SPATIAL SIGNATURES OF CEREMONY AND SOCIAL INTERACTION: GIS EXPLORATORY ANALYIS OF TULE CREEK VILLAGE (CA-SNI-25) SAN NICOLAS ISLAND, CALIFORNIA

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ABSTRACT

Spatial Signatures of Ceremony and Social Interaction: GIS Exploratory Analysis of Tule Creek Village (CA-SNI-25), San Nicolas Island, California

By

Richard B. Guttenberg

The spatial patterning of artifacts and features excavated from Tule Creek Village (CA-SNI-25), San Nicolas Island, CA provides an opportunity to analyze the intrasite correlations between artifact types, materials, and features, and allows for inferences to be made regarding the context and use of space at a late Holocene village. Excavations at East Locus at CA-SNI-25 have yielded evidence of trade with other islands as well as evidence suggesting complex ceremonial activity, such as dog and bird burials, large hearths, stacked stone features, and multiple pits which vary in size, shape and depositional content. The artifact assemblage, favorable geographic setting, and inferred ceremonial activity observed at East Locus in comparison to other late Holocene sites on San Nicolas suggest that CA-SNI-25 served as the primary center for social and economic interactions on the island during a time when the intensification of complex spheres of interaction are observed throughout the southern California Bight.

I use intrasite GIS and exploratory methods, such as spatial autocorrelation and hot-spot analysis to isolate distributions of formal artifacts and features and examine the organization of space in both ceremonial and utilitarian contexts. This provides a visual and interactive platform conducive to analyzing the abundant data collected during open area excavations at CA-SNI-25. The statistical analysis allows for inferences to be made regarding the manufacture and use of artifact types and toolkits in ceremonial and

utilitarian contexts, as well as the import and use of exotic materials. Ultimately, spatial analysis using intrasite GIS reveals possible linkages of artifacts and features, as well as patterns of spatial and temporal variability in technology, subsistence, and behavior at a village on San Nicolas just prior to European contact.

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This thesis is dedicated to my late father Herschel, who never had the opportunity to complete his education. He would be so proud of my accomplishment, but have no idea what any of this means.

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Research Context

Introduction

The interpretation of spatial patterning observed in archaeological deposits has been an approach used by archaeologist for decades (Hodder and Orton 1976; Wallon 1973, 1974). Recognizing patterns in archaeological data was initially a practice of observation, intuition, and speculation until methods were developed that allowed archaeologists to quantify patterns of spatial association between artifacts and ecofacts recovered from excavations (Bartlett 1974; Dacey 1963, 1973). The spatial analysis of archaeological data reveals patterns of human activities and behaviors that shed light on the social interactions and adaptations that took place in prehistory. Understanding how human populations organized and defined their habitations and living spaces is key to understanding the behaviors associated with their everyday practice and adaptive strategies.

Early methods of spatial studies were developed around complex mathematical models developed for other sciences (Bartlett 1974; Clark and Evans 1954; Cliff and Ord 1975; Cox 1981; Dacey 1963; Getis 1964). Many of these studies focused on the interpretation of artifacts and faunal remains uncovered from early Paleolithic house floors (Hodder and Orton 1976; Whallon 1973, 1974). Intrasite spatial analysis at this scale reveals patterns of domestic activities and use areas in both family-unit habitations and multi-family village sites. Additionally, middle range theoretical approaches were employed to spatial studies by using ethnographic comparisons of hunter gatherer village organization and activity areas, both on an intrasite and landscape scale (Binford 1980, 2001). This research proved to be invaluable, but limited in its comparative approach, assuming that human adaptive strategies fall into universal and descriptive models. Spatial studies are best approached with large datasets and in specific cultural contexts in order to best interpret the archaeological spatial patterning.

As spatial archaeology developed in practice, the limiting factor in conducting spatial studies with large datasets was the difficulty in working within the mathematical and statistical models (Kvamme 1989; McCoy and Ladefoged 2009). Until the introduction of easily accessible and user-friendly computers and software products, much of this work was limited in scope due to the complexity of the models. Archaeologists seized on the technological advances in other sciences and employed methods borrowed from geology, biology, chemistry, physics, and geography. Multiple and interdisciplinary methods are now widely used in archaeology, as researchers employ an archaeometric approach to their studies. Among these methods are Geographic Information Systems (GIS), software systems developed by geographers for global, regional, and local mapping.

The use of GIS in archaeological research has greatly increased in recent years (Connoly and Lake 2006; Kvamme 1999; Lock and Stanic 1995; Wheatley and Gillings 2002). In Europe and the Middle East GIS is widely used and has become a basic part of the archaeological toolkit (Katsianis et al. 2008; Knabb 2008; Lawson 2007; Lieff 2003; McCoy and Ledefoged 2009; Sharon et al. 2004). The application of GIS in New World archaeology is less common in comparison and is generally limited to regional analysis (Kvamme 1999, 1995; McCoy and Ladefoged 2009; Pletka 2005). This holds true for archaeological research on the California Channel Islands.

Regional applications of GIS on the Channel Islands typically include settlement analysis, resource procurement, and landscape archaeology (Kennett 2005). Less common is the application of GIS in an intrasite scale. This is due, in part, to a general lack of large-scale excavations on the Channel Islands in recent years. Intrasite analysis is best suited for open block excavations that expose a significant portion of an archaeological site (Guttenberg et al. 2013). There are a handful of previously excavated sites on several of the Channel Islands that make excellent candidates for intrasite analysis, much of the research on the islands is now limited to testing for management purposes.

On San Nicolas Island, a few sites have been excavated using large open block grids. Fore example, the Tule Creek Village (CA-SNI-25), a large late Holocene village and perhaps the last one occupied by native people was excavated in contiguous blocks. In this thesis I use GIS exploratory analysis to explore spatial associations of artifacts and raw materials at CA-SNI-25. I further contend that GIS can be used as an effective tool for conducting spatial analysis on an intrasite level elsewhere on San Nicolas Island and other site locations on the Channel Islands that were investigated with large open-block excavations.

Several studies using GIS and spatial analysis have been conducted on San Nicolas Island (Afifi 2000; Casaus 1998; Martz 2002; Merrill 2004). These studies focused on island-wide landscape analysis, comparing site and resource distributions. Martz (2002) conducted the initial GIS work on the island in the 1990s, which involved pedestrian surveying and mapping sites using Global Positioning System (GPS). These studies led to the creation of GIS data for the island’s archaeological sites and features.

Data from that initial survey are incorporated into my current research. Additional work followed that utilized the GIS data compiled to describe the settlement patterns on the island (Afifi 2000). Other spatial studies have been conducted recently at CA-SNI-25 utilizing mathematical models as well as statistical analysis (Merrill 2004; Cannon 2006).

I use GIS and cluster analysis to further examine the associations of artifacts and features at the site. I have recently applied these methods to support previous research (Guttenberg et al. 2013). My research highlights the use of GIS exploratory analysis in tandem with multiple methods in order to better understand functional linkages between artifacts and features. The comparable clustering of sandstone saws and circular shell fishhooks, for instance, led me to confirm the associations of these artifacts demonstrated by recent experimental and analytical methods (Kendig et al. 2010).

I expand on my previous research by incorporating a larger dataset. I conduct an aggregate lithic analysis, comparing the distributions of local and extra-local toolstone and the distributions of formal tools crafted from imported lithic material. The distributions of local vs. extra-local lithics may show variations in toolmaking activity areas based on material type. The presence of imported lithic material indicates regional trade occurring at CA-SNI-25. Any variations in the spatial distributions of lithic materials observed could indicate a different approach to tool manufacturing based on material type.

I also examine the distribution patterns of red ochre, calcite, and quartz crystals within a particular locus on the site that shows evidence of ceremonial activity. Knierim and others (2012) describe the use of these materials in ceremonial contexts. The patterns of distribution in comparison with the various features that are abundant at the site may demonstrate spatial signatures in the organization of ceremonial space at CA-SNI-25.

I employ a visual, quantitative, and contextual approach to exploring the use of space at CA-SNI-25. This methodology provides an opportunity to shed light on the possible linkages of these artifacts, as well as patterns of spatial and temporal variability in technology, social interaction, and subsistence at Tule Creek Village just prior to European contact.

Research Goals and Theoretical Orientation

The designation, use, and maintenance of ceremonial space and activity areas in village sites is well noted in the ethnographic and archaeological record (Grenda and Altschul 2002; Hale 1995; Hodder and Orton 1976; Kroll and Price 1991). Activity areas are often delineated and maintained for specific purposes, such as areas intended for tool manufacture, preparation and processing of food resources, or areas defined specifically for ceremonial or religious purpose (Arnold 2001a; Hale 1995; Johnston 1962; McCawley 1996, 2002). During the late Holocene the southern California Bight witnessed intensification of political and social complexity among the Chumash on the northern Channel Islands and the mainland along the Santa Barbara coast (Arnold 1992, 2001a, 2001b; Erlandson and Jones 2002; Gamble 2008; Rick 2001b). Chumash society exhibited a hierarchical elitism based on the control and production of resources, and engaged in regional trade and exchange between the northern islands and the coastal mainland via the sewn plank canoe, or Tomol (Gamble 2008; King 1976, 1990). There are similar, yet smaller scale patterns of interaction and social complexity observed contemporaneously among the Gabrieliño, Luiseño, and Nicoleño peoples occupying the southern Channel Islands and the coastal mainland of what is now the Los Angeles basin and Orange County (Bean and Smith 1978; Grenda and Altschul 2002; Johnston 1962; Koerper et al. 2002; McCawley 1996, 2002).

The Chumash who occupied the northern Channel Islands and the coastal mainland from Point Dume to Point Conception maintained a complex cultural sphere of interaction between coastal and inland groups on the mainland, and the groups inhabiting the northern Channel Islands of Santa Cruz, Santa Rosa, San Miguel, and Anacapa (Arnold 2001; Gamble 2008). During the late Holocene the Chumash experienced a period of increased cultural complexity characterized by social stratification, craft specialization, seasonal gatherings, ceremonial activity, and widespread trade and exchange between the mainland and island groups via the Tomol, or plank canoe (Arnold 2001; Gamble 2008; Hudson and Blackburn 1982). Arnold and others claim that the Tomol served as a means of production in a complex economic system where specialized craft items such as shell beads (*Olivella biplicata*) manufactured on the islands and were exchanged for subsistence items found on the coast, such as deer meat and acorns (Arnold 2001; Gamble 2008; Hudson and Blackburn 1983). Furthermore, the Tomol allowed for the fishing of benthic fish species in the deeper channel waters. The exploitation of benthic fish was also made possible with the innovation of the circular shell fishhook (Salls 1988; Strudwick 1986).

