can be proposed:


Figure 17. Linear Depression near Feature 137.


Figure 18. Stone Retaining Wall at the Northern End of Feature 38.

Figure 19. Feature 38 near Mata'ala Ridge.

Figure 20. Channel of Feature 38.

1. **The ditch was used as a path connecting the various portions of the settlement**. Historic sources note that the interior of Olosega was covered in thick vegetation during the occupation of the settlement, which may have made a path a necessity. The location of the path was determined by the access to different areas of the settlement and the overall ease in construction of the path along the slope division. The downslope channels, which are cut at intervals along the feature, served to drain the path after substantial rainfall, while the upslope channel served as a path itself connecting the ditch to a number of features upslope. Although an interpretation of the ditch as a path is reasonable given the nature of the landscape, it is unlikely that a ditch would have to be built as deep and long as this, and have continued down the cliff side of the ridge if it primarily functioned as a path.
2. **The ditch served as a defensive feature**. Although the ditch is shallow at times, it would still have posed a challenge to oncoming opponents. In addition, a simple palisade would have enhanced the defensive capabilities of this feature to make it a very formidable obstacle. A number of reasons, however, can be suggested as to why this feature is not defensive. First, the channels cut into the ditch would not be needed to drain water. If anything, standing water would add another obstacle to oncoming enemies. Second, little in the way of residential remains were discovered above the ditch. Instead, the only features that were recorded were star mounds and a small number of terraces, the majority of which do not exhibit signs of occupation. As a result, the only defensive function that this feature would have provided is as a refuge for people during an attack, a last line of defense, which is unlikely given the amount of

work that was needed to create such a feature when the defense of the actual residential area could have been improved just as easily if not easier given the limited land area that would need to be modified for that defense.

3. **The ditch was a water control device**. Water control, specifically for irrigated cultivation, is well known in the Pacific Islands, but is rarely found in Samoa (although a few features on Tutuila and Upolu have been interpreted as being water control devices). Close examination of the sides of this feature indicate that water movement occurs within the ditch, which likely then drains through the channels described above, although no standing or moving water is present when it is not raining. The majority of these channels are cut in stream banks, allowing for the water to drain into those streams. The one channel that does not follow this pattern may have been used to drain water into the ditch from the upslope area.

The feature does not appear to have been a water control device to bring water to any specific area, but, rather, it would have kept water from running onto the main residential portions of the settlement. Sediments would also have been moving with the water as it eroded off the interpreted cultivated land upslope of the ditch. As a result of the divergence of water and sediment into stream banks, taro cultivation in those stream banks, which is common practice in Samoa, would be enhanced by the increased nutrients that eroded soil would have brought. This ditch, therefore, would have allowed for not only the channeling of water, but also the sediment that the water carried; depositing the sediment in the stream banks, replenishing soil nutrients, and making taro cultivation in the stream banks more productive.

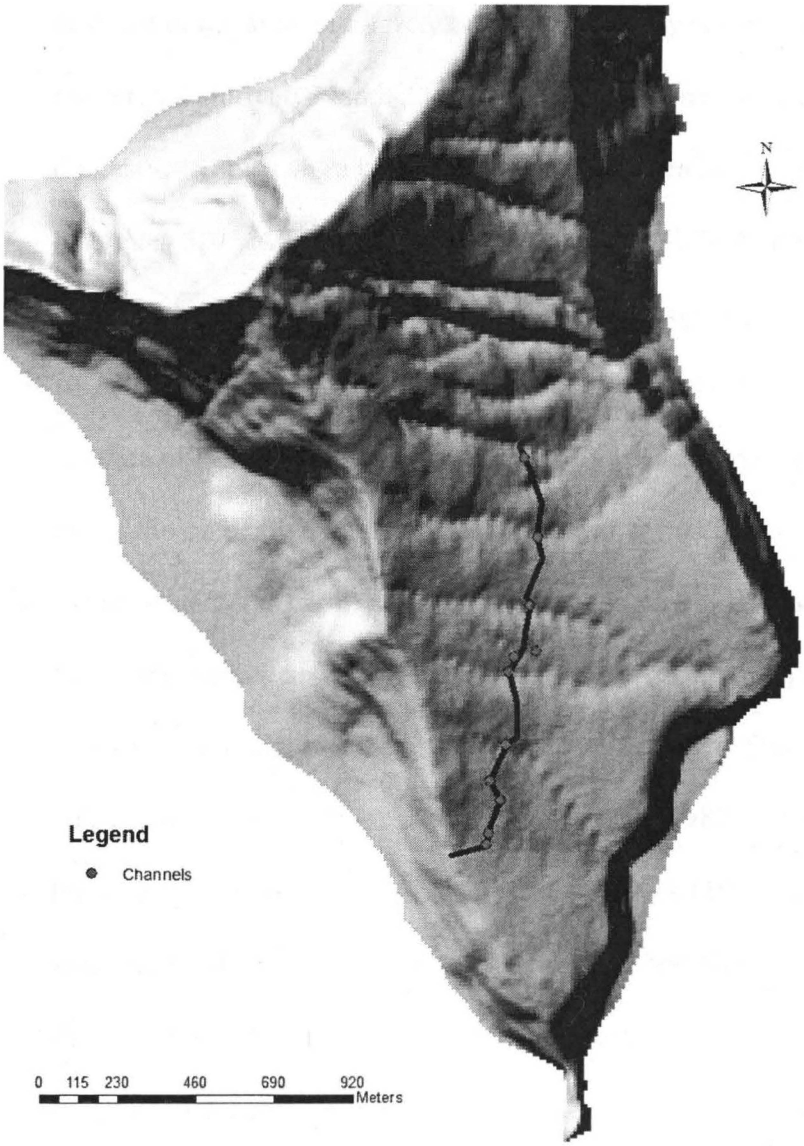

Figure 21. Distribution of Channels across Olosega.

4. **The ditch was a pig barrier**. Today, feral and domesticated pigs are common in Polynesian Island faunal assemblages. Abundant evidence of feral pigs was observed during the survey, with numerous pig wallows and living specimens observed, but no pigs were observed upslope of the ditch. This was originally attributed to the steep

gradient of the area, but it may be that the ditch was used to help keep pigs out of the interpreted cultivated land. At the time this settlement was in use, it is likely that domesticated pigs were kept in the residential area of the settlement, much like examples that have been described (Buck 1930:323). Although feral pigs may have been present as well, it was these domesticated pigs that were affected by this barrier. As discussed in Chapter 6, it appears that swidden horticulture was being practiced upslope of the ditch and residential activities were occurring downslope of the ditch. If this is the case, it would have been important for the population to be able to keep their domesticated pigs out of their garden areas as pigs can cause substantial damage. Ethnographic and archaeological sources have recorded barriers between villages and cultivated land that had the primary purpose of keeping the domesticated pigs out of the cultivated zone (e.g., Buck 1930; Jennings et al. 1982; Kirch 1994). Although these barriers are commonly constructed of stone, Buck (1930:323), quoting an ethnographic manuscript of Judd, indicates that the pig wall behind Ofu village was a ditch cut into the bank instead of a fence constructed of stone. The barrier of Judd was not described in detail, and, more generally, it is unknown how large a ditch would have to be to keep pigs out, or deter pigs from entering a given area. These factors, in addition to the fact that we do not know how deep Feature 38 was when it was originally constructed, before infilling due to erosion, means that it is difficult to determine how effective the ditch would have been as a pig barrier.

A number of other functions can surely be interpreted for Feature 38, but those presented above appear to be the most likely. It should also be noted that these alternatives are not mutually exclusive. Instead, the ditch could have realistically served each of these functions. The idea of exaptation (Gould and Vrba 1982) is not new to archaeology and has even been used to interpret the function of star mounds (Herdrich and Clark 1993), but it is underappreciated and often forgotten. Cooptation is common in biology, so why wouldn't it be a factor culture? If the ditch was meant to keep people out, it would have also kept pigs out; if the ditch could form a path for water, why not for people, perhaps changing over time. Nevertheless, because of the large labor investment and management required to construct this feature, it was likely built with a primary function in mind. Its primary use as a path seems less likely given this labor input as less labor intensive options would be available, such as a smaller ditch or a small sunken path similar to other linear depressions and ditches in the area. Although its use as a defensive feature is possible, this interpretation seems less likely than if it were used as a water control device or a pig barrier because of its location and morphology, specifically the presence of channels and limited width in some areas. Therefore, the ditch as a water control device and pig barrier is the likely primary function.

Depressions

The depressions in the study area, as a group, were different. Some are located on terraces (Features 7, 18, 28, 69, 98, 99,144, 154, 179, 195, 203, 213), some quite small. Others, on the other hand, that are located off the terrace are large (Figure 22), but they still appear to be in association with that terrace (Features 104, 145, 157, 158, 165). For further descriptive information, see Appendix 1. It should, however, be noted that the metric data of these should be taken with caution as it was difficult to take accurate measurements given their morphology. Nevertheless, many of these features were large.

A number of functions can be tentatively proposed for these features. The small depressions could be remnants of hearths or cooking areas, although no charcoal or fire-cracked rock was seen in their vicinity. As has already been discussed, the large depressions located on ditched terraces may be *umu ti (*Features 7 and 158), but many of the other large depressions in the area do not exhibit the same characteristics; specifically, they lack stone lining. Although a similar interpretation can be assigned to other depressions, the differences in morphology may suggest differences in function. Therefore, I propose their possible use as either water or food storage devices. Oral histories and environmental constraints, namely intermittent streams, indicate that water shortage may have been a problem on Olosega (Kramer 1902-03). If a period of drought struck, a water crisis could arise, resulting in the need for water storage. Environment data from the Pacific indicates that periods of drought occurred during the prehistoric period as a result of various processes including El Nino as well as global cooling and warming. If these depressions were used as water storage devices, one would expect to find a clay lining at the bottom of these depressions or some other system that would not allow for water to seep back into the soil.

Another possibility is their use for food storage, specifically as *masi* pits. In Samoa, *masi* refers to fermented breadfruit, but *masi* can refer to other fermented foods throughout Polynesia. *Masi* is a way of preserving food, especially useful as famine food in the past, and it is still eaten on some islands today. To make *masi,* ripe breadfruit must be stored in an underground pit for an extended period of time. *Masi* can then be stored for long periods of time, unlike taro and ripe breadfruit. Like water shortage, the need for *masi* pits would likely stem from environmental stresses, including droughts and natural disasters such as hurricanes, tsunamis, or earthquakes. For example, much of the breadfruit crop was lost in Olosega and Ofu in the spring of 2010 because of a tropical storm. Because of modern technology and shipping, *masi* was not needed, but if this were to happen in the prehistoric period, stored *masi* would have been extremely beneficial. Additionally, stored *masi* would provide food for refugees under siege. In a preliminary survey of the interior of Olosega, Hunt did note the presence of a possible *masi* pit (Hunt and Kirch 1988), but it is unclear if he was referring to one of these depressions.

Figure 22. Feature 45. Center of the Photograph.

Cox (1982:395) has noted that large depressions, such as the ones noted here, may have been used for a variety of purposes at different times throughout its use-life, a kind of exaption (Gould and Vrba 1982). Thus, it may have been that a single depression was used to store water, used to ferment breadfruit, and then used as an *umu ti.*

Miscellaneous

One important feature discovered during the survey was incompatible with all other feature classes. This feature was a large open area without true borders exhibiting a large number of water-worn stone and coral scatters as well as a few stone artifacts. The size of the area is similar to that of Feature 86 and some of the other larger terraces. No surface structures were found on this feature, but a number of terraces surrounded it including Features 160, 161, and 162. Only a quick surface survey was conducted to the west of the feature and identified an additional terrace, although what is beyond that terrace is unknown.

Given its location among a number of intensively inhabited terraces and the nature of the feature, I suggest the possibility that this area is a *malae.* Although *malae* have not been confidently identified as described in ethnographic sources within archaeological sites in Samoa, some have suggested the possibility of their presence (e.g., Best 1993). This particular example differs from the common morphology and size typical of modern *malae*, but it is similar enough to interpret it as such. It is clear that activity took place within the feature, but actual habitation structures are absent. If a *malae*, it is expected this feature will be in a central location within that particular portion of the settlement, but not the actual center of the whole dispersed settlement region. At this time, however, no additional interpretations can be provided.