The southern Channel Islands and the coastal mainland south of Point Dume witnessed a similar, yet smaller scale intensification of social, economic, and ideological complexity (Grenda and Altschul 2002; Bean and Smith 1978; Johnston 1962; Raab et al. 2009). McCawley describes the Gabrieliño at the time of Spanish contact as a complex and stratified society with economic prosperity, political strength, and wealth of material culture (McCawley 1996, 2002). Though little is known of the peoples occupying San Nicolas Island from the ethnohistoric record, the archaeological record suggests that there was considerable and regular contact with the inhabitants of the other islands and the mainland (McCawley 1996, 2002; Rick et al. 2001; Vellanoweth 2001). Based on evidence of contact, one may assume that the Nicoleño maintained similar cultural traits as their island neighbors such as elaborate ritual and ceremonial practice, craft specialization, and a tradition of oral narrative that has been well described by McCawley and others (Johnston 1962; McCawley 1996, 2002). Such evidence may be seen in the spatial patterning of artifact types and ceremonial features that will be analyzed in this thesis.

Evidence of ritual and designated ceremonial space has been previously reported at CA-SNI-25, as well as other late Holocene sites throughout the bight (Bartelle et al. 2010; Hale 1995, Hudson and Blackburn 1986; Knierim et al. 2013; McCawley 1996; Raab et al. 2009). The Lemon Tank site on San Clemente Island, CA-SCLI-1524, is a late Holocene village site that exhibits dog burials and numerous pit and "ideological" features similar in nature to those observed at CA-SNI-25 (Hale 1995). CA-SCLI-1524 has excellent potential for exploratory analysis in comparison to Tule Creek Village. Both sites share a temporal similarity and have produced an abundance of data indicative of ceremonial activity. As described above, Hale (1995) has documented numerous features at the Lemon Tank site found within a ceremonial complex similar to those at East Locus, including dog burials, caches of ochre and seeds, artifacts made of exotic stone such as chert and steatite, hearths, and fishing kits. Most of these features exist within a central structure area, which Hale has posited as a ceremonial enclosure similar to those described in the *toloache* ceremony, or boys' puberty rite among Luiseño and other Southern California peoples (see DuBois 1908). Other research has suggested this possibility as well at East Locus (Knierim et al. 2013). The abundance of comparable features and artifacts between Lemon Tank and East Locus, coupled with a spatial analysis of both sites would undoubtedly shed new light on possible religious links between the two island peoples as well as reinforce those links with their mainland neighbors.

Historical accounts from Sebastian Vizcaino's expedition describe elaborate ritual practice and specific ceremonial space designated at a Gabrieliño village at Isthmus Cove on Santa Catalina Island (McCawley 1996). Gamble and others describe widespread ceremonial feasting and ritualized community gatherings practiced on the northern Channel Islands and the coastal mainland during the late Holocene (Arnold 2001b; Gamble 2008). Such practices are inferred from the archaeological record by evidence of dense faunal remains observed in spatial context with ritual paraphernalia, pit features, and fire hearths. Intrasite spatial analysis using GIS may allow for correlations to be made between artifact types observed in context with ceremonial features similar to those reported in ethnographic and ethnohistoric accounts.

The goal of this thesis is to better understand the spatial relationship of activities that took place at CA-SNI-25. Of particular interest is to explore the designation and ceremonial and utilitarian use of space at East Locus, as well as the nature of social interaction that occurred at the village site. The analysis of the spatial distributions of several artifact types in context with ceremonial features may help us to understand the complex nature of activities that took place at Tule Creek Village.

The application of GIS exploratory analysis allows for the visual display of spatial patterns that are not immediately apparent in large data sets. Furthermore, GIS analysis provides a definitive direction for secondary analysis of previously analyzed data. I will apply the intrasite spatial patterning observed in the preliminary analyses and re-examine the constituents in the areas that showed clustering. Comparing clusters of materials will allow me to hypothesize on the functional relationships between artifacts and features and the overall organization of space at East Locus.

For instance, the distribution of sandstone saws and shell fishhooks at CA-SNI-25 has implications regarding the organization of shell fishhook production, an important technological innovation associated with the rise of social complexity in the region (Guttenberg et al. 2013; Kendig et al. 2010; Smith 2013; Smith et al. 2015). The innovation of the fishhook expanded the use of deep water and kelp bed fisheries utilized by Native Americans occupying the Southern California Bight, which contributed to significant changes in the ways people exploited marine environments, and introduced new resources into the economy (Arnold 2001b; Kennett 2005; Strudwick 1986).

Evidence of deep water fish remains and ceremonial feasting at CA-SNI-25 suggests an increased production from fishing harvests and a potential for food surplus (Bartelle et al. 2010). Martz (2005) argues that this development parallels a rise in population levels and densities on San Nicolas Island. Furthermore, fishing technology is believed to have paved the way for the development of craft specialization, the accumulation of personal wealth, and elite-based social stratification. These subsequent developments go hand in hand with the emergence and use of the plank canoe as a vehicle of food procurement, trade, and travel between the islands and the mainland, perhaps the most significant factor influencing social, political, and economic change in the region.

My specific objectives in this thesis are to examine, quantify, and expand on these correlations with a larger and more comprehensive data set. The intrasite analysis of spatial patterning of artifact types will help to correlate artifact manufacture and use, and aid in our understanding of behaviors associated with material wealth, social stratification, and commerce with neighboring peoples throughout the southern California Bight. Furthermore, the exploratory spatial analysis of inferred ceremonial activity at Tule Creek Village may provide a template for further research into ceremonial practices, as well as a signature of spatial patterning for ceremonial space that can be applied elsewhere when larger excavations are not feasible.

The excavations at East Locus of CA-SNI-25 produced abundant data that suggests economic commerce with other islands and both a ceremonial and utilitarian use of space at the site. I will use the data from these excavations to address a number of specific questions:

1.) Does the spatial patterning of features, artifact types, and artifact materials at CA-SNI-25 indicate a separation between utilitarian and ceremonial space at East Locus?
2.) Does the presence and spatial patterning of exotic materials obtained through trade with other islands and the mainland suggest that CA-SNI-25 may have served as a hub for economic exchange and social interaction on San Nicolas?

3.) Does the analysis of intrasite spatial patterning at CA-SNI-25 reveal a signature for ceremonial activity that can be applied to other late Holocene sites throughout southern California?

In summary, my research questions are aimed at developing a method of applying GIS exploratory analysis to better define activity and use areas at CA-SNI-25. I will compare these results with the distribution of features at East Locus and evaluate the degree to which the distribution of materials is related to the purpose and use of the features. This analysis will allow me to infer the context of these relationships, and attempt to identify archaeological signatures that may be recognized in other archaeological contexts in southern California.

This thesis is organized in the following manner. Chapter 2 illustrates and environmental background for the San Nicolas Island and the Southern California Bight, including sections on geology, topography, flora and fauna. I focus on the geologic formations and topographic features of the Channel Islands and coastal mainland to provide context for the potential source locations of raw lithic material imported to San Nicolas Island. Chapter 3 provides a cultural and archaeological background for the Southern California Bight and San Nicolas Island. Chapter 4 presents the Materials and Methods used in my analysis, and also features a narrative description of the manner in which CA-SNI-25 was excavated. In Chapter 5 I present the results of my analysis, and in Chapter 6 I enter into the Discussion and Interpretation of my results and address my research questions presented in Chapter 1. Lastly, Chapter 7 is a summary of my findings, along with the conclusions I have reached through my research and some implications for future research using GIS exploratory analysis.

CHAPTER 2

Environmental Setting

Geographic Location

In this chapter I describe the geographic location of San Nicolas Island in context with the other southern and northern Channel Islands, and in relation to pertinent locations on the coastal mainland. I take a geographic approach in this section and focus on the topographical features of the islands and the mainland such as mountain ranges and river systems. I also describe the geologic formations throughout the region. The geology of the islands and the coastal mainland is significant because part of my research is directed towards the regional trade of lithic materials and the differential use of lithics exotic to San Nicolas. This approach provides a regional context to the geographic area around San Nicolas Island, and helps illustrate the complexity of inter-regional social interaction occurring at CA-SNI-25 during the Late Holocene.

Southern California Bight

The Southern California Bight is described as the northwest-southeast trending curve in the southern California coastline from Point Conception to the northwest coast of Baja, California (Altschul and Grenda 2002). The offshore area of the bight contains eight islands known as the Channel Islands. The eight islands are divided geographically between the northern and southern groups. The northern Channel Island group includes Anacapa, Santa Cruz, Santa Rosa, and San Miguel. The southern island group includes Santa Catalina, Santa Barbara, San Clemente, and San Nicolas (Figure 2.1).

Figure 2.1 Southern California Bight and the Channel Islands.

The offshore area of the bight parallels three coastal geographic provinces on the mainland: the North Coast, Central Coast, or Los Angeles Basin, and the South Coast (Vellanoweth and Grenda 2002). These regions can be delineated by hydrological boundaries, as well as physical and biogeographical variations.

The North Coast province encompasses sections of Santa Barbara and Ventura counties and the coastal mountains known as the Transverse Ranges. The Transverse Ranges include the Santa Ynez and Santa Monica mountains. The North Coast is bordered by two primary river drainages, the Santa Ynez River in the north, which flows into the ocean near the present day city of Lompoc, and the Santa Clara River on the southern end of the region, which enters the ocean just south of Ventura.

The central coastal region, also referred to as the Los Angeles Basin, encompasses the area between southern Ventura county and northern Orange county, including the Los Angeles coastal region (Vellanoweth and Grenda 2002). The Transverse Ranges establish the northern boundary of this region. Prominent mountains in this section of the Transverse Ranges include the Santa Monica, San Gabriel, and the San Bernardino mountains. On the southern end of the central province are the Peninsular Ranges that extend south and form the Baja California peninsula. There are three major river drainages in the central region, the Los Angeles River, which flows to the Santa Monica Bay near Marina del Rey, the San Gabriel River entering the ocean near the City of Long Beach, and the Santa Ana River which terminates between the cities Huntington and Newport Beach in Orange County. All three of these drainages share a similar hydrological pattern of meandering through their respective floodplains and experiencing periodic episodes of flooding. A geographic feature distinctive to the central region is the Palos Verdes peninsula extruding southwest from downtown Los Angeles and situated between the Los Angeles and San Gabriel Rivers. Palos Verdes is an uplifted marine terrace composed of Miocene sediments including shale that is characterized by whitish to buff colored deposits and distinctive bedding, which is know as the Monterey Formation (Dibblee 2011; Schoenherr 1992:325). This rock unit contains lithic material commonly used as toolstone, such as Monterey chert and Altamira shale (Dibblee 2011). Monterey chert has been recovered from archaeological deposits at CA-SNI-25.