Additionally, two circular stone alignments were identified associated with Features 92 and 164, but not actually situated on the terraces. The size and shape of these two alignments suggest their use as what Carson (2006) identifies as planting circles. To test this interpretation, it is suggested that future research projects test the chemistry of soil within the stone circles and compare it with the chemistry outside the stone circles as it is likely that the soil within the planted areas would have increased soil nutrients as has been indicated by research elsewhere (e.g., Ladefoged et al. 2010; Vitousek et al. 2004).

Limitations of this Survey

Because this research project is preliminary, potential problems in need of remedy exist. It is important for these problems to be explicitly presented so that future researchers understand the potential shortfalls. The most notable of these problems is the need for a chronology of settlement. Although this chronology can be extrapolated using the morphology of the features and data from elsewhere in the archipelago (e.g., Davidson 1974; Holmer 1980; Pearl 2004, 2006), this is not good enough. A number of historic artifacts were identified during the survey illustrating the area's use well into the historic period, but it is unclear whether this is a reflection of residential or cultivation activities.

Additionally, the GIS analysis conducted using these data could only consider the settlement as a whole, and not as separate clusters because the locational data have, at best, 10-m accuracy. Although I have confidence that these data are sufficiently accurate to be able to understand large scale distribution, the relationships between specific features cannot be explored with confidence. Thus, I conclude that it would be inappropriate to explore, here, intra-cluster distribution. However, this could test many of the interpretations presented here and provide much more data on the village layout, particularly if such further research explored the relationship between linear depressions and other features.

Future research will need to map these features with a more precise GPS unit, preferably one with sub-meter accuracy.

Finally, areas that were not surveyed as part of this project may change interpretations presented in this thesis. Specifically, areas to the north of the study area may change interpretations on the nature of Feature 86 if it becomes apparent that it is not a central feature. In addition, further survey upslope of Feature 38 may identify new terraces that may or may not falsify the present interpretations of the features and the area in general.

Oge Coastal Plain Survey and Coring Program

Geomorphological processes that affect settlement have long been a popular research topic in Samoa (e.g., Clark and Herdrich 1988; Clark and Michlovic 1996; Dickinson and Green 1989; Kirch and Hunt 1993; Pearl 2006). To better understand the system of coastal settlement on Olosega and to obtain data for the analysis of landscape change, a small reconnaissance survey and coring program was conducted on the east coast of the island. Although limited in scope, it was hoped that enough preliminary data would be acquired to permit for future research objectives to be formulated, allowing for a more comprehensive archaeological coverage of this area. The following are the results of the coring and survey, and a discussion of their implications. All descriptions are from field observations, and no soil samples were taken for further analysis. Again, this research was meant to be preliminary and simple, focusing primarily on the prehistoric settlement of the area and not necessarily on the geomorphological processes at work.

As noted in the methods section of this thesis, this portion of the island was examined by reconnaissance survey using a limited number of transects. Coring was unsystematic and dependant both on the vegetation and nature of the soil in the area. In some areas, the coring device could not penetrate deep enough to provide any useful information. When this occurred, the sample was abandoned and a new location was chosen. All soil characterizations were made by the author in the field using moist samples. A Munsell color chart was not used.

Results of the Coastal Reconnaissance Survey

Only two features were identified on the Oge coastal plain. Coral and natural stone cover the surface making identification of features quite difficult in this area. The features are assigned different site numbers as they were a significant distance away from each other and are described as follows.

<u>AS-12-51</u>

This site consists of a single *fo'aga* (grinding stone) located on the beach approximately 3 m from the water's edge at high tide. Three separate facets were identified on this large boulder, the first measuring 38 cm x 24 cm, the second measuring 16 cm x 34 cm, and the third measuring 58 cm x 62 cm. The boulder on which these facets were found is made of porous basalt and is 1.2 m x 1.35 m x 0.9 m. All facets appear to be quite deep and well used.

<u>AS-12-52</u>

This site consists of a single boulder alignment (Figure 23) that is perpendicular to the shoreline, measures 14.8 m long, and is made up of a single course of large basalt cobbles and small boulders. This type of feature is sometimes used as boundaries for land between and among families. If this is true, more features like this may be expected in this area, although the nature of ground cover does not allow for these features to be easily identified.

Results of the Coring Program

Core 1 was located approximately 40 m from the present shoreline in a heavily forested area just inland of an old beach dune (Figure 24). Coral and shell were scattered across the surface and natural basalt was abundant, although no cultural material was found. The sample penetrated 57 cm beneath the surface and was terminated due to an obstruction. Only one layer was identified in this core, which was dark red/brown silty clay with a few coral inclusions.

Core 2 was located approximately 35 m from the present shoreline in a heavily forested area lying about 50 m north of core 1. Coral and shell were scattered around the surface and large basalt boulders were in the vicinity. A few pieces of possible midden shell were identified in the area, although no artifacts were discovered. The core penetrated 50 cm below surface showing three stratigraphic layers. The first, from 1-25 cm, was red/brown silty clay, similar to that found in Layer I of core 1, with a few coral inclusions. The second, which extended from 25-38 cm below surface (bs), was a black loamy sand with coral inclusions at the bottom. Toward the end of this layer, an auger bit had to be used due to the compact nature of the soil, so the transition between layers II and III was now clearly observed. The third and final layer, extending from 38-50 cm bs, was light brown loamy clay having a similar texture to Layer II. The core had to be terminated before the conclusion of this Layer due to obstructions.

Core 3 was located at the far end of southern coastal plain at Oge approximately 20 m from the beach with coral and shell scattered over the surface. The core penetrated 44 cm bs and was terminated due to an unidentified obstruction. Only one layer was observed, which was dark red/brown clay with coral inclusions. This was similar to the first layers in the previous two cores, except this layer contained more clay.

Core 4 was located on the south side of the stone alignment of site AS-12-052. Along with this alignment, stone, coral, and shell are scattered around the surface, but none appear to be cultural. The core penetrated 44 cm bs and was terminated due to an obstruction of coral, with two layers being identified before the termination. The first layer was dark red/brown silty clay with numerous coral inclusions, which extended from 1-38 cm bs. The second layer, extending from 38-44 cm bs, had a more sandy texture than the previous layer, although the color did not change, perhaps representing a transitional layer.

Core 5 was located on the north side of the stone alignment within a scatter of non-cultural stone, shell, and coral. The core penetrated 41 cm bs into two stratigraphic layers. The first was dark red/brown clay with few coral inclusions that extended from the surface down to 6 cm bs. The second extended from 6 cm bs to the termination point and was more compact, lighter in color, and contained numerous basalt inclusions, but was of similar texture to the first layer. Charcoal flecking was noted below 30 cm bs, but not enough was observed to warrant collection for a possible radiocarbon date.

Core 6 was located at the base of the cliff on the northern coastal plain of Oge approximately 6 m from core seven. Coral and shell were scattered over the surface, but fewer in number compared to locations previously described. Only one layer was identified that extended down to the termination of the core at 31 cm bs. This layer was a dark red/brown clay, similar to layers observed in the upper layers of other cores, that included a limited number of small phenocrysts.


Figure 23. Stone Alignment Designated as AS-12-052.

Core 7 was located approximately 6 m west of Core 6 with the hope of extending the coring device further into the soil to ascertain whether another layer would be encountered. The core penetrated 81 cm bs before termination, allowing for three layers to be identified. The top layer was silty clay with a dark red/brown color that had few inclusions extending from the surface down to 15 cm bs. The second layer, 15-75 cm bs, was again silty clay with a lighter color and slightly different texture than the previous layer, but again few inclusions were noted. The third and final layer encountered was more compact silty clay with a slight texture change and a few more basalt inclusions, but no color change was noted. The core was terminated because a rock obstruction.

In summary, most cores did not show signs of substantial human settlement. The only layer that is here interpreted as being a cultural layer is Layer II from Core 2, which was black loamy sand with coral inclusions at the bottom of the layer, but no further testing was carried out in the vicinity to ascertain the exact nature of the deposit. In addition to this possible cultural layer, a deposit with charcoal flecking was also discovered.

In all locations, a layer of dark red/brown silty clay was discovered as the uppermost layer. It is likely that this is the result of geomorphological activities, specifically erosion from the back of the valley and the interior of the island as this soil type is similar to that collected from the interior. Because the deepest core was only 81 cm bs, it is unclear how deep this deposit may be. These data, combined with the presence of charcoal flecking within a layer, suggest that this erosion is at least partly due to forest clearance, anthropogenic burning in particular.

Interpretations

Although this portion of the project was neither intensive nor extensive, a few interpretations can be considered. Like the nearby sites of To'aga (Kirch and Hunt 1993) and Va'oto, complex geomorphological change occurred at this location. In comparing the coring results from this project with the results from To'aga and Va'oto, many similarities become evident. Like those sites, the Oge coastal plain largely consists of calcareous sand, but terrigenous clays presently overlay much of the area, particularly behind the modern beach dune.

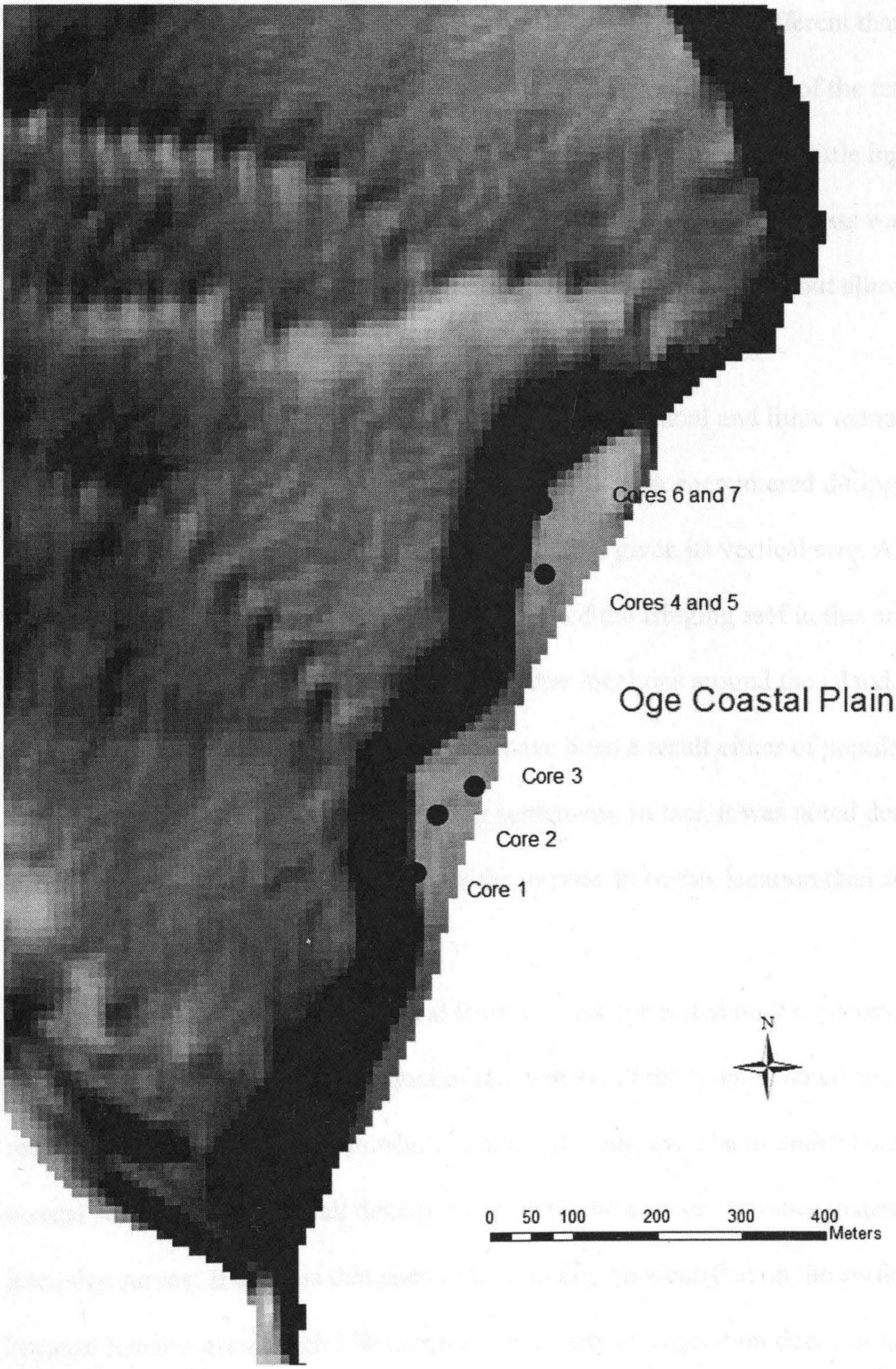

Figure 24. Location of Cores and Oge Coastal Plain.

The depositional processes of the clay, however, may be different than those observed at To'aga where Kirch and Hunt (1993) suggest that much of the terrigenous deposition at To'aga was due to mass wasting and sheet erosion with little input from alluvium. At Oge, like To'aga and other coastal plains on the island, mass wasting and sheet erosion occurred and can be identified at the back of the plain, but alluvial deposition is also likely given the intermittent streams that flow into the area.

Archaeologically, the remains suggest that residential and lithic manufacturing have occurred in this area in the past. The lone cultural deposit encountered during coring remains unevaluated, but it appears to be substantial given its vertical size. Although there is evidence of prehistoric activity, the small size of the fringing reef in this area would have made this location less desirable than many other locations around the island. Its use, especially if it was used permanently, may have been a result either of population pressure or ease of access to this area from another settlement. In fact, it was noted during the survey how much easier it was to access the interior from this location than from the Olosega side of the island.

While only two archaeological features were identified on this survey, it is probable that more exist on the plain. The goal of this portion of the project, however, was not to record and describe the plain in whole. Rather, the purpose was to understand the nature of coastal settlement and overall density by undertaking a reconnaissance instead of an intensive survey. It appears that sites cannot readily be identified on the surface either because remains are in such low density, the density of vegetation does not allow for identification, or because geomorphological activities have hidden them from view; a mix of the three being the most likely.

Most of the adzes recovered during the survey were found on or near Feature 86. This feature is in the center of the total distribution and appears to be an important center of the settlement (see Terraces). Whether these artifacts were actually manufactured or used in proximity to this terrace is debatable, as some are water-worn and a stream runs adjacent to the feature, which may contribute to artifact displacement. Given, the sheer number, however, it seems likely that some adze-related activities were occurring in the vicinity of the feature.

All the adzes recovered appear to be manufactured out of medium gray, somewhat fine-grained basalt with little material variability. Specimen 86-5, however, appears macroscopically to have been made of a finer-grained rock than other adzes in the collection.

Collected Artifacts from the Interior

During the survey, 24 artifacts were discovered and collected, which included 13 whole or fragmentary adzes, two adze blanks, one adze preform, two whetstones, two possible flake tools, and four flakes, one of which exhibits polish. In addition, some other miscellaneous artifacts were observed, but not collected, including a possible nutting stone and a large basalt tool.

The adzes were classified using the typology of Green and Davidson (1969b). Metric data, including maximum dimensions and weight, were obtained using a digital caliper and scale, and these results are shown in Table 1. Within the following discussion the term adze refers to a finished product showing polish as defined by Green and Davidson (1969b). A preform refers to an artifact in the final stages of the adze manufacturing process that has the morphological characteristics of the finished product, lacking only polish. A blank refers to an object in the adze manufacturing process that has not yet taken the general morphology of the finished product. The term whetstone refers to an artifact that exhibits signs of being used as an abrader or polisher, specifically striations, on one or more surfaces. Finally, flake tools refer to flakes that appear to have been modified and used for a utilitarian purpose, while the term flake merely refers to the ubiquitous waste material associated with the knapping process. These artifacts along with their metric attributes are listed in Table 1.

Adzes

Of the 13 whole and fragmentary adzes recovered, six represent Type I (Figure 25), three are probable Type III (Figure 26), two are probable Type VI (Figure 27), and the final two could not be classified (Figure 28). Not all of the artifacts collected can be unambiguous assigned to a type because they are fragmentary. Some have characteristics that could possibly indicate two different types and in those cases, the artifact was placed within the type most likely represented. This typological analysis indicates that the most common adze was the Type I, which is in keeping with the pattern observed elsewhere in Samoa (Clark 1996). All other types have minimal representation, but it should be noted that Type III was the next most common, which Hunt and Kirch (1988) identify as well represented in Manu'a

A degree of re-sharpening is indicated by specimen 86-4. This Type I adze appears to have been used and subsequently re-sharpened to produce a more useful bevel instead of creating an entirely new adze. In addition, adze specimen 93-2 exhibits a tang. Although the tang on this artifact is quite clear, it is not shouldered like typical east Polynesian examples and is relatively small. Although specimen 87-2 could not be assigned to a specific type, it does appear to have been eventually reworked to form another tool, as one side of this artifact appears eventually to have been used as a chopper.

Table 1. Metric Data for Artifacts.

Artifact	Type	Weight	Length	Width	Thickness
93-1	Type III Adze	27.7	85.81	29.26	14.54
86-10	Type III Adze Fragment	27.6	50.67	35.41	19.79
187-2	Type I Adze	85	82.79	58.89	22.06
187-1	Type I Adze	72.4	69.48	48.68	26.61
143-1	Adze Blank	114.1	108.6	52.4	29.3
143-2	Whetstone	112.1	115.5	75.5	25.5
94-1	Type VI Adze Fragment	35.9	57.1	32.3	23.9
195-1	Adze Preform	89.4	83.7	50.7	24.3
59-1	Polished Flake	4.9	46.5	23.9	8.4
103-1	Flake	11.7	56.1	47.2	14.7
103-2	Modified Flake	14.1	61.2	39.6	12.2
93-2	Type I Adze Fragment	105.4	83.4	43.3	31.4
87-1	Type I Adze Fragment	18.2	48.5	29.5	16.6
87-2	Adze Fragment	110.8	95.9	61.6	24.0
86-1	Type VI Adze	98.9	92.4	36.0	36.8
86-2	Type III Adze Fragment	28.5	64.0	35.2	15.7
86-3	Type I Adze Fragment	40.9	51.1	43.7	17.8
86-4	Type I Adze	41.2	67.7	45.2	18.6
86-5	Adze Fragment	33.0	48.5	33.6	31.2
86-6	Adze Blank	25.1	60.5	35.3	16.8
86-7	Modified Flake	10.9	44.9	27.4	13.8
86-8	Modified Flake	45.4	61.1	53.6	21.8
86-9	Flake	4.7	43.3	28.7	7.0

Preforms and Blanks

A single preform manufactured of a basalt type similar to the adzes was found on Feature 195. The general morphology of the artifact is quadrangular, which, along with the position of the bevel, indicates that this specimen was likely intended to be a Type I or III (Figure 29).

Two adze blanks were found near Feature 86, both exhibiting characteristics of the adze manufacturing process, but only in the preliminary stages. Although these blanks cannot be placed into a specific type, they appear to have quadrangular cross sections. Like the adzes and preform, these blanks are made of fine grained basalt.

Flakes and Flake Tools

Of the four flakes collected, all are relatively small, one exhibiting polish which indicates modification of a finished adze. Although the number of flakes collected is not enough to make any interpretations, the absence of large flakes indicates only late stage lithic manufacturing. In addition, two flakes that exhibit evidence of further modification or use were also discovered, although this damage due to modification and/or use is limited. Both of these artifacts were collected from the surface of Feature 86. As for potential functions, retouch is present on one side of 86-7, which suggests that it served as a side scraper, while 86-7 possesses a round body and a small protrusion, suggesting its use as either or burin or a drill.

Grinding Devices

In addition to a small number of *fo'aga* (grinding stones), identified during the survey (see feature descriptions), two small artifacts that appear to have been used as grinding devices were also collected (Figure 30). Both were manufactured of basalt, but specimen 143-2, which measures 115 x 75 x 25 mm, is angular in shape, while the other, which measures 96 x 77 x 43 mm, is a water-worn cobble. The angular one was discovered on Feature 143, while the provenience information for the other was lost during the transit of the artifacts. The grinding facet of specimen 143-2 is much more concave in nature than the other, which is flattened.

Miscellaneous

Two artifacts that could not be grouped within the broader classifications listed above were also found. These two artifacts, discovered on Features 16 and 188, were not collected because of transportation issues. The artifact found on Feature 16 was a water-worn cobble that exhibits signs of pecking, interpreted as a possible nutting/anvil stone. The other artifact, found on Feature 188 is unique. It is a large, heavy piece of basalt, measuring ca. 43 cm, which appears to have been modified on its lateral edges. The flaking scars are large, and are present along both sides, portions of each side being concave (Figure 31). This morphology suggests that the artifact's use as a spoke shave of some sort, possibly shaving bark from trees, although no actual use-wear was observed on the artifact.

Figure 25. Type I Adzes. Top Row from Left: 87-1, 86-4, 86-3.
Bottom Row from Left: 87-2, 93-2, 187-1.

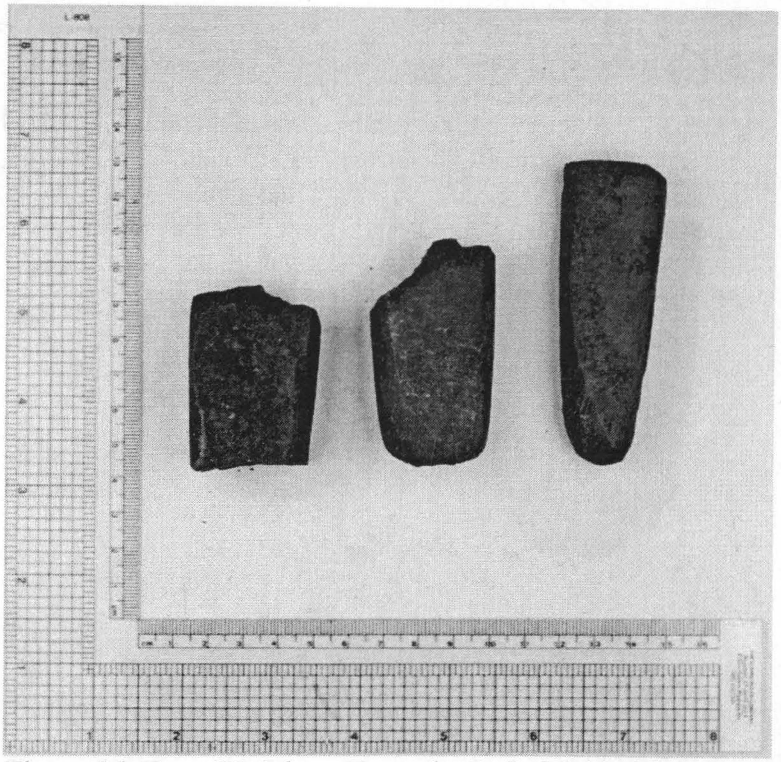

Figure 26. Type III Adzes. From the Left: 86-10, 86-2, 93-1.

Figure 27. Type VI Adzes. From the Left: 94-1, 86-1.