The southern coastal province extends from southern Orange County to the border between the U.S. and Mexico. This province includes the Peninsular Ranges that extend south and form the Baja peninsula. These mountains feature prominent drainages that serve as tributaries to the San Luis Rey and San Diego rivers. The coastline of the southern province is characterized by coastal lowlands that were formed around the outlets of the two major rivers, steep Pleistocene terraces that were carved by wave-cut erosion, and narrow sandy beaches (Schoenherr 1992:627-633).

California Channel Islands

The eight Channel Islands are continental islands that are situated relatively close to the mainland, and share similar geological and biogeographical characteristics with the mainland (Schoenherr et al. 1999). The Channel Islands were formed by uplift and faulting from the continental shelf off of the coast of California (Schoenherr et al. 1999:47). This resulted in a submarine landscape of basins and offshore ridges that continued to be uplifted by tectonic activity between the two large tectonic plates that converge along the San Andreas Fault (Schoenherr et al. 1999:47). The tops of these offshore ridges are the Channel Islands. The resulting geologic structure of the Channel Islands is quite varied due to the complexities of the upward faulting and plate tectonic movement.

The northern Channel Islands are an extension of the Santa Monica Mountains and form the southwestern boundary of the Transverse Ranges (Schoenherr et al. 1999:47). This island group is oriented along an east-west line and parallels the Santa Barbara Channel. Prior to the rise in sea levels at the end of the Pleistocene, the four northern islands were joined and formed a single landmass referred to as Santarosae Island. As a result of their fairly recent physical connection and their close proximity to the mainland, the flora and fauna of the northern islands share many similarities to that of the northern coastal mainland of the Southern California Bight.

The geological composition of the northern islands is mostly Cretaceous sedimentary rock, primarily sandstone and shale, overlain by more recent Miocene and

Quarternary marine deposits (Dibblee 2001, 2010a, 2010b; Schoenherr et al. 1999; Sorlein 1994). However, Anacapa Island is primarily composed of Miocene volcanic rock under beds of Pleistocene sedimentary deposits.

Santa Cruz Island is the largest of the Channel Islands and has perhaps the most complex geology of the northern islands. The Santa Cruz Fault runs roughly southwest to northeast across the middle of the island, thus creating distinctive geologic contacts along the fault line (Dibblee 2001). Miocene volcanics are seen in underlain exposures on the north end of Santa Cruz Island, while the geology of the south end is characterized by a combination of Miocene sedimentary deposits and Cretaceous metamorphic rock (Dibblee 2001; Schoenherr et al. 1999; Sorlein 1994). Outcrops of sedimentary deposits containing Monterey chert occur on the northeast end of Santa Cruz and served as quarries for toolstone that was manufactured locally on the island, and exchanged through vast trade networks between the islands and the coastal mainland (Arnold 1991, 1992, 1993, 2001b; Cannon 2006; Rosenthal 1996). Another prominent lithic source that occurs on the northern islands is located on San Miguel, where Cico chert was quarried and also utilized as a trade commodity throughout southern California (Erlandson et al. 1997).

As mentioned, the terrestrial environments of the northern islands share many similar biological and ecological characteristics between both island habitats and habitats in the northern coastal province on the mainland (Schoenherr et al. 1999). The northern islands all share a similar Mediterranean climate with the coastal mainland. Springs, seeps, and seasonal drainages supply all four islands with freshwater, however water is limited on Anacapa. The vegetation of the northern islands is diverse and quite similar to the coastal mainland. The plant communities on the islands are predominately coastal sage scrub and chaparral, however, coastal grasslands, riparian plant communities, pine forests, oak woodlands, and coastal marshes are also found on the northern islands (Schoenherr et al. 1999).

The southern Channel Islands are more dispersed than the northern group, and due to a more arid climate, exhibit less biodiversity in comparison to the northern islands (Schoenherr 1999). The southern islands are exposed submarine ridges that were formed as a result of uplift and faulting, and unlike the northern islands, were never joined as a single land mass. Santa Catalina Island, the largest of the southern islands and closest to the mainland, lies approximately 32 km (20 mi) from Point Vicente on the Palos Verdes Peninsula (Schoenherr et al. 1999). The outer southern Channel Islands, San Clemente, Santa Barbara, and San Nicolas, are smaller and more remote than the other islands, and due to their remote locations, these islands all have limited biodiversity (Schoenherr et al. 1999). San Clemente is the largest of the three outer southern islands, and lies the furthest south, approximately 79 km (49 mi) from the Palos Verdes Peninsula, and 102 km (63 mi) northwest of San Diego (Schoenherr et al. 1999:314). Santa Barbara is the smallest Channel Island, with a total area encompassing approximately 1.6 square kilometers (0.62 mi^2).

The geology of the southern Channel Islands is primarily composed of Miocene volcanic rock and Quarternary marine sediments, however, the geology of Santa Catalina Island is much more complex. The entire northwestern portion of Santa Catalina Island is composed of older Franciscan formation metamorphic rock such as serpentinite, blueschist, greenschist, and amphibolite (Schoenherr et al. 1999). The southeastern side of Santa Catalina is composed of younger Miocene plutonic rock that was intruded into the earlier Franciscan metamorphic rock (Schoenherr et al. 1999). Outcrops of the Franciscan complex metamorphic rocks are abundant on Santa Catalina, as well as some areas of the Palos Verdes Peninsula. Materials such as serpentinite and steatite were quarried for use in the manufacture of groundstone artifacts and appear across the archaeological record of southern California (Cannon 2006; Hudson and Blackburn 1987; Scalise 1994).

Due to the ecologically limiting factors of island environments and geographic isolation from the mainland, large terrestrial fauna is mostly lacking on both the northern and southern island groups (Schoenherr 1999). Terrestrial fauna on the Channel Islands includes both island endemic species, such as the white-footed deer mouse (*Peromyscus maniculatus*) and domesticated animals and intrusive species introduced by human interactions, particularly sheep (*Ovis aries*) and the black rat (*Rattus rattus*) that have had devastating effects on the island habitats.

The island fox (*Urocyon littoralis*) is a terrestrial vertebrate that appears on all of the islands except for Anacapa and Santa Barbara. The island fox is genetically similar to the mainland fox (*Urocyon cinereoargentus*) but is smaller in size and serves as an example of island dwarfism (Schoenherr et al. 1999:30). It is unknown when the island fox first arrived on the northern islands, although there is evidence that the populations of the island fox on the northern islands predate the appearance of the fox on the southern islands. The early inhabitants of the southern Channel Islands likely introduced the island fox approximately 5,000 years ago, utilizing the animals as pets and exchanging them through trade (Vellanoweth 1998).

San Nicolas Island

San Nicolas is the most distant and remote of the eight California Channel Islands. Although it is one of the four southern Channel Islands, it is centrally located between the northern and southern island groups. San Nicolas lies approximately 120 km (75 mi) southwest of Los Angeles and is approximately 98 km (60 mi) from the nearest point on the mainland (Martz 2008). The island is relatively small, measuring only 14.5 km (9 mi) long and 5 km (3 mi) wide, and has a maximum elevation of 277 m (909 ft). San Nicolas is characterized by five topographic zones that include the large relatively flat central plateau, the northern and relatively steep southern cliffs, northern coastal terrace, southern coastal terrace and the dune fields of the west end (Martz 2002) (Figure 2.2).

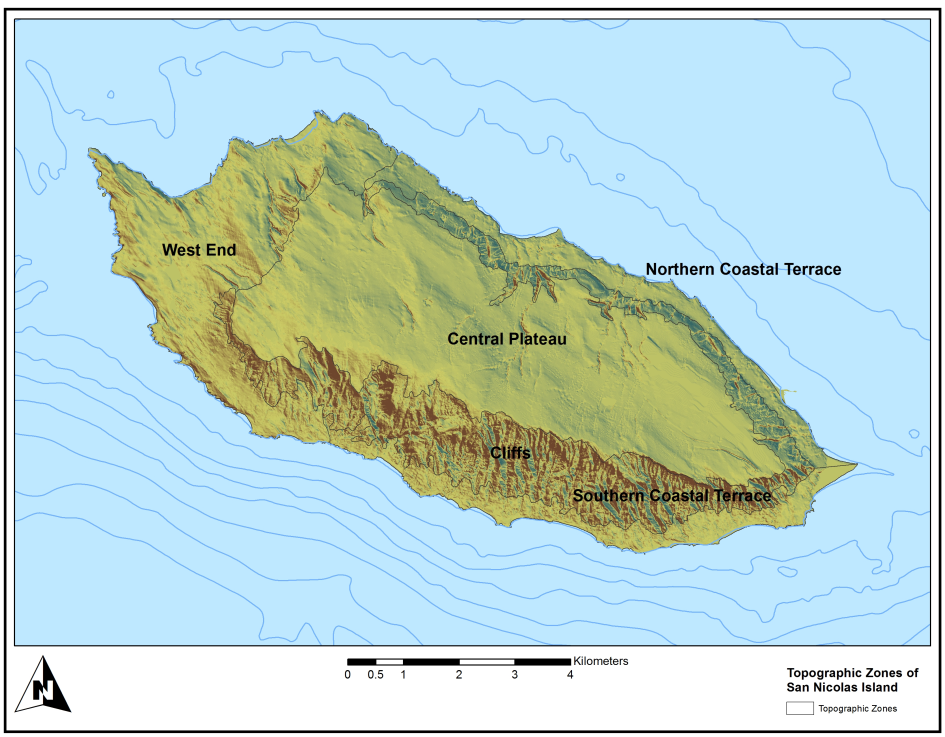

Figure 2.2 San Nicolas Island Topographic Zones.