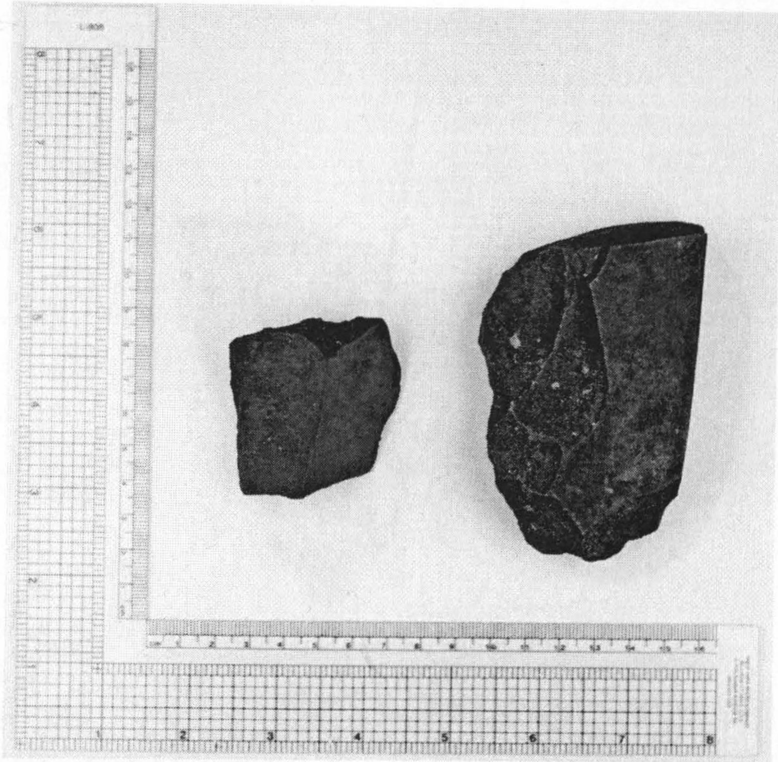

Figure 28. Unclassified Adzes. From the Left: 86-5, 87-2.

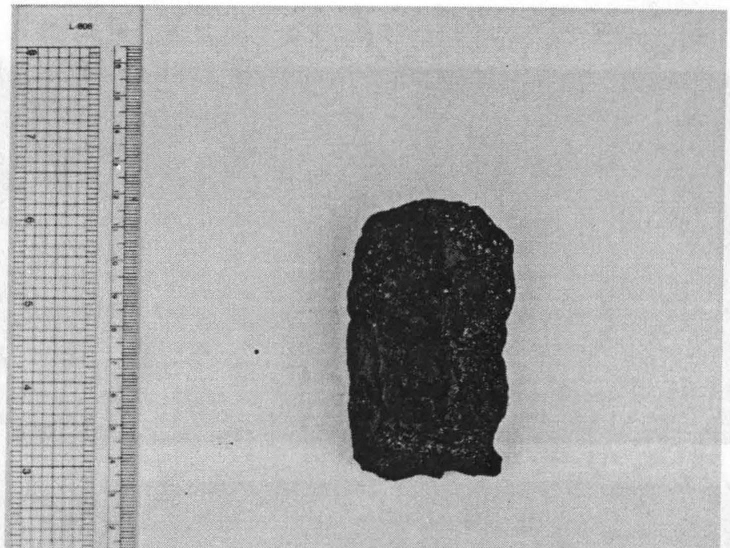

Figure 29. Preform (195-1).

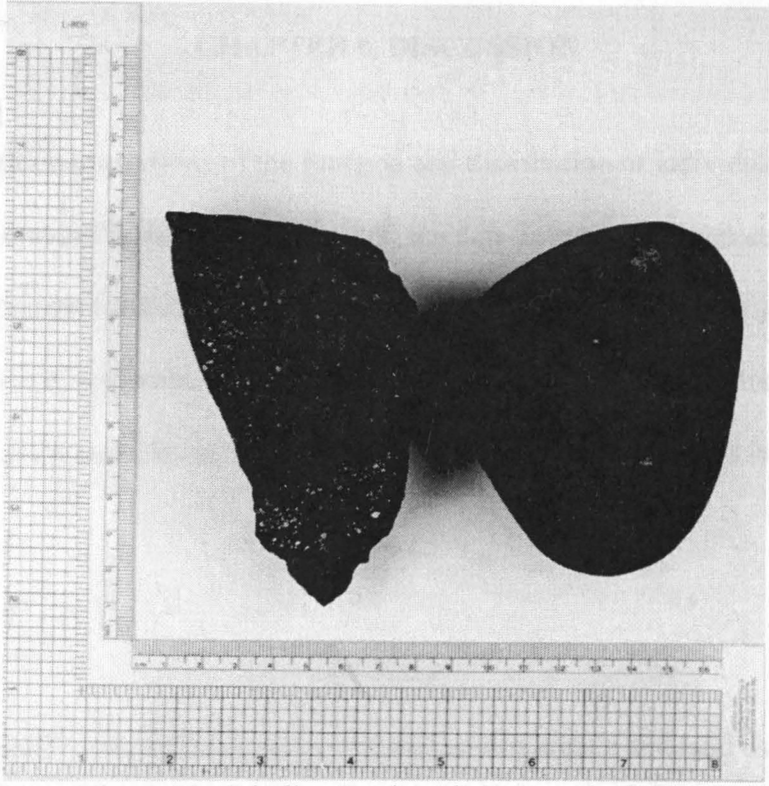

Figure 30. Grinding Devices (143-2 on the left).

Figure 31. Artifact Found on Feature 188.

CHAPTER 6. DISCUSSION

Although interpretations of the function and distribution of individual features have already been discussed in the previous chapter, the data have not yet been considered as a whole. In this chapter I will do just that, integrating the data to create more general interpretations about settlement on Olosega. Specifically, these interpretations, along with interpretations in the conclusion, will explicitly address the research goals laid out in chapter three.

Land Use

In Chapter 1, I presented questions related to subsistence and land use in the project area to better understand the human-environment relationship, which were:

1. *Are there archaeological indicators of past land use activities?*
2. *Are there environmental indicators of past land use activities?*
3. *If so, how do these land use activities relate to the settlement pattern as a whole?*

In this section, I answer those questions.

The interior of Olosega is covered by a variety of vegetation types, the majority within the survey area being either modified or secondary forest (Liu and Fischer 2004). The modified forest consists primarily of coconut, breadfruit, and *ti*, but candlenut and Tahitian Chestnut were also noted. Today, all these plants can be used for economic purposes, commonly grown in and around villages in Samoa. The secondary forest, on the other hand, contains abundant hibiscus (*fau)* and just a few economic plants; specifically, some coconut, breadfruit, and *ti*. The growth of such secondary forest commonly occurs after major disturbance to the vegetation of that area, such as logging or fire that destroy the primary forest. In Samoa, it is common for swidden plots to revert quickly back to secondary growth after the plot is left fallow. Thus, if these two vegetation types can be used as indicators of past land use, the modified forest of Olosega corresponds well with arboriculture practiced in the vicinity of modern villages, while the secondary forest appears to correlate well with modern examples of reverted swidden plots.

Although it is possible that the division is not quite as precise in reality, according to a United States Forest Service (Liu and Fischer 2004) vegetation survey the division between the modified and secondary growth forests on Olosega is fairly clear. Feature 38, the large ditch feature, roughly follows this division, originating at the ridge top and terminating in a stream bank near the center of the island (Figure 32). Although this observed pattern deviates slightly near the center of the island, a strong correlation between the modified/secondary forest border and Feature 38 is indicated. As discussed earlier, there are a number of interpretations for this feature, but the most likely, given the data available, are interpretations suggesting its use as either a water control device or a pig barrier. If the secondary forest upslope of Feature 38 does represent reverted swidden plots, then the use of a ditch as a pig barrier or water control device gains additional support. Specifically, the feature, given that the sides were steep enough, would have served to keep pigs downslope of the feature and, as a result, out of the swidden plots. It also would have helped keep pigs from going off into the bush and going feral. As a water control device, the feature may have functioned to protect the area downslope of the swidden plots from erosion caused by the upslope plots. In addition, as has already been discussed, the ditch would have channeled water into stream banks, depositing the soil nutrients and water from the above swidden plots, which may have acted to enhance the ability of the population to cultivate these stream beds, thus adding another potential mode of production along with the arboriculture downslope of Feature 38 and the swidden gardens above the feature.

When compared to the distribution of other features in the area, this divided landscape becomes more marked. For instance, although terraces are located upslope of Feature 38, the large majority of these do not have surface-scatters, or light pavings, of stone and/or coral that are commonly considered remains of structure floors. It is possible that these terraces were used to support structures, but these structures were probably different than those located on terraces downslope of Feature 38. Instead, the upslope terraces may have been used as activity areas associated with the cultivation of the nearby slopes, or perhaps as tool manufacturing areas. It is unlikely they were used as temporary habitation unless they are not contemporaneous with the rest of the settlement.

Yet another possibility is their use as agricultural features. Because many of the upslope terraces are located near or in stream banks, this type of sediment retention technique may have been necessary to support horticulture. Although possible for the above reasons, I consider their use as agricultural features unlikely due to their low density, even upslope of Feature 38, and the presence of some possible structural remains on a few of the terraces.

Contrary to terraces located upslope of Feature 38, the majority of terraces located downslope of the feature exhibit at least some signs of coral and/or stone paving. If these pavings can be taken as evidence of past structures, logic then suggests that the majority of residential remains were situated downslope of Feature 38, within what appears to be modified forest consisting of a number of economic plants.

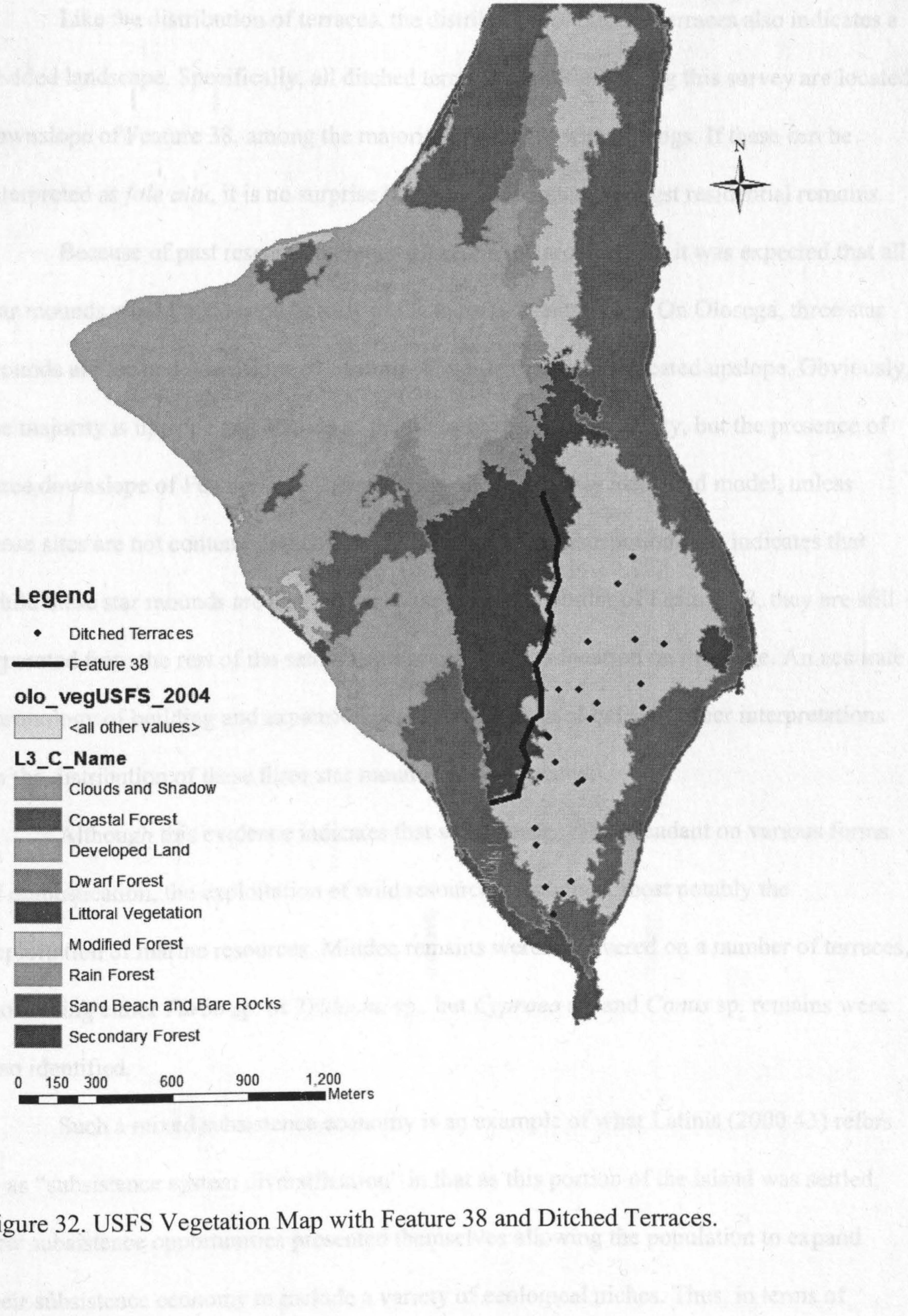

Figure 32. USFS Vegetation Map with Feature 38 and Ditched Terraces.

Like the distribution of terraces, the distribution of ditched terraces also indicates a divided landscape. Specifically, all ditched terraces identified during this survey are located downslope of Feature 38, among the majority of terraces with pavings. If these can be interpreted as *fale aitu*, it is no surprise that they are located amongst residential remains.

Because of past research on other islands in the archipelago, it was expected that all star mounds would be located outside of the main residential area. On Olosega, three star mounds are located downslope of Feature 38, while the rest are located upslope. Obviously, the majority is upslope and outside of the focus of residential activity, but the presence of three downslope of Feature 38 does not follow the previously identified model, unless those sites are not contemporaneous with the terraces. A distribution map indicates that while these star mounds are downslope of the proposed border of Feature 38, they are still separated from the rest of the settlement because of their location on the ridge. An accurate chronology of building and expansion needs to be proposed before further interpretations on the distribution of these three star mounds can be created.

Although this evidence indicates that subsistence was dependant on various forms of domestication, the exploitation of wild resources continued, most notably the exploitation of marine resources. Midden remains were discovered on a number of terraces, most being either *Turbo* sp. or *Tridacna* sp., but *Cypraea* sp. and *Conus* sp. remains were also identified.

Such a mixed subsistence economy is an example of what Latinis (2000:43) refers to as "subsistence system diversification" in that as this portion of the island was settled, new subsistence opportunities presented themselves allowing the population to expand their subsistence economy to include a variety of ecological niches. Thus, in terms of classification, the subsistence economy of this population cannot be grouped in the traditional farmer or hunter-gatherer groupings. Instead, a composite economy developed that would have acted as a risk management device to the environmental variability discussed below. As Latinis (2000) and Terrell (2002) note, arboreal subsistence development is based on the potential longevity of the population living in the area as tree cropping has few immediate positive effects as compared with swidden gardening. Those populations who develop such subsistence strategies understand the risks involved in living in their particular environment and were willing to counteract those risks for the benefit of future generations.

In short, the vegetation on Olosega, along with various archaeological features, informs us about the land use practices of the area. Specifically, Feature 38 serves as a border between the interpreted swidden horticulture plots and the tree cropping occurring within and around the residential area downslope of Feature 38.The USFS vegetation survey also indicates a small area of secondary forest located in the northeast portion of the project area. Because of the vegetation type and the lack of archaeological remains found during the survey, it is possible that this small area was also put under swidden cultivation.

Evidence of Social Differentiation

The analysis of features within the study area identified individual features and combinations of features that may inform us on the socio-political structure of the settlement and, therefore, answer these questions regarding evidence of social differentiation presented in Chapter 1:

1. *Are there individual features on Olosega that may reflect social differentiation?*

2. *Does the pattern of settlement as a whole reflect social differentiation?*

Feature 86, the large terrace with unique size and central position, suggests that some type of centralized leadership had developed within the settlement. This leadership, it is suggested, was exercised over the whole of the project area, not just the immediate area surrounding the terrace. The clusters within the terrace feature class, however, suggest that the settlement was also separated into different social entities that may resemble what Holmer (1980) refers to as wards. Thus, this poltical system appears to have had tiered leadership with multiple social positions, including commoners, chiefs, and a paramount chief, that were likely constantly negotiated by way of settlement position and competition. Although this political hierarchy appears to be present, it remains unclear whether or not it is similar to political systems recorded ethnographically (see Mead 1930).

Within this suggested political system, high ranking officials had substantial power. These individuals, specifically the paramount chief, had the ability to control and manage enough labor to substantially modify the landscape of Olosega. Additionally, the sheer number of star mounds present on Mata'ala ridge, which is a larger density than anywhere else in Samoa to date, indicates the power and nature of the political system. Competition was clearly a significant component of the political system.

Settlement Pattern

Patterns of village layout and orientation became apparent over the course of data analysis. In this section I will answer the questions presented regarding settlement pattern in Chapter 1 which were:

1. *Is settlement on Olosega nucleated or dispersed over the landscape and how does this compare with known archaeological and ethnographic examples?*
2. *Is it possible to identify archaeological correlates of modern village structures such as the* malae *or* fale tele*?*

Because no excavation was conducted as part of this project, everything is reliant on how one interprets surface features and the data associated with those features. In this thesis, I assume that all features are, for the most part, effectively contemporaneous and part of one settlement area, although clearly this needs to be tested.

From the analysis of surface features in the interior of Olosega, it would appear that some modern village structures can be identified in the archaeological record. Specifically, *a malae,* numerous *fale aitu,* and a small number of *fale umu* were identified in the settlement. Other features, such as *fale tele* and *fale o'o,* are likely present within the settlement, but the nature of this research does not allow for those designations as this time.

In terms of the overall pattern, centrality appears to be an important factor to the settlement layout of Olosega as the largest complex of terraces and walkways are centrally located, which is in keeping with the number of scholars that have argued such a point including Shore (1982), Herdrich and Clark (n.d.), and (Allen 1993). Although there appears to be a central feature on Olosega, it is difficult to establish the social relationships of other features with that central feature archaeologically. Moreover, the settlement on Olosega is much more dispersed than historic villages, making such comparisons difficult.

Because of the difference between archaeological and historical examples of settlement, it has been suggested that the historic model of settlement layout was created as a response to European contact; specifically, a response to European disease and subsequent population decline (Davidson 1969b). The layout and orientation observed by Shore (1982), specifically the linear binary opposition, may have developed with the creation of linear transportation (i.e., the road) and the introduction European trade goods from the ocean. At contact, people wanted to be closer to the coast in order to reap the benefits of European trade (Davidson 1969b), and it is not surprising, for that reason, that the most impressive structures were placed in the most visible areas for these visitors to see, such as a central location in the front of the village. It is reasonable to suggest that the population would rather visitors see their elaborate guest houses and high status dwellings than to see their simple cook houses and gardens. Although the bush appears to have always been the realm of the ghosts, it is the individual's perceptions of space that determine what is bush and what is not. The creation of a new household by an individual, for instance, is what delineates between the space of control and chaos.

The pattern suggested here for the inland of Olosega implies a special cognition based on a focal area for each political unit, be it a *pitonu'u,* a *nu'u,* or the household. Proximity to that central area, however, may not correspond with status, although this is extremely difficult if not impossible to detect in archaeological survey. It would be expected given a model such as the one proposed by Herdrich and Clark (n.d.) or Shore (1982) and excavation may enlighten us on this subject.

The settlement layout on Olosega appears to be more similar to other archaeological examples than historical examples in the archipelago, specifically the work conducted on Upolu by Jennings et al. (1982), Jennings et al. (1976), Jennings and Holmer (1980), and to some extent Wallin and Martinsson-Wallin (2007). Like Olosega, settlement on 'Upolu appears to cluster around large features, the clusters being commonly referred to as wards associated with the ethnographically documented *pitonu'u* (Holmer 1980; Jennings et al. 1982). Although I divide the Olosega data into clusters, and recognize these clusters as separate entities, I do this more cautiously than Holmer. As Jennings et al. (1982) have pointed out, some small modern villages have a number of high-ranking household that do not separate themselves into separate wards, but go on to indicate that separate wards may exist in the larger modern villages. The fact is, though, that these prehistoric settlements are continuously distributed across the landscape, and any clustering into wards or even household units is difficult to distinguish, especially when no stone walls exist to identify borders.

In the Mt. Olo tract, distinguishable borders were present in the form of paths or walls, but this does not appear to be the case on Olosega. The paucity of these boundaries on Olosega (although paths do connect features in some areas) suggests that land ownership may have been geared more toward the community than to the individual family. This type of land tenure seems to correspond with that seen in the proposed cultivated area, where no field divisions were observed. Just as likely, however, is that what was used to separate these units was not the same as on 'Upolu. The boundary may have been a row of trees or a wooden fence that did not survive into the modern era. In fact, a probable boundary was discovered during the coastal survey where large stone for construction is more accessible. Furthermore, more refined spatial data regarding the relationship between linear depressions and other features may yield additional patterns (for example see Features 22-24).

Another major difference between the two settlement areas is the apparent centralized feature, Feature 86, on Olosega, even though the settlement appears to be separated into different clusters. Although analysis of the Mt. Olo tract suggested a complex socio-political atmosphere (Holmer 1980), the analysis did not identify any feature that could have indicated centralized leadership for the whole settlement comparable to Feature 86 on Olosega.

Yet another difference between the settlement on Olosega and other settlements in Samoa is the nature of the features present, most notably the new feature class of ditched terraces. These features appear to be specialized sites, possibly serving a religious function, but their presence on Olosega only should not be taken as evidence that religious structures did not exist elsewhere in Samoa. Instead, their morphology is more of a response to the environmental conditions than cultural preference for form, as ethnographic examples well attest (Buck 1930; Stair 1897). Additionally, the presence of a possible *malae* on Olosega, although researchers have suggested their existence elsewhere in the archipelago, is suggested with more confidence in this study, and, thus, it appears that their existence extends back into the prehistoric period. Unfortunately, the area surrounding this feature was not surveyed completely.

Additionally, although Wallin and Martinsson-Wallin (2007) suggest interior settlement on ‘Upolu may have had a ritualistic function, this does not appear to be the case on either Olosega or Tutuila. For instance, many of the features on Olosega are ordinary habitation areas with pebble and coral pavings or manufacturing/production areas. On Tutuila, Eckert and Welch (2010) have shown that the inland settlement at Vainu’u was likely a temporary camp evolving into a small ordinary habitation through time. Although ritualistic settlements may have developed elsewhere, the data do not reflect such an interpretation for Olosega.

Settlement Distribution

Before any further studies of settlement patterns can be undertaken on Olosega, multiple hypotheses should be presented that can be tested. Because this thesis is the first attempt at identifying large scale settlement on Olosega, such models will be proposed to serve as guides for such future testing. These questions related to settlement distribution presented in Chapter 1 will be answered in this section:

1. *How does settlement change through time and across space?*
2. *What is the nature of settlement at different periods of time in different areas of the island?*
3. *If changes are present, what may cause these changes?*

Excavations conducted on both Ofu and Olosega indicate that coastal settlement occurred from colonization (ca. 2900 B.P.) until early in the 2nd millennium AD (Clark et al. in prep.; Hunt and Kirch 1988; Kirch and Hunt 1993). It is at this time that there appears to have been a change in settlement with coastal settlement appearing to reduce in size and become more dispersed in the late prehistoric period. Many of the coastal features appear to relate to isolated burning or cooking events (American Samoan Power Authority site files), or isolated household units.

At To'aga, Kirch suggests continued occupation until the historic period evidenced by house mounds and *masi* pits, but no absolute dates have confirmed this, and these features are dispersed over the landscape, not appearing to represent large scale occupation. Likewise, a number of features have been identified around Sili village in Olosega that have been linked to the 2nd millennium A.D. based on morphology, but no dates have confirmed this suggestion, and, regardless, the settlement is small (Best 1992; Moore and

Kennedy 1996). The survey conducted on Oge coastal plain also did not identify areas of large-scale settlement, but did indicate at least some use of the area. It must be understood, however, that these surveys were conducted in heavily vegetated areas, specifically around To'aga and Oge coastal plains, and it is possible a larger number of features actually exist but were not identified.