The geological composition of the island is primarily alternating beds of Eocene sandstones, siltstones, and interbedded marine sediments consisting of a conglomerate of metavolcanic and metasedimentary cobbles within a matrix of sandstone and mudstone (Vedder and Norris 1963:13). Periodic exposures of these conglomerate beds and sandstone shingle beaches serve as primary sources of toolstone (Kendig et al. 2011, Rogers 1930, Taylor 2012). Numerous cobble quarry locations have been located in the interior drainages and wind-eroded blowouts on San Nicolas (Clevenger 1982, Taylor 2012). However, the most productive and easily accessible cobble sources on the island occur along beaches where cobbles erode from the conglomerate beds and are reworked by wave erosion (Taylor 2012).

The island's size, isolation, lack of diverse habitats and relatively arid landscape support a limited variety of flora comprised primarily of coastal sage scrub, chaparral, and grasses with few edible endemics (Junak 2008). Terrestrial native fauna are likewise limited to the island fox, the deer mouse, the island night lizard, land snails and a variety of insects (Schoenherr et al.1999). None are particularly useful as a source of raw materials or sustenance.

In contrast to its sparse terrestrial resources, San Nicolas Island is surrounded by highly productive and diverse marine habitats. The island's rocky intertidal and subtidal zones are home to the most extensive kelp forest per capita among the California Channel Islands and support a wide variety of shellfish, fish, marine mammals, and sea birds (Mariani 2001; Pondella et al. 2005; Schoenherr et al. 1999:345-346).

In summary, San Nicolas Island is a small and remote island at the outskirts of the Southern California Bight. Because of the scarcity of terrestrial resources available on the island, the prehistoric inhabitants of San Nicolas relied heavily on the harvesting of shellfish, and ultimately the emergence of fishing. Although the geology of the island provided adequate lithic material for the manufacture of chipped and groundstone tools, evidence suggests that raw lithic material was traded from quarries on neighboring islands as well as the coastal mainland.

The following chapter outlines the prehistory of the Southern California Bight and San Nicolas Island. The chronological sequences are presented in order to highlight the development of technology and social interactions that are relevant to this thesis. Further discussion of the material culture of the Nicoleño is provided, along with accounts of the religious practice and behaviors that will ultimately assist in the interpretation of the archaeological signatures observed at East Locus, CA-SNI-25.

CHAPTER 3

Cultural and Archaeological Background

Introduction

There are several chronologies that are used to illustrate the cultural sequences for Southern and Central California (King 1990; Wallace 1955; Rogers 1929). Each of these sequences describes cultural horizons and phases observed in the archaeological records of the Santa Barbara Channel region, Los Angeles Basin, Southern California coastal region, and the Mojave Desert, respectively. For my purposes I will define the cultural sequences of the Southern California Bight using a combination of the geologic time scale, and the most recent descriptions (Erlandson 1988; 1994, Glassow et al. 2007).

Once the general background of the Southern California Bight has been outlined, I will discuss the chronology of San Nicolas as well as the history of archaeological research on the island. Historic accounts of early European visitors to the region will be presented in order to illustrate Gabrielino and Nicoleño culture and practice. These accounts will also help provide context and setting to life at CA-SNI-25 at the time of contact.

Terminal Pleistocene and Early Holocene (13000 to 7000 cal BP)

Some of the earliest evidence for human occupation in North America is found on the California Channel Islands. Despite rising sea levels and erosion of coastal habitats numerous Terminal Pleistocene and Early Holocene archaeological sites have been discovered on the Channel Islands and the coastal mainland (Erlandson 1994; Rick et al. 2005). The earliest evidence of human occupation on the Channel Islands is found on Santa Rosa Island. Human remains were found at the Arlington Springs site that dated to approximately 13,000 years ago (Johnson et al. 2002). Further evidence of Terminal Pleistocene occupations is found on San Miguel Island. The Daisy Cave and Cardwell Bluffs sites are characterized as low-density shell middens that date to approximately 12,000 and 11,400 cal BP (Erlandson and Braje 2008; Erlandson et al. 1996).

These sites provide evidence of human occupation of the Northern Channel Islands in the Terminal Pleistocene. However, there is limited evidence on the Southern Channel Islands or the coastal mainland for human occupation prior to the Early Holocene, approximately 10,000 to 6650 cal BP (Erlandson et al. 1996; Glassow et al. 2007; Johnson et al. 2000). Evidence suggests that Early Holocene populations on the mainland increased and were highly mobile, utilizing coastal strands to harvest marine resources.

Many archaeological sites dating to this time period are predominately small and characterized as short-term habitations used for gathering and processing shellfish, fish and sea mammals (Glassow et al. 2007; Rick et al. 2001, Vellanoweth et al. 2002). However, several large coastal village sites date to approximately 9,000 BP, such as CA-ORA-64 in Newport Beach, the Harris site in San Diego, Diablo Canyon in San Luis Obispo, and CA-ORA-83 in Huntington Beach (Erlandson et al. 2007:58-59).

As population densities increased along the coastal mainland the archaeological record yields artifact assemblages consisting mostly of large millingstones, such as manos, metates, and stone bowls, and a general scarcity of well made flaked stone tools (Glassow et al. 2007). Archaeological evidence from this time period shows an increase in diversification of food resources, such as shellfish, birds, and small mammals. Early mainland coastal groups exploited bay and estuary marine habitats (Erlandson and Rick

2002; Rick and Erlandson 2000), but the diet from this period appears to have relied heavily on the processing and milling of hard seeds (Wallace 1955). It is likely that these populations consisted of small extended families of mobile foragers using these sites as a residential base with limited socio-political complexity (Glassow et al. 2007).

Middle Holocene (7000 to 3350 cal BP)

The Middle Holocene represents a greater increase in population densities, more complex tool technology, expansion of food resources, increased social complexity, and greater evidence of trade and interaction between coastal and inland populations (Glassow et al. 2007). Technological changes during this period include change in lithic technology. Mortars and pestles appear in the archaeological record, indicating an increase in acorn processing, and a greater abundance of flaked stone appears, suggesting a marked increase in hunting of larger game. Other technological innovations are seen during the Middle Holocene, such as the the circular shell fishhook, as well as a wide array of bone and shell tools and ornaments (Moratto 1984; Strudwick 1986). Archaeological sites from this period are characterized by small year-round and seasonal settlements (Glassow et al. 2007).

Evidence for a vast network of trade and exchange emerges during the Middle Holocene. Items such as shell beads manufactured on the Channel Islands appear in inland sites on the mainland (Vellanoweth 1995; 2001). In exchange, obsidian was traded from the inland deserts to the coastal regions and both the northern and southern Channel Islands. Additionally, the Middle Holocene saw an influx of Shoshonean Takic speaking groups migrating from the inland deserts to the coastal region (Kroeber 1976). This migratory incursion is viewed geographically as a linguistic wedge between the northern and southern coastal areas of the Bight. Kroeber (1976) argues that this incursion represents a population replacement of Hokan speaking populations by Uto-Aztecan speaking peoples migrating westward. Further evidence of population replacement during this period is seen in osteological analyses of human remains on the southern Channel Islands (Eshleman and Smith 2007; Kroeber 1976; Potter and White 2009; Reinman and Townsend 1960; Valentin 2010; Walker 1986).

Late Holocene (3350 cal BP to present)

The Late Holocene is widely studied by archaeologists working within the Southern California Bight (Arnold 1991, 1992, 1993, 2001a, 2001b; Larson et al. 1994; Raab and Larson 1997). This is largely due to the well-noted increases in population densities and a rapid increase in social complexity. The Late Holocene is also a focus of interest because of a wealth of evidence suggesting this period to be a time of climatic and environmental stress (Jones et al. 1999; Larson et al. 1994; Raab and Larson 1997). An event known as the Medieval Climatic Anomaly (MCA) has been suggested to have an immense impact on coastal environments and populations around AD 800 – 1300 (Jones et al. 1999; Larson et al. 1994; Raab and Larson 1997; Yatsko 2000). The developing increases of social and technological complexity in light of environmental stress has been a topic of a great deal of the archaeological investigations of Late Period sites (Arnold 1991, 1992, 1993; Glassow 1996).

Permanent village sites with large populations are observed throughout the coastal and inland areas. Increased technological complexity is observed in the archaeological record, suggesting that populations had developed a more diversified approach to subsistence. Perhaps the most significant developments of this period are the plank canoe (*tomol*) and bow and arrow. The plank canoe allowed for deep-water fishing and provided the vehicle for the transport of Olivella (*Callianax* spp.) shell beads from the Channel Islands to the mainland. This development further expanded the networks of trade and exchange between the islands and the mainland. The bow and arrow transformed hunting by providing a more effective and accurate tool for capturing smaller game, and also served as an effective weapon. The development of craft specialization is apparent in the increase in the manufacture of standardized shell beads, bone and lithic ornaments, and ritual items. Religious paraphernalia, rock art, and elaborate burial practices suggest elaborate ritual and ceremonialism was practiced during this period.

Arnold and others (Arnold 1992, 1995; Glassow et al. 2007) describe a Middle-to-Late Transition occurring in the Late Holocene between around AD 1150 to 1300 characterized by a notable increase in coastal settlements and marine subsistence, particularly fishing. An intensification of fishing is observed in coastal sites, along with significant changes in technology and social organization. Technological changes to marine subsistence patterns include the introduction of the circular shell fishhook and net weights, which allowed for coastal and island populations to significantly expand their diet (Glassow et al. 2007). Inland populations developed innovations in lithic technology which allowed for intensified hunting, and further diversified their subsistence with an increase in acorn production, pulpy tubers and roots, as well as marine resources (Glassow et al. 2007). An increase in sedentism occured in this period as evidence of extended occupation is observed in archaeological records, particularly in the coastal region. There is evidence of additional developments in social organization that indicate an increase in ceremonial and elaborate ritual practice, and socially stratified society.

Wealth and status differentiation are apparent in mortuary practices and more elaborate ornamentation is observed in artifact assemblages, suggesting a change in social and political complexity. This accompanies evidence of an increase in trade and exchange between coastal and inland populations (Glassow et al. 2007).

San Nicolas Island

Although the oldest archaeological sites are believed to have been inundated by rising sea levels after the last glacial maximum (Inman 1983; Nardin 1981), 551 sites have been identified throughout the island (Martz 2002, 2005). A radiocarbon date (8,400 BP) from a single *Mytilus spp.* shell from CA-SNI-339 represents the oldest known human habitation on San Nicolas Island. Other radiocarbon dates from sites representing villages, camps, seafood processing locations, and flake stone reduction areas indicate an increase in human habitation from the early to late Holocene (Martz 2005: 65). Evidence suggests that the majority of the sites on San Nicolas were occupied during the late Holocene (Martz 2005).