Although no chronometric dates are available from the interior settlement of Olosega, local oral history has it that the settlement dates to the late prehistoric period, and the nature of the remains seems also to suggest such a chronology. Thus, I suggest the following preliminary settlement pattern for Ofu and Olosega: 1) Early settlement was located primarily on the coast with some exploitation of resources in the interior. Subsistence, as with early colonizers in west Polynesia, was based primarily on the exploitation of the productive fringing reef around both islands, supplemented by limited horticulture and other food production activities. 2) At the beginning of the 2nd millennium A.D., at least a portion of the population shifted from the coast to the interior. The interior became the economic focal point of the settlement, but small scale exploitation of marine resources continued as indicated by the coastal features on Ofu and midden remains in the interior. Although settlement continued on the coast in the form of dispersed households (Best 1992; Kirch and Hunt 1993; Moore and Kennedy 1996), it did not reach the extent it previously had until the historic period. 3) Settlement then shifted back to the coast due either to increased trade relations or decreased population (Davidson 1969b). Although the interior continued to be cultivated, long-term occupation was limited, if it was even occurring.

In the past, settlement patterns like the one described above have been explained as a response to increased warfare. Specifically, settlement on the broad slopes of Olosega provides a natural defense to attack. This need for defense was traditionally attributed to attacks by Tongan invaders (see Davidson 1969b and Kikuchi 1963) but could also have been the result of interisland warfare within the archipelago as status competition increased. Although this interpretation is plausible, it is difficult to falsify because it is difficult to identify increased warfare in archaeological deposits, other than the development of fortifications. Nevertheless, viewshed analysis indicates that much of the ocean east of the island is seen from the primary settlement area, while the area to the west can only be seen from the ridge top. Because of this view, ample time would be available to prepare for an invasion from the neighboring islands of Ta'u and Ofu, making the settlement area much more defendable than any of the coastal plains on the island.

Recently, climatic events have been suggested to have had a great affect on human settlement in the central Pacific (e.g., Field 2004; Nunn 2000, 2003a, b, 2007; Nunn and Britton 2001; Pearl 2006). Relevant to this thesis is the proposed A.D. 1300 event posited by Nunn (2000, 2003a, b) and Nunn and Britton (2001), which holds that decreases in relative sea level and colder than normal temperatures diminished the productivity of central Pacific marine environments, impacting both subsistence and settlement patterns. If this A.D. 1300 event occurred, I suggest that such a significant event may have impacted Olosega coastal settlement as well. Although a coastal population could have cultivated the natural marsh located behind the village, it is unclear whether prehistoric taro production was practiced in this environment and if the marsh was even developed at this time. Because of these questions, it is reasonable to suggest that cultivation expanded, not intensified, into and throughout the interior of the island as marine resources became rarer as a result of environmental changes. From the interior of the island, the population would be able to exploit terrestrial resources, such as root crops, tree crops, and animal domesticates as well as continuing to exploit marine resources, but less intensely and with less reliance than before. In addition to bet-hedging by the exploitation of multiple ecological niches, the population developed storage devices, namely *masi* pits, as a response to environmental unpredictability. A mass population movement may not, however, have occurred. Instead, the only movement that would be necessary is enough of a movement to allow for the coastal environment to be exploited below its carrying capacity.

Although increased competition is not a necessary response to the above scenario, it may have occurred. Pressure on food resources would have caused the need to protect what resources the population could acquire. In the case of Olosega, especially if it were a large population movement, the best way to protect resources, and the human population, is to move into a naturally defensible position like the interior. Therefore, it was not the resource depression itself that caused settlement change; it was the human choices as a response to that depressed resource that caused society to change. Culture change is a continuous process that is affected by a variety of factors. The environment merely changed the direction of development by constraining, but not determining, that development. Thus, such changes cannot be thought of as catastrophic in nature, it was a mere response.

This pattern of subsistence and landscape change is not isolated to Olosega. Increased sediment rates have been documented in a number of valleys on Tutuila and Ofu including 'Aoa (Clark and Michlovic 1996), A'asu (Pearl 2006) and at To'aga (Kirch and

Hunt 1993). In response to this pattern, Pearl (2006), for Tutuila, has proposed that a major shift in the mode of production, namely expanded cultivation, correlates with a major climatic event, suggesting that the motive behind expansion was landscape change in the Tutuila valley floors. Olosega, on the other hand, is much different environmentally than the alluvial valley formation on Tutuila. Because of these environmental differences, I propose that the expansion of cultivation and settlement in the interior impacted by decreased marine productivity, specifically reef resources, and not by valley infilling or other landscape alterations.

The traditional climatic data employed for the modeling of past climate in Oceania have recently been scrutinized (Allen 2006). According to Allen (2006:527), data suggest that the A.D. 1300 event was actually the inverse of what Nunn (2000, 2003a, b, 2007) has suggested; specifically, sea temperatures were warmer during this time. Even with these changes to the model, Allen concludes that this event, with its increased sea temperature and ENSO frequency, would still have been very disruptive to the marine ecosystem, thus, affecting human subsistence strategies.

To date, evidence for such decreases in the productivity of marine environments has been limited in Samoa. This may be due to the lack of midden sites dating to the 2nd millennium A.D., but even those sites that do date to this period, specifically Fatu-ma-Futi, have not been interpreted to show any evidence of lower marine resource productivity at this time (Morrison and Addison 2008), which was explained as perhaps being unique to Fatu-ma-Futi given its environment and the nature of ENSO activity in Samoa as compared to other parts of the Pacific. The data used in the analysis of Morrison and Addison (2008:26; Table 1), however, exhibits a substantial decline in total shellfish abundance between Layers II and III dated to the 2nd Millennium A.D., including three key species in central Pacific faunal assemblages: *Trochus* sp., *Turbo* sp., and *Tridacna* sp. Although such decreases in abundance could be due to a multitude of reasons, both environmental and cultural (Morrison and Addison 2008:31), it remains plausible that the A.D. 1300 event had some impact.

Similar to a decrease in available resources, an increase in human population could have caused the settlement shift. The principle is similar to resource depression, namely that the particular area could no longer support the human population requiring a human response. It would be expected that if this were the case all other available land would also be occupied, which does not seem to be indicated by available data.

Recently, Addison and Matisoo-Smith (2010) have proposed a substantial population movement into the area in the middle of the 1st millennium A.D. They propose that this migrating group was able to take control of the region by conquest, and, thus, it would not be surprising that such a population would prefer to establish a settlement in a defensible position such as the interior of Olosega. Additionally, they argue that a change in land use practices may have been brought about by these migrants (2010:6).

In addition to economic or migratory influences, culture could surely have been a factor, such as the establishment of a new settlement by a junior line. Cultural influence, however, cannot be directly tested by further archaeological work. If, however, no other models seem to suffice, such untestable interpretations become more appealing. Until then, it is better to examine models by testing derived hypotheses than to settle for an untestable interpretation.

CHAPTER 7. CONCLUSIONS

As one of the research goals, I have identified, described, and interpreted a prehistoric Polynesian settlement in the inland portion of Olosega Island. This settlement, which includes habitation terraces, star mounds, depressions, ditches, and a new feature class termed ditched terraces, is dispersed across the landscape in a discernable pattern. Specifically, the vast majority of what has been interpreted as residential remains is located downslope of a large ditch, Feature 38, that stretches across the southern half of the island's interior. Mixed among these residential remains are a number of economic plants traditionally used by Polynesian cultures. Meanwhile, upslope of Feature 38, much of the vegetation consists of secondary forest indicative of the landscape's past use as swidden gardens, likely by the inhabitants of the residential remains downslope. These two areas are tied into the same archaeological landscape by Feature 38, which appears to have been a barrier used either to keep pigs from destroying the upslope gardens or to keep the products of erosion from building up on the residential features downslope.

The complementing nature of this landscape with its ability to produce a wide variety of food stuffs that occupy a number of ecological niches is the result of a complex interplay and evolution that took place over hundreds of years between the environment and the human inhabitants of that environment. Included within this evolution is a process of choices made by the individuals within the population that allows the human system to inhabit and exploit the environment in the way that results in what is identifiable archaeologically. It is these choices, not the particular environment of an area, which will eventually lead to the occurrence of certain events. In other words, a specific environment alone will never determine an event to take place. Environments, however, clearly have an impact, but its role in shaping a human cultural system is not one of ultimate causation, but, instead, is one of many factors within a process that works within developmental constraints. Human cultures in the Pacific, therefore, do not only adapt to their environments, but more broadly co-evolve with them within a non-linear and dynamic system (McGlade 1995; Rooselvelt 1999). Because this process is part of a complex system, it is unpredictable and small changes to the system greatly affect the outcomes.

I began this thesis with a quote by Roy Rappaport regarding the human-environment relationship in which he describes the relationship as one of adaptation. I then posed the question of whether or not the relationship should be viewed in such a way. By way of the research presented here, I conclude that there are significant difficulties in terming this human-environment relationship one of mere human adaptation, it is preferred that such interactions be thought of in a non-linear (McGlade 1995), or more robustly evolutionary, way, much like the process of domestication (O'Brien and Wilson 1988; Rindos 1980) wherein both environments and humans adapted to each other while also evolving in different ways that may not be adaptive. This systemic relationship is continuously unstable and not in a state of stasis or equilibrium like once thought (McGlade 1995).

The island of Olosega has provided a case study of this evolutionary relationship between humans and their environment, but this project is merely preliminary as more work needs to be conducted to better understand the connection between the historical ecology and cultural history of the area. For instance, future investigations need to focus on understanding the nature of coastal settlement in the last 1000 years, while complimentary work needs to focus on resolving chronological issues of interior production and eventual settlement. Additionally, climatic and environmental data are needed to better understand the local sequence of landscape change and resource availability, specifically the collection of data that informs us on marine resource availability in the last millennium.

In conclusion, although the data presented and interpreted in this thesis contribute to the archaeology of Samoa, the Pacific, and archaeology as a whole, much work remains to be conducted in this area. I describe in this thesis the end point of a complex coevolutionary relationship between humans and their environment in an island environment while also illustrating the continued potential of Olosega to provide a case study to understand this complex interaction through time. The interpretations and models presented within this thesis are not supposed to be the answer to what actually happened. The purpose of this thesis, instead, is to provide preliminary models that can be tested in order to gain a better understanding of the data. In essence, this study is a baseline meant to show the potential of Olosega in providing important archaeological data. Further archaeological and ecological investigations in Samoa and the Pacific will continue to provide data on the choices that different populations make to respond to environmental change and variability.

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APPENDIX I. TABLES OF MAJOR FEATURE CLASSES

Table 2. Terraces.

Feature Number	Length	Width	Northing	Easting	Area	Size Class	Stone?	Coral?
2	20.85	4.41	8430914	649658	91.9485	1	Yes	No
4	34.58	15.99	8430897	649571	552.934	4	No	No
5	26.31	10.7	8430937	649554	281.517	3	Yes	No
6	23.18	8.05	8430975	649532	186.599	2	No	No
8	30.49	6.01	8431000	649516	183.245	2	Yes	No
9	22.97	7	8431075	649549	160.79	2	No	No
10	32.5	9.76	8431086	649508	317.2	3	No	No
11	24.29	13.64	8431107	649443	331.316	3	No	No
12	30	10	8431157	649457	300	3	No	No
13	27	15	8431207	649460	405	3	Yes	Yes
14	15	10	8431260	649410	150	2	No	No
15	24.07	10.39	8431318	649412	250.087	3	yes	No
16	8	6.7	8430950	649726	53.6	1	Yes	Yes
17	17.34	6.38	8430975	649683	110.629	2	Yes	No
18	17.6	13.6	8430973	649675	239.36	3	Yes	Yes
19	52	16	8430966	649641	832	5	Yes	Yes
20	21.43	7.59	8430967	649594	162.654	2	Yes	No
21	11.8	10	NA	NA	118	2	No	No
22	8.8	8.3	8431021	649678	73.04	1	Yes	Yes
23	6.15	4.4	8431010	649684	27.06	1	Yes	Yes
24	36	8.34	8431034	649670	300.24	3	Yes	No
25	18.43	5	8431070	649652	92.15	1	Yes	Yes
26	26	7.7	8431061	649644	200.2	3	Yes	Yes
27	32	7	8431059	649622	224	3	no	No
28	35.91	12.68	8431086	649610	455.339	3	No	No
29	6	6	8431105	649595	36	1	Yes	No
30	42	12.4	8431122	649607	520.8	4	Yes	yes
31	26.5	12.7	8431173	649584	336.55	3	Yes	Yes
32	37	7.2	8431205	649585	266.4	3	Yes	Yes
33	34.55	11.1	8431252	649574	383.505	3	Yes	No
34	14.2	9.2	8431280	649580	130.64	2	Yes	no
35	48.4	17.5	8431307	649579	847	52	Yes	Yes
36	43	13.8	8431371	649576	593.4	4	Yes	Yes
39	32.4	11	8431380	649404	356.4	3	Yes	Yes
40	29	12.6	8431568	649308	365.4	3	Yes	No
41	13.4	6.8	8432153	649143	91.12	1	No	No
42	63	9.2	8431127	649761	579.6	4	Yes	Yes
43	14.6	8	8431065	649785	116.8	2	Yes	Yes
44	9	6.3	8431117	649811	56.7	1	Yes	Yes
45	11.6	5.8	8431182	649748	67.28	1	Yes	Yes
46	19.1	8.5	8431164	649728	162.35	2	Yes	yes