Early archaeological investigations on San Nicolas were conducted between 1870 and 1950, and were primarily antiquarian expeditions where huge amounts of museum-quality artifacts were collected and removed from the island (Martz 2005). Numerous individuals conducted these investigations including Stephen Bowers, Bruce Bryan, Léon de Cessac, Philip Orr, Malcolm Rogers, Paul Schumacher, and Arthur Woodward (Schwartz and Martz 1992:46). The amounts of collected artifacts number in the thousands, and are mostly housed in museum and private collections around the world (Martz 2005).

In the 1950s archeological studies began on San Nicolas Island that focused on problem-oriented research and employed a more scientific approach (Schwartz and Martz 1992). Archaeologists working on the island began to evaluate the archaeological sites on the island as "resources" that could be used to answer questions related to prehistoric subsistence and settlement patterns, and artifact typologies and chronologies on the San Nicolas (Schwartz and Martz 1992). Researchers working on the island between the 1950s and the 1970s collected an abundance of data, but the level of documentation was still inadequate considering the number of undisturbed and intact archaeological resources observed on San Nicolas, many of which remained unidentified (Schwartz and Martz 1992).

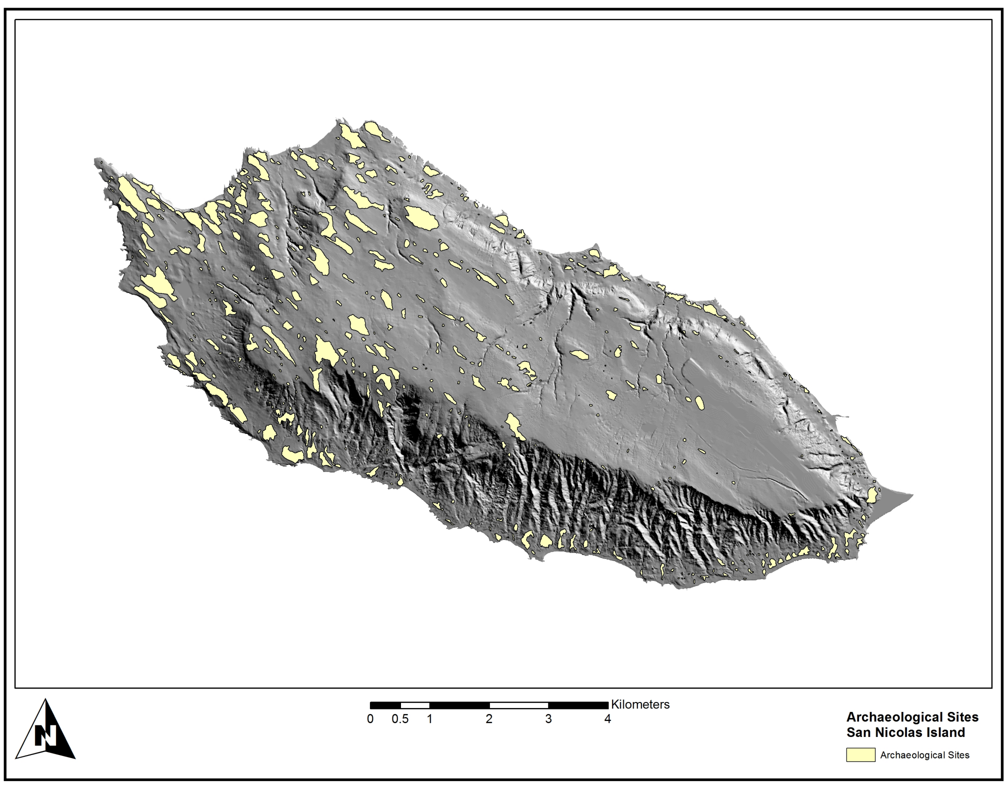

Figure 3.1 San Nicolas Island archaeological site locations.

It wasn’t until the 1980’s where efforts began to perform island-wide systematic surveys on San Nicolas. The early surveys resulted in the recordation and mapping of 358 archaeological sites (Reinman and Lauter 1984). There are currently 551 archaeological sites identified on the island, many of which have been tested and evaluated (Martz 1994; Rosenthal and Jertberg 1997; 1998a, 1998b; Vellanoweth 1996) (Figure 3.1). Much of this research focused on dietary reconstructions, lithic analysis, faunal analysis, chronologies, and osteological studies (Bleitz-Sanburg 1987; Clevenger 1982; Kerr and Hawley 2000; Lauter 1982; Vellanoweth and Erlandson 1999). In order to properly evaluate the identified archeological resources on the island, an island-wide testing program was designed and implemented (Martz 2005).

Nicoleño

The prehistoric inhabitants of San Nicolas Island, the Nicoleño, were likely culturally related to the Gabrielino (McCawley 1996). Because so little is known of the intricacies of Nicoleño culture, we must infer that Nicoleño life was comparable to the Gabrielino. Linguistically, Gabrielino is a language in the Takic family, and part of the greater Uto-Aztecan linguistic stock (Bean and Smith 1978:538; Golla 2007:74-75). The Gabrielino occupied a large territory encompassing the area south of the Chumash territory at Point Dume, to the Newport Bay. The territory extended as far eastward as the San Gabriel and Santa Ana mountains, and included four river drainages. The Los Angeles, San Gabriel, Rio Hondo, and Santa Ana rivers provided fresh water for the Gabrielino populations that occupied the valleys and Los Angeles-Santa Ana coastal plain (McCawley 1996). The Gabrielino tribal territory also encompassed the four

Southern Channel Islands: Santa Catalina, Santa Barbara, San Clemente, and San Nicolas (Bean and Smith 1978; McCawley 1996).

The Gabrielino have been described as one of the “wealthiest, most populous, and most powerful ethnic nationality in aboriginal southern California,” and were rivaled in influence only by the Chumash (Bean and Smith 1978:538). Historic accounts describe the Gabrielino living in politically autonomous villages, or tribelets, along the coast and river valleys in populations of approximately 50 – 200 individuals (Bean and Smith 1978:540-44). Larger villages were situated along the protected areas near the coast. The tribelets were organized as chiefdoms and composed of lineages headed by a dominant lineage leader, or village “chief” (Bean and Smith 1978:544). Gabrielino political and social structure was also organized in a moiety system that was common to other Takic speaking cultures in southern California (Bean and Smith 1978:543).

Similar to the Chumash, the Gabrielino are known for elaborate material culture and artisanship. Artifacts with intricate carvings, pigment, and decorative inlay of shell and minerals are found in the archaeological record throughout the Gabrielino territory on both the islands and mainland (Bean and Smith 1978; Hudson and Blackburn 1987). The Gabrielino are perhaps best known for artifacts crafted from steatite obtained from Santa Catalina Island. Steatite was commonly used for bowls, comals, and other types of items used for cooking because of its heat conducting properties. Steatite was also carved into pipes, animal effigies, ornaments, and ritual objects (Bean and Smith 1978; Hudson and Blackburn 1987).

Gabrielino Religion - Chinigchinich

Historic accounts suggest that the Gabrielino had an elaborate religious practice based around creation myths related to a god-like figure called Chinigchinich (Boscana 1848; Bean and Smith 1978:548; McCawley 1996). The Chinigchinich religion combined aspects of Uto-Aztecan shamanic and religious practice with elements of Christianity and developed over the course of time as a "fusion of a number of distinct currents of religious thought" (McCawley 1996:143). Along with the recognition of a creator-god and other lesser deities, the Chinigchinich religion involved a complex cosmology that was interpreted by a religious elite with "knowledge and supernatural power not available to the general population" (McCawley 1996:144). The religious elite likely performed shamanic duties involving trancelike states of consciousness achieved by the ingestion of Datura (*Datura stramonium*). This practice allowed for the religious elite to interact with supernatural beings as an intermediary between the cosmological world and the general population (McCawley 1996:147).

Another element of the Chinigchinich religion was the designation and maintenance of a ceremonial enclosure called the *yovaar*, where numerous public and private rituals and ceremonies were observed (McCawley 1996). Ritual and ceremony were an integral part to all aspects of Gabrielino culture (McCawley 1996:143-169). Virtually every life event was defined and marked by ceremonies, rituals, festivals, feasting, and celebratory occasions all based in religious practice. Rites of passage, such as birth, boys and girls puberty, and marriage were recognized and observed through the prism of Gabrielino cosmology. Social ties and moral obligation were preserved through oral narratives and manifested in gatherings where the redistribution of wealth occurred in the form of ceremonial feasting and trade of material goods (McCawley 1996:91-92).

Annual rituals, such as the Summer Solstice and Winter Solstice ceremonies, and the Harvest Ceremony were performed seasonally and marked the significance of the change in season, as well as to honor the deities for providing abundance (Boscana 1933; McCawley 1996). The rituals associated with the summer and winter solstice events often involved astrological observations and solar alignments (McCawley 1996:160-161; Romani et al. 1988).

The Harvest Celebration was a performance lasting four to five days and was conducted to give thanks to the female deity who provided food and other resources from the earth (McCawley 1996:161). This series of events was generally attended by visiting lineages, often travelling long distances to participate in the celebrations of feasting, song, and dance. The Harvest Celebration was often coupled with other significant ceremonies, such as the Mourning Ceremony and the Eagle Rite, a highly symbolic and elaborate performance that involved the ritual slaying of a bird (McCawley 1996:165-166). These events involved the visitation of other lineages to the village and likely provided the platform for trade and exchange, redistribution of resources, and allowed for inter-village marriage.

Mortality and death were highly significant aspects of Gabrielino culture. The passage of death was marked by series of rituals that were intended to guide the soul of the deceased into the afterlife (McCawley 1996:155-158). The series of rituals began with a funeral ceremony and culminated with the performance of the Mourning Ceremony. The Gabrielino Mourning Ceremony was a multi-day event often lasting an entire week (McCawley 1996:162). The performances were conducted annually, between one to four years after the most recent passing of a friend or family member, and generally involved four rites: clothes washing, clothes burning, image-burning, and distribution of property of the deceased to members of the village (McCawley 1996:162).