Table 2. Continued.								
47	40	11.6	8431176	649723	464	3	Yes	Yes
48	46	18.5	8431212	649695	851	5	Yes	Yes
49	31.5	9.6	8431248	649686	302.4	3	Yes	Yes
50	47.6	12.1	8431286	649614	575.96	4	Yes	Yes
51	57	8	8431125	649629	456	3	Yes	Yes
52	15.1	6.2	8431200	649607	93.62	1	Yes	Yes
53	47.6	13.5	8431175	649643	642.6	4	Yes	Yes
54	23.6	7.6	8431250	649655	179.36	2	Yes	Yes
55	7	5.2	8431223	649651	36.4	1	Yes	Yes
56	NA	NA	8431185	649686	0	0	NA	NA
57	12.9	9.7	8431357	649616	125.13	2	Yes	Yes
58	25.8	13.6	8431353	649659	350.88	3	Yes	Yes
59	13.7	6.9	8431328	649738	94.53	1	Yes	Yes
60	28.6	12.3	8431352	649720	351.78	3	Yes	Yes
62	16.6	10.8	8431399	649697	179.28	2	Yes	Yes
63	7.8	6.7	8431405	649689	52.26	1	Yes	Yes
65	22.1	7.4	8431410	649680	163.54	2	Yes	Yes
66	20.8	10.5	8431408	649659	218.4	3	Yes	Yes
67	19.2	7.9	8431433	649640	151.68	2	Yes	Yes
68	43.5	12.7	8431450	649631	552.45	4	Yes	Yes
69	37	14.7	8431472	649594	543.9	4	Yes	Yes
71	44.9	12.4	8431498	649625	556.76	4	Yes	Yes
72	29.1	8	8431507	649556	232.8	3	Yes	Yes
73	15.7	7.9	8431487	649542	124.03	2	Yes	Yes
74	18.8	9.8	8431459	649545	184.24	2	Yes	Yes
75	29.6	10.1	8431487	649500	298.96	3	Yes	Yes
76	27.6	7.8	8431523	649536	215.28	3	Yes	Yes
77	19.2	12	8431467	649471	230.4	3	Yes	Yes
78	41.5	11.3	8431632	649480	468.95	3	Yes	No
80	43.1	11.2	8431135	649692	482.72	3	Yes	Yes
81	59	8.3	8431146	649644	489.7	3	Yes	Yes
82	61	18	8431157	649620	1098	6	Yes	Yes
84	27.6	7.2	8431554	649583	198.72	2	Yes	Yes
86	74	27.5	8431591	649626	2035	6	Yes	Yes
88	21.1	8.4	8431497	649734	177.24	2	Yes	Yes
89	11.8	8.6	8431484	649734	101.48	2	Yes	Yes
90	29.5	18.1	8431480	649835	533.95	4	Yes	Yes
91	7.3	6.7	8431469	649849	48.91	1	Yes	No
92	24.6	13.9	8431567	649830	341.94	3	Yes	Yes
93	200	14.3	8431741	649889	2860	6	Yes	Yes
94	34.3	8.9	8431698	649878	305.27	3	Yes	No
95	6.3	4.9	8431698	649908	30.87	1	Yes	Yes
96	11.6	5.1	8431321	649698	59.16	1	Yes	Yes
97	22	6.2	8431390	649701	136.4	2	Yes	Yes
98	48.4	11.5	8431607	649694	556.6	4	Yes	Yes
99	45	15.2	8431625	649720	684	4	Yes	Yes

Table 2. Continued.

101	26.2	10.2	8431617	649766	267.24	3	Yes	Yes
102	23.7	15.7	8431639	649805	372.09	3	Yes	No
103	37	15	8431706	649743	555	4	Yes	Yes
105	37.3	18	8431768	649742	671.4	4	Yes	Yes
106	27.3	11.7	8431743	649701	319.41	3	Yes	Yes
107	19.3	10.2	8431707	649665	196.86	2	Yes	Yes
108	27.7	15.1	8431724	649656	418.27	3	Yes	Yes
109	17.3	7.8	8431745	649618	134.94	2	Yes	No
110	18.5	6.7	8432501	649531	123.95	2	No	No
111	20.2	9.9	8432467	649497	199.98	2	No	No
112	42.2	8.8	8432303	649527	371.36	3	Yes	No
113	15	9	8432220	649561	135	2	No	No
114	NA	NA	8432095	649563	0	0	No	No
115	30.7	10	8431385	649600	307	3	Yes	Yes
116	25	7.3	8431405	649599	182.5	2	Yes	Yes
117	27	21.8	8431659	649655	588.6	4	Yes	Yes
118	23.5	8.8	8431690	649641	206.8	3	Yes	Yes
121	30.3	8.3	8431822	649532	251.49	3	Yes	No
122	13.8	7.5	8431788	649474	103.5	2	No	No
123	15.8	8.2	8431821	649464	129.56	2	Yes	No
124	16.6	5.7	8431790	649438	94.62	1	Yes	No
125	17.7	7.9	8431817	649426	139.83	2	No	No
126	16.8	5.3	8431832	649417	89.04	1	Yes	No
127	15.9	4.3	8431824	649374	68.37	1	No	No
128	14.8	4.6	8431831	649343	68.08	1	Yes	No
129	17.8	4.6	8431705	649415	81.88	1	No	No
130	38.2	8.2	8431664	649427	313.24	3	Yes	No
131	19.6	4.6	8431686	649451	90.16	1	Yes	No
132	21.1	8.6	8431709	649483	181.46	2	No	No
133	28.3	10.9	8431729	649495	308.47	3	Yes	No
134	21.9	11.2	8431702	649584	245.28	3	Yes	Yes
136	15.9	11.5	8431654	649608	182.85	2	Yes	Yes
137	15.8	8	8431649	649609	126.4	2	Yes	Yes
138	12.2	3.1	8432508	649061	37.82	1	Yes	No
139	6.8	4.5	8432576	649039	30.6	1	No	No
140	16.4	3.4	NA	NA	55.76	1	No	No
141	12.9	6.9	8432754	648860	89.01	1	No	No
142	24.2	16.1	8431756	649726	389.62	3	Yes	Yes
143	31.3	12.2	8431724	649732	381.86	3	Yes	Yes
144	30.7	16.6	8431693	649821	509.62	4	Yes	Yes
146	25.9	16.1	8431648	649877	416.99	3	Yes	Yes
148	12.2	10.3	8431738	649974	125.66	2	Yes	Yes
149	27.8	15.5	8431753	649965	430.9	3	Yes	Yes
150	29.1	15.3	8431722	649927	445.23	3	Yes	Yes
151	34.2	11.9	8431789	649988	406.98	3	Yes	Yes
152	47	19.1	8431771	649952	897.7	5	Yes	Yes

Table 2. Continued.

154	39.9	13.8	8431828	650023	550.62	4	Yes	Yes
155	29.5	10.4	8431831	650002	306.8	3	No	No
156	17.4	12.3	8431892	649961	214.02	3	Yes	Yes
157	31.1	16.3	8431957	649951	506.93	4	Yes	Yes
160	29.2	9.1	8431973	650048	265.72	3	Yes	No
161	10.2	7.1	8431947	650062	72.42	1	No	No
162	35.5	13.7	8431958	650091	486.35	3	Yes	Yes
163	27	15.6	8431949	650113	421.2	3	No	Yes
164	18.2	10	8431894	650117	182	2	Yes	Yes
165	22.2	15.5	8431902	650178	344.1	3	Yes	Yes
166	23.3	8.4	8431850	650215	195.72	2	Yes	Yes
167	20.2	7.3	8431955	650257	147.46	2	No	No
168	21.8	13.3	8431975	650264	289.94	3	No	Yes
169	31.7	13.3	8431975	650203	421.61	3	No	Yes
170	27.4	14.9	8432018	650219	408.26	3	No	Yes
171	18.4	10.6	8432009	650235	195.04	2	Yes	No
172	25.8	6.4	8431929	649618	165.12	2	No	No
173	25.2	10.1	8431981	649638	254.52	3	Yes	No
174	26.5	9.3	8431963	649661	246.45	3	Yes	No
175	30.4	13.7	8431909	649649	416.48	3	Yes	No
176	15.5	5.8	8431979	649676	89.9	1	Yes	No
177	20.9	11.8	8431982	649693	246.62	3	Yes	Yes
178	20.4	7.21	8431951	649696	147.084	2	Yes	Yes
180	27.8	8.1	8431981	649735	225.18	3	Yes	Yes
181	26.1	9.1	8431950	649737	237.51	3	Yes	Yes
182	37.1	12.5	8431949	649773	463.75	3	Yes	Yes
183	21.1	9.9	8431998	649770	208.89	3	Yes	Yes
184	17.2	12.7	8432057	649787	218.44	3	Yes	No
185	19.8	12.1	8432095	649819	239.58	3	Yes	Yes
186	23.8	20.4	8432094	649858	485.52	3	Yes	Yes
187	27.6	15.4	8432112	649846	425.04	3	Yes	Yes
188	185	10.2	8432113	649890	1887	6	Yes	Yes
189	22.2	12.1	8432156	649894	268.62	3	Yes	Yes
190	27.8	17.5	8432194	649890	486.5	3	Yes	Yes
192	46.7	15.9	8432266	649951	742.53	5	Yes	Yes
194	18.9	22.8	8432332	649924	430.92	3	Yes	No
195	30.6	21.6	8432354	649917	660.96	4	Yes	No
196	28.6	11.2	8431208	649485	320.32	3	Yes	Yes
198	35	7	8431162	649563	245	3	No	No
200	13.6	7.4	8431761	649465	100.64	2	No	No
201	18.2	5.5	8431883	649302	100.1	2	No	No
202	27.4	6.6	8431933	649292	180.84	2	yes	No
203	19.7	NA	8431943	649327	0	0	No	No
204	28.5	7.5	8431931	649287	213.75	3	Yes	Yes
205	16	7.5	8431963	649307	120	2	No	No
206	22.5	5.3	8431951	649344	119.25	2	No	No

Table 2. Continued.								
207	30	11.6	8432005	649459	348	3	No	No
208	27.8	NA	8432020	649498	0	0	Yes	No
209	19.3	4.5	8432016	649533	86.85	1	No	No
210	15	NA	8432028	649526	0	0	No	No
211	25.3	8	8432013	649547	202.4	3	Yes	No
212	23.4	12.4	8432038	649557	290.16	3	No	No
213	19.3	9	8432028	649568	173.7	2	yes	no
214	26	9	8432028	649533	234	3	Yes	No
215	22.7	6.8	8432033	649471	154.36	2	Yes	No
217	14.6	4	8432053	649504	58.4	1	Yes	Yes
218	26.5	7.4	8432032	649462	196.1	2	Yes	Yes
219	23	7	8432065	649446	161	2	Yes	Yes
220	13.8	7.9	8432061	649381	109.02	2	No	No
221	26	6.7	8432089	649394	174.2	2	Yes	No
222	20.8	9.8	8432142	649322	203.84	3	No	No
223	NA	NA	8431166	649498	0	0	NA	NA
224	13.3	11.7	8431900	649232	155.61	2	No	No
225	NA	NA	8431084	649562	0	0	NA	NA
226	NA	NA	8431035	649567	0	0	NA	NA
227	26	6	NA	NA	156	2	NA	NA

Table 3. Ditched Terraces.

Feature Number	Length	Width	Northing	Easting	Area
1	35.7	21.64	8430889	649599	772.548
7	35.57	21.9	8430995	649571	778.983
37	28.3	14	8431429	649551	396.2
61	12	11.6	8431400	649700	139.2
64	10.9	11.2	8431417	649716	122.08
70	25.6	15.4	8431488	649609	394.24
79	11.4	8.3	8431018	649674	94.62
83	22.2	15.4	8431585	649582	341.88
85	18.9	16.4	8431594	649576	309.96
100	19.5	13	8431656	649748	253.5
120	15.7	23.5	8431774	649622	368.95
104	17.4	17.6	8431719	649776	306.24
119	18.2	18.2	8431774	649702	331.24
147	21.5	14.1	8431700	649954	303.15
153	35	15	8431795	649946	525
158	25.6	30.9	8431970	649921	791.04
159	17.2	26.5	8431953	650035	455.8
179	25.4	17.3	8431961	649740	439.42
191	29	17.1	8432191	649854	495.9
193	28.7	19.6	8432296	649914	562.52
197	20.5	24.8	8431229	649527	508.4
199	24	12.5	8431160	649535	300

Table 4. Star Mounds.

Site Number	Length	Width	Northing	Easting	Projections	Coral Facing
AS-12-019	22.7	15	8431179	649424	6	No
AS-12-020	25.6	17	8431204	649423	6	No
AS-12-021	28.8	14.1	8431303	649371	8	No
AS-12-022	24	17.4	8431374	649333	6	No
AS-12-023	27.4	12.9	8431439	649324	5	No
AS-12-024	40	12.2	8431496	649317	4	No
AS-12-025	28.7	15.8	8431642	649291	4	No
AS-12-026	23	9	8431724	649281	3	No
AS-12-027	27.8	15.2	8431818	649246	3	No
AS-12-028	35	14.5	8431837	649250	6	No
AS-12-029	27	15	8431911	649211	7	Yes
AS-12-030	28.6	18	8431960	649182	8	No
AS-12-031	22.8	11.5	8432035	649160	8	Yes?
AS-12-032	22	10.5	8432092	649151	5	No
AS-12-041	28.3	14.4	8432212	649141	6	No
AS-12-042	23.4	10.5	8432245	649119	8	Yes?
AS-12-043	25.7	10.5	8432311	649121	10	No
AS-12-044	19.8	9.2	8432342	649124	9	No
AS-12-045	21.3	9.2	8432379	649115	5	No
AS-12-046	18.6	8.9	8432398	649093	4	No
AS-12-047	22.9	13.1	8432453	649080	3	No
AS-12-048	15.1	16.4	8432546	649047	4	No
AS-12-049	17.1	10.1	8432768	648866	6	No

Table 5. Depressions.

Feature	Length	Width	Depth	Comments
7	4	4		Stone lined on ditched mound
18				Small
28	5.84	5		One of three
28	3.27	3.97	0.25	One of three
28	2.19	2.5	0.28	One of three
69	7.5	4.1	0.5	
97	3	3	0.25	
98				Small
99	2	2		
144	1.5	1.5	0.2	Boulders around depression
145	7.3	3.8	0.6	
104				Large
154			0.20-0.30	Large Diameter
157	5.0-6.0	5.0-6.0	1.0-1.5	
158				Stone lined on ditched mound
165	8.7	7.2	1	
179				Small
195	2	2	1	
203	0.5	0.5	0.2	
213				Small

APPENDIX II. NEAREST NEIGHBOR ANALYSIS

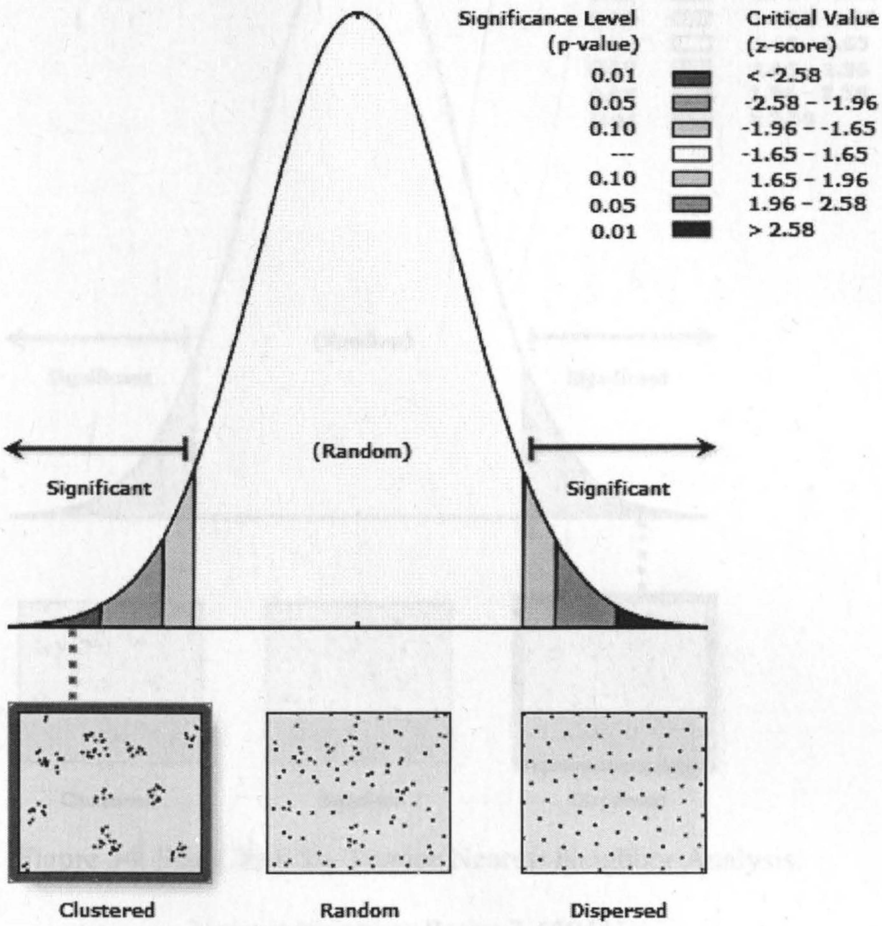

Figure 33. Terrace Nearest Neighbor Analysis.

Nearest Neighbor Ratio: 0.658794
z-score: -9.115180
p-value: 0.000000
<u>Terraces</u>

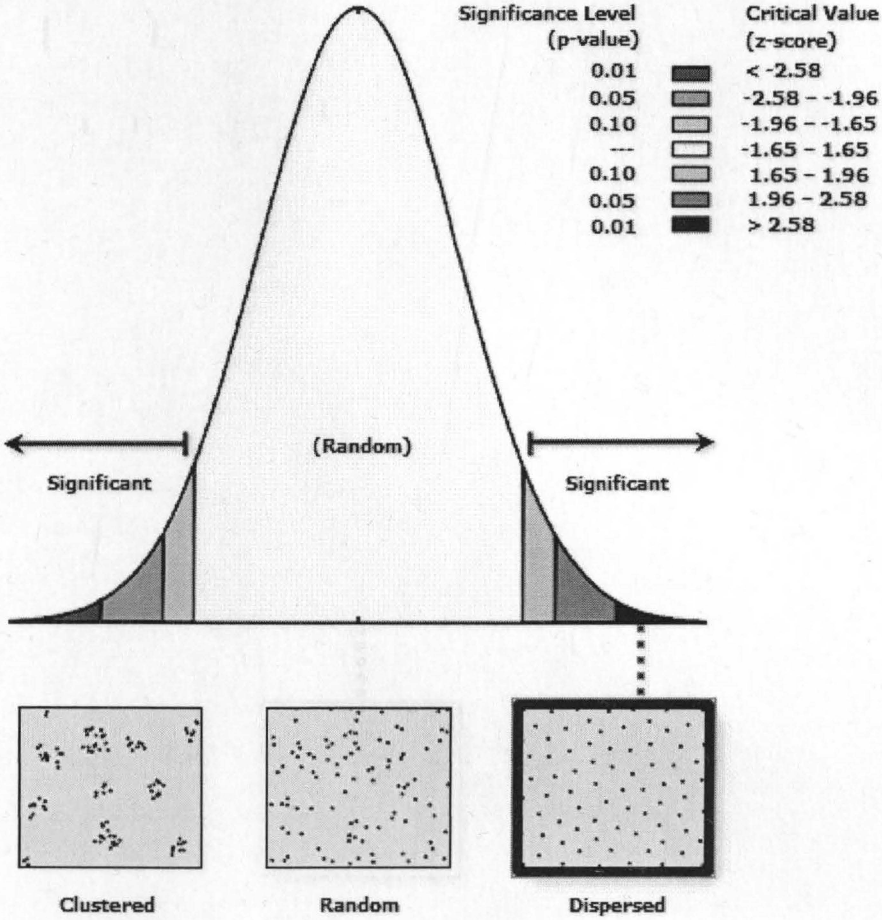

Figure 34. Size Class Six Terrace Nearest Neighbor Analysis.

Nearest Neighbor Ratio: 3.459431
z-score: 9.410130
p-value: 0.00000
Size Class 6 Terraces

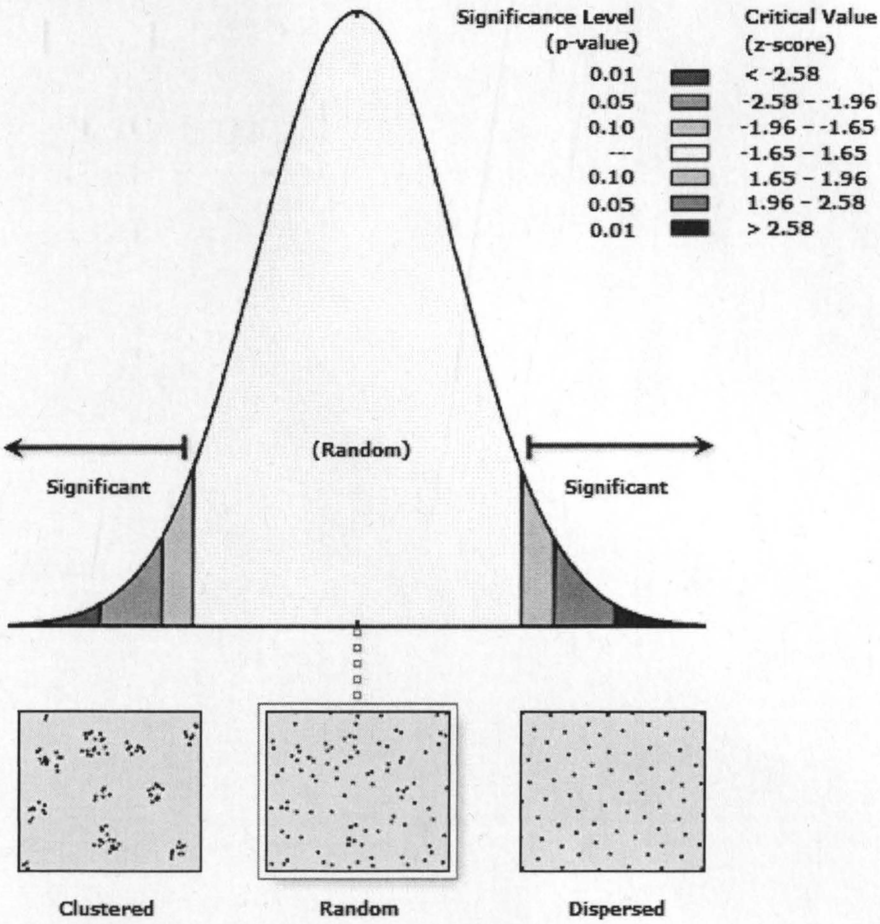

Figure 35. Ditched Terrace Nearest Neighbor Analysis.

Nearest Neighbor Ratio: 1.133956
z-score: 1.201998
p-value: 0.229364
<u>Ditched Terraces</u>