Each of these rites and ceremonies were conducted in the sacred space of the *yovaar*. This is significant to my research because I am suggesting that the features observed at East Locus are consistent with the features representing sacred space discussed in the historical accounts of the Gabrielino (Boscana 1933; Johnson 1962; McCawley 1996).

Nicoleño at Contact

At the time of European contact the inhabitants of San Nicolas Island were referred to as the Nicoleño, and were a small population of maritime hunter-gatherers (Martz 2005). The Nicoleño spoke a language from the Takic family within the Uto-Aztecan linguistic group (Munro 1999). There is no evidence that Spanish explorers ever landed on San Nicolas (Wagner 1929), so much of what is known about the Nicoleño during the ethnohistoric period is derived from the field notes of J.P. Harrington. According to Fernando Librado, Harrington's primary Chumash informant, the Nicoleño were of Gabrielino descent and closely tied with the inhabitants of Santa Catalina Island (Hudson 1981:194). Librado also claimed he was told by Martin Violin that the Nicoleño "spoke the language of the Gabrieleños" (Harrington 1986:R104FL70), and "came from Xu'Ja' [Catalina language for Santa Catalina Island) and a few (he said) were from Xálá?at' [San Clemente in San Clemente language]" (Harrington 1986:R104FL65). José de Los Santo Juncos, another of Harrington's consultants, claimed the Nicoleño were

"…powerful witches. They used to pass to and from the island on basalas of Tules [bundled reed canoes]" (Harrington 1986:R104F40).

The Nicoleño were severely impacted by the incursion of Russian fur traders and Aleut hunters in the early 1800s (Martz 2005). The Russians and Aleutian hunters visited San Nicolas Island for extended periods of time hunting sea otters (*Enhydra lutris*), and evidence suggests that there were numerous conflicts between the Aleuts and the Nicoleño (Morris et al. 2014). The violent encounters decimated the Nicoleño population (Kroeber 1976:633-634). In 1853, the last remaining Nicoleño were removed from the island, and the island was then used for sheep ranching. The overgrazing sheep destroyed much of the native vegetation on San Nicolas, and were ultimately removed when the United States Navy assumed control of the island in 1943 (Swanson 1993). San Nicolas now serves as a naval offshore landing base and weapons testing facility (Martz 2005).

The Lone Woman of San Nicolas Island

In 1835, the Spanish schooner *Peor es Nada* was sent by the padres at Mission Santa Barbara to San Nicolas with orders to remove the remaining Nicoleño population and bring them to the mainland. During this episode, a single Nicoleño woman was left behind. The Spanish took the captured Nicoleño to San Pedro, Los Angeles, and Mission San Gabriel (McCawley 1996:210; Schwartz 2003, 2005). There are few records of what became of the Nicoleño once they were relocated to the mainland.

The woman left behind by the Spaniards, known as Juana Maria, remained on San Nicolas in isolation for 18 years (Hardacre 1880; Nidever 1937). After three unsuccessful attempts to locate her, she was finally found in 1853 by George Nidever. Nidever and his crew located the lone woman near a spring where she had occupied a roofless house. She wore a sleeveless dress of cormorant feathers and was surrounded by several dogs (Hardacre 1880; Nidever 1937). She was brought to Santa Barbara to live with Nidever and his family where she died shortly after. During her brief time in Santa Barbara, several attempts were made to communicate with her, but the native Chumash speakers local to Santa Barbara likely conversed in dialects that the lone woman could not understand (Munro 2000).

The story of the lone woman was later depicted in the children's book, *Island of the Blue Dolphins* (O'Dell 1960), and has captured the interest of archaeologists and historians for years. Recent discoveries on San Nicolas have shed light on the account of the lone woman, and have led to an increase of popular interest in her story. After years of archival research, a cave was discovered by the naval archaeologist and with the help of faculty and students from California State University, Los Angeles, sediments were removed from the cave yielding evidence of occupation that likely predates the sheep grazing era on the island (Schwartz 2013). The cave, CA-SNI-551, correlates with historic accounts of an "Indian Cave" that was thought to have been occupied by Juana Maria during her 18 years alone on the island (Hardacre 1880; Nidever 1937). Another discovery made by Navy archaeologists and researchers from the University of Oregon was a cache of artifacts in two redwood plank boxes, known as the "Redwood Box Cache" (Erlandson et al. 2013). This unique cache of artifacts and raw materials displays a blend of artifact styles characteristic of both San Nicolas and the Aleutian Islands. The discovery of the box cache has led researchers to posit that the items may be either directly or indirectly associated with the activities of the lone woman during her isolated years on San Nicolas (Erlandson et al. 2013).

Although there is no direct evidence linking the village that the Lone Woman resided in before the Spanish removed the last of the Nicoleño from the island, CA-SNI-25 is believed to be the last sizable village on San Nicolas at the time of contact. It remains possible, although difficult to demonstrate from the archaeological record, that Tule Creek Village was the home to Juana Maria, her family, and her ancestors.

Tule Creek Village (CA-SNI-25)

The Tule Creek site (CA-SNI-25) is a large Late Holocene village situated on the north end of the central plateau (Figure 3.2). The site overlooks Corral Harbor, a calm inlet that would have served as a favorable canoe launch (Bowers 1890:57)(Figure 3.3*a*). Harrington describes an informant account of a boat trip from Santa Rosa Island to San Nicolas, where the "San Nicolas Island Indians saw the cayucos approaching and the came out in their boats and conducted them into their San Nicolas harbor through the gap." (Harrington 1986:R104FL65). The description of the gap at the San Nicolas harbor likely refers to Corral Harbor, and the Indians that greet the arriving boat party were likely residents of Tule Creek Village.

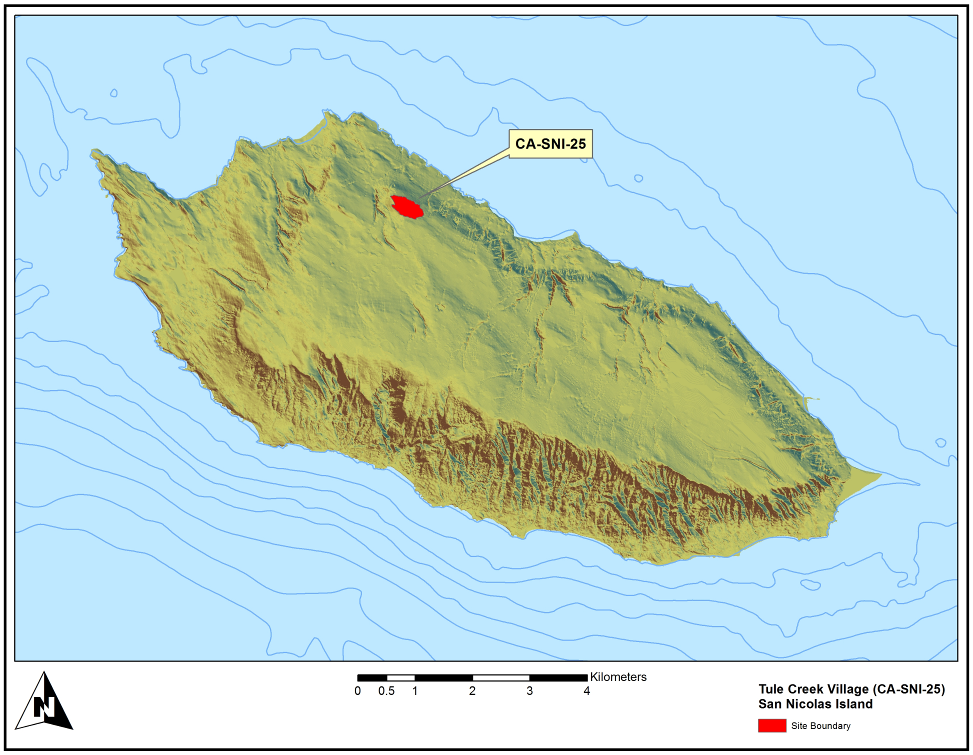

Figure 3.2 Location of Tule Creek Village (CA-SNI-25).

The site is adjacent to Tule Creek and approximately 2 km southeast of Thousand Springs, which are excellent sources of fresh water. Malcolm Rogers (Rogers 1930) conducted the earliest formal investigations of CA-SNI-25, characterizing it as a large village site with house pits, a communal structure, at least one cemetery, flaked stone tools, and dense midden with numerous features and excellent preservation (Rogers 1930). Tule Creek site serves as an excellent example for exploring the organization and use of space in both daily and ceremonial contexts.

Recent field investigations at CA-SNI-25 began in 2001 and were completed in 2009. The investigations focused primarily on two separate loci: East Locus and Mound B, although several other loci were tested as well (Figure 3.3*b*). I focus on East Locus for my spatial analysis because of the numerous features of interest, and it was sampled using contiguous block excavations conducive to identifying behavioral patterns from the distribution of artifacts and features.

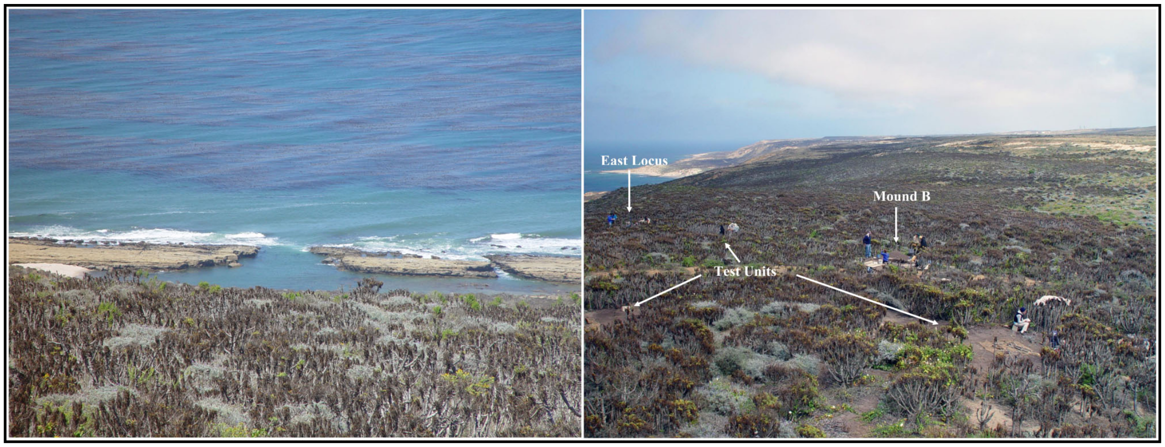

Figure 3.3 left to right: (a) View of Corral Harbor from Site, *(b)* View of East Locus, Mound B, and Test Units at CA-SNI-25.

The excavations yielded abundant ceremonial evidence at East Locus including several dog burials, multiple hearths, discrete pits, balancing stone caches, ochre, and other features representing ritualized activities (Cannon 2006)(Figure 3.4). At Mound B, however, the field school crews encountered more domestic activities that were deposited during at least three major periods of habitation. Over 100 radiocarbon dates were used on well-preserved single pieces of shell, bone, and charcoal to establish a chronology for the site, suggesting it was used between about 5,000 cal BP and 500 cal BP. Although the site was used for approximately 5,000 years, the major occupation as a village occurred between about 800 and 500 cal BP (Kendig et. al 2010) (Table 1).

Figure 3.4 Excavations at East Locus with a view of Fire Hearths and Pit Features, Looking Northeast.

Table 1. Selected Radiocarbon Dates for CA-SNI-25. Selected samples show dates of features discussed in this thesis.

Sample #	Unit and Context	Stratum/ Level	Material	Uncorrected ^{14}C Age (B.P.)	Calibrated Age (cal B.P.), 1 Sigma[a]	Calibrated Age (B.P.), 2 Sigma[a]
	East Locus[b]					
OS-54411	Unit 8, Hearth Feature F-6	IV/2	Charcoal	175 ± 30	220-170	225-73
OS-54562	Unit 7, Hearth Feature F-9	V/1	Charcoal	395 ± 70	510-430	530-306
OS-54355	Unit 7H, Fishing Tackle Kit Feature 7H-1	II/1	*H. cracherodii*	1090 ± 35	520-450	596-397
OS-54397	Unit 7L, Feature 7L-1	IIB/1	*M. californianus*	5700 ± 35	5910-4780	5966-5721
OS-55336	Unit 8E2, Left Handed Fishhook	II/4	*Norrisia norrisi*	1180 ± 35	512-598	637-486
OS-55465	Unit 8A, Saddle Bead	I/1	*Olivella biplicata*	1180 ± 35	512-598	637-486
OS-66789	Pit 7Q-1	II/8	*H. cracherodii*	900 ± 30	274-379	439-245
OS-66910	Dog Burial	---	*Canis familiaris*	680 ± 25	570-670	677-563
	Mound B[b]					
OS-54354	Unit 11, top of mound	II/3	*H. cracherodii*	880 ± 30	360-260	428-128
OS-54413	Unit 52, Shell and Lithic Feature	I/3	*H. cracherodii*	225 ± 35	520-460	564-400
OS-54360	Unit 58, Pit Feature	IIB/1	*H. cracherodii*	4750 ± 35	4810-4670	4835-4569
OS-54358	Unit 57, Hearth Feature	I/3	*H. cracherodii*	4800 ± 30	4840-4770	4900-4623
OS-54357	Unit 55, Pit Feature	II/3-IIB/1	*H. rufescens*	4890 ± 35	4940-4830	5030-4796
	Mound A[c]					
Beta-116352	Index Unit	-	Charcoal	130 ± 40	147-62	152-54
Beta-116920	Index Unit	-	Charcoal	550 ± 50	631-522	651-509
Beta-116351	Index Unit	-	Charcoal	650 ± 90	672-553	733-513
Beta-175270	Index Unit	90 cm	*Canis familiaris*	530 ± 40		740-660

Stratigraphy

The stratigraphic integrity of CA-SNI-25 is largely intact and well preserved. Excavations at East Locus and Mound B encountered three strata (I, II, II). Stratum I is the uppermost deposit of cultural material mixed with wind-blown sand and vegetation. This stratum represents the most recent phase of occupation at the site, and is likely disturbed by modern activities and erosion. Stratum I is characterized as a dark gray to brown sandy soil with inclusion of roots and fragmented cultural constituents (Cannon 2006:101). Stratum II is an intact cultural deposit that largely represents the occupation of the village site. This stratum is described as a dark gray silty sand with a great density of cultural constituents. Most of the features that characterize East Locus were associated with Stratum II. Stratum III is a light brown sand that contains little to no cultural constituents, and is mostly considered sterile.

For my purposes, I have separated my sample stratigraphically between Stratum I and Stratum II. While I focus primarily on Stratum II, I am hopeful my analysis of both strata helps to understand Stratum I, and the spatial and behavioral variations that occurred during the terminal occupation at Tule Creek Village.

Research on the materials excavated from CA-SNI-25 is ongoing. As it continues, the wealth of new information gleaned from the archaeological record contributes to our understanding of the past lifeway at Tule Creek Village. In the next chapter I provide an in depth description of the field methods used during the course of the archeological investigation at CA-SNI-25. I also outline my methods of analysis, including a brief narrative on the development of spatial studies in archaeology and GIS cluster analysis. Lastly I describe the materials used for my analysis.

CHAPTER 4

Materials and Methods

Introduction

The archaeological record of San Nicolas Island is relatively limited, and until recently, poorly understood. Fortunately, the archaeological record of the island is relatively intact. Due to the island's remote locale, limited access, and lack of widespread development, San Nicolas offers a rare glimpse into the past. Archaeological investigations on the island are limited to the early expeditions that used antiquated field techniques (Bowers 1890; Bryan 1970; Cessac 1882; Rogers 1930), and the later work conducted by Meighan, Eberhart, Rozaire, Reinman, and others (Meighan and Eberhart 1953; Reinman 1988; Reinman and Lauter 1981, 1984; Reinman and Townsend 1960, Rozaire 1959, 1960). In recent years the U.S Navy directed and implemented a management plan for cultural resources on the island that included testing and evaluation of archaeological sites (Grenda and Maxwell 2006; Martz 1991, 1994a, 1994b; Schwartz 1994, 1995, 2007, Schwartz and Martz 1995). The faculty and students at California State University Los Angeles and Humboldt State University have provided the latest contributions to the archaeological record of San Nicolas (Ainis et al. 2014; Bartelle et al. 2010; Cannon 2006; Guttenberg et al. 2013; Kendig et al. 2010; Knierim et al. 2013; Smith et al. 2015). These recent studies involved large-scale excavations that employed modern archaeological techniques, which allowed for in-depth analysis of domestic activities, ceremonial use of space, trade, and socio-political organization (Cannon 2006).

The initial interest of CA-SNI-25 as a site with enormous research potential came out of the island-wide index unit study conducted between 1991-2001 (Martz 2008), as well as the Malcolm Rogers field notes previously discussed. Data from the index unit investigation dated the site to the Late Holocene, and revealed the largest stone artifact assemblage of all the sites in the study, including exotic lithic materials such as obsidian, fused shale, and chalcedony (Martz 2008). These data suggest that Late Holocene inter-island trade and social interaction were occurring at the site. Additionally, a dog burial was discovered at 90-102 cm below datum in the lower dark stratum of one of the original test units. Dog and other animal burials have been reported on the southern Channel Islands (Hale 1995; Raab et al. 2009) and are an indication of ceremonialism and social complexity. The interpretation formulated from the results of the index unit investigation of CA-SNI-25 is that "the assemblage represents dense, layered, domestic refuse from a fairly substantial residence site" (Martz 2008). That information coupled with the descriptions of the village site and cemetery provided by Rogers, suggested that CA-SNI-25 might have been a significant Late Holocene village on San Nicolas.

For this thesis I will examine several material types to explore the spatial organization at CA-SNI-25. I examine sandstone saw abraders and circular shell fishhooks to better understand activity areas associated with shell fishhook production. I examine formal lithic artifacts fashioned from both local and extra-local toolstone to explore the patterns of stone tool use in both domestic and ceremonial applications. Furthermore, the presence and use of extra-local lithic material is evidence of regional trade (Cannon 2006:89), and the spatial distributions of such materials may indicate extensive inter-island social interaction at CA-SNI-25. Lastly, I examine the distribution of calcite crystals and red ochre to examine the use of possible ceremonial materials in context with the numerous features observed at East Locus.

Field Methods

Excavations at CA-SNI-25 began in 2001 and were completed in 2009. However, the initial investigations of CA-SNI-25 began in 1996 as part of the index unit program designed to "determine settlement patterns, subsistence strategies, and cultural sequences on the island" from a sample of approximately ten percent of the prehistoric sites on San Nicolas (Martz 2008). The index unit program was also designed to determine the eligibility of archaeological sites on San Nicolas for inclusion into the National Register of Historic Places (Martz 2008).

In 2001, the Humboldt State University (HSU) field school began the archaeological testing of CA-SNI-25 by collecting a series of auger samples in order to target the areas of the site with the most intact midden deposits. Two sets of 1m x 1m test units were established in locations derived from the results of the auger samples, Units 1 and 2, and Units 10 and 11, the latter of which would later be expanded into the loci known as Mound B. During the field seasons of 2002-2003, the California State University Los Angeles (CSULA) field school established three additional sets of test units, Units 3-8. Units 7 and 8 had clearly visible features in the stratigraphy and were revisited the following field season by the HSU field school and re-opened and expanded. The expansion of Units 7 and 8 would later become the loci known as East Locus (Figure 4.1). As described in the previous chapter, East Locus was expanded from Units 7 and 8 to expose the numerous features and dense and complex midden deposits that were encountered. Because of the complexity of features and the opportunity to explore a number of social activities at this locus, I have concentrated the focus of this thesis on East Locus.

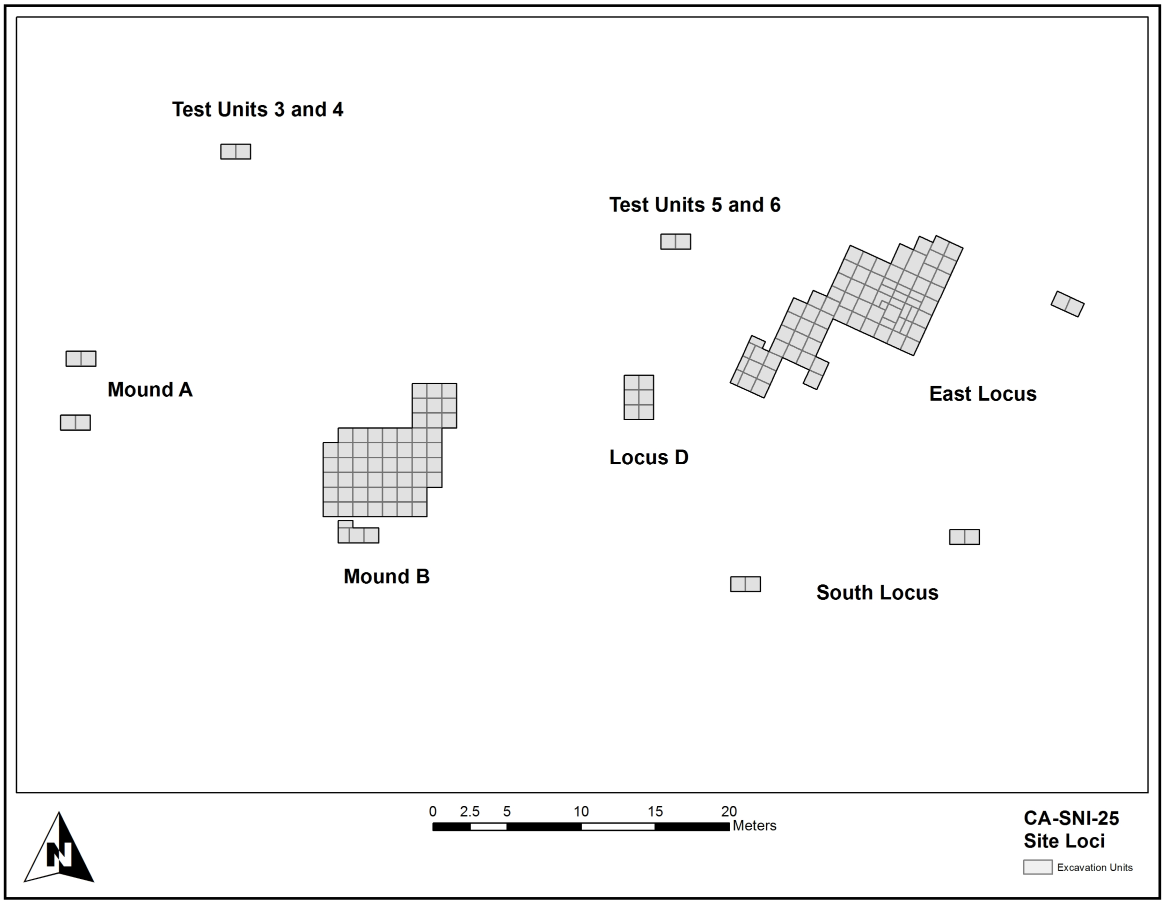

Figure 4.1 Site map of loci and excavation units at CA-SNI-25.

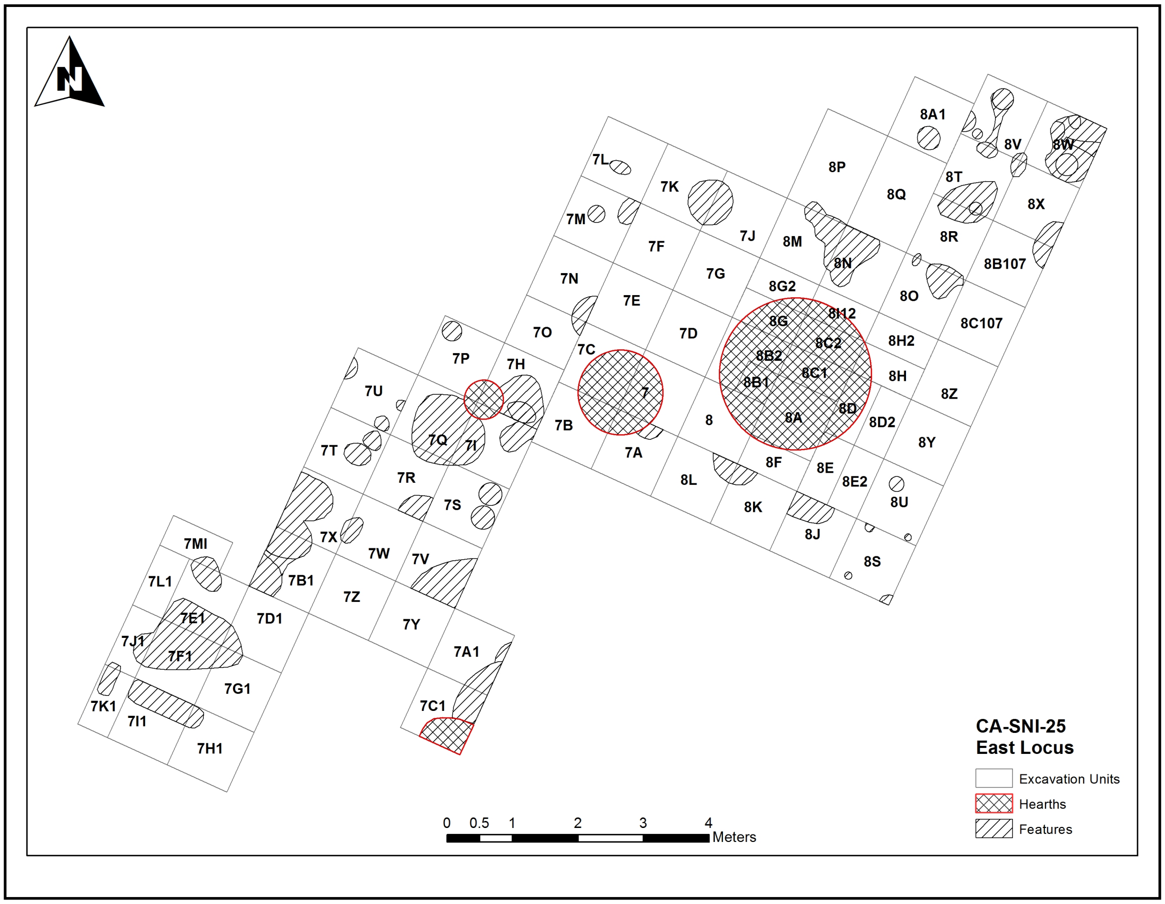

Figure 4.2 East Locus unit grid and features, CA-SNI-25.

Additional work that took place in the spring of 2004 involved a complete survey and mapping of the entire site boundary with the use of a survey transit (Merrill 2004), and the excavation of the four units that comprise South Locus, Units 60-63. To effectively map the site for proper provenience, a site datum was established on a concrete pad north of Building 115, and a grid was created to conduct a systematic survey and mapping of the site.

Most of the excavations at CA-SNI-25 were performed using stratigraphic excavation techniques (Cannon 2006). Excavations were highly detailed and were conducted using trowels, brushes, bamboo skewers, aspirators, dustpans and scoops. Arbitrary 10 cm levels were used within stratigraphic deposits. Transitional layers between strata were designated with a Roman numeral and a letter (e.g., Strata IIA) (Cannon 2006). Any features encountered were excavated separately and were given a unique feature field designation. For the purposes of this study, I have renamed pits and features from East Locus to maintain consistency (Figure 4.3 Table 2).

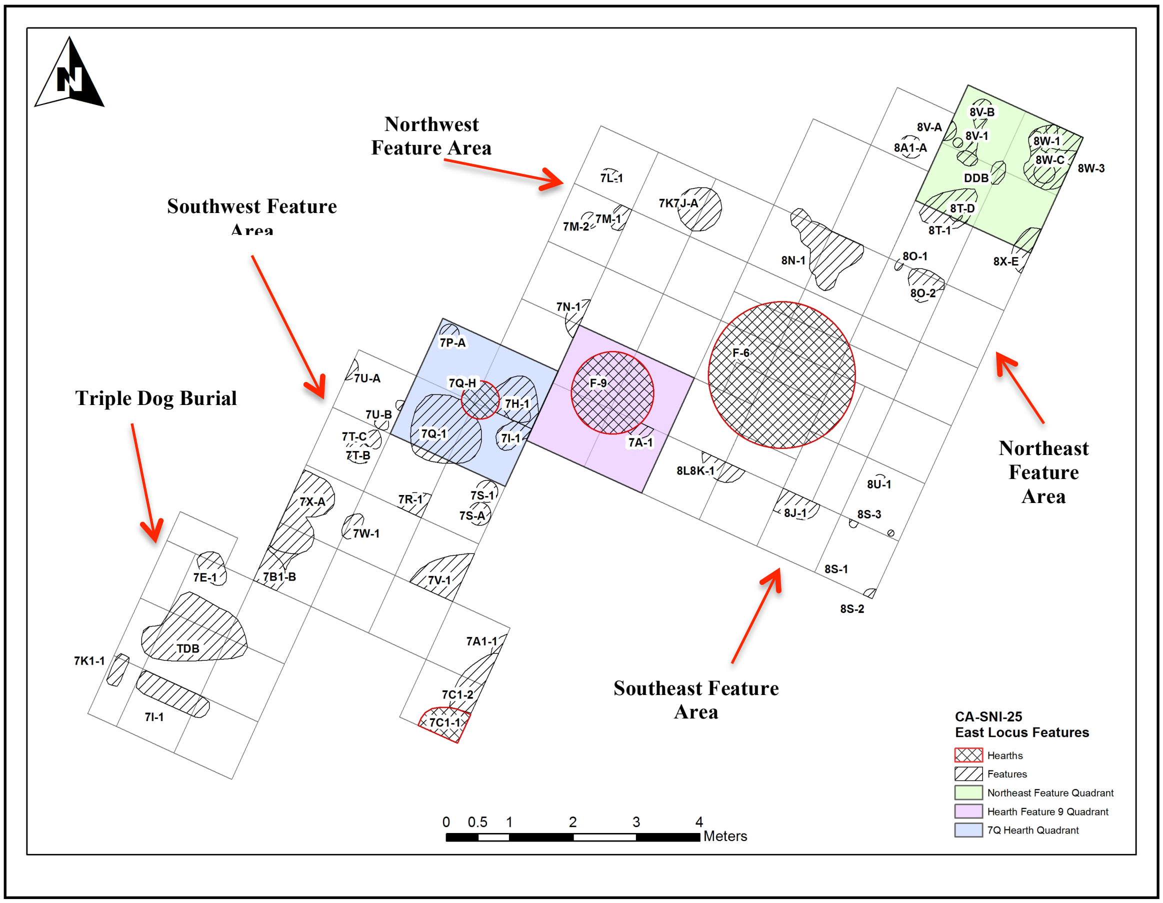

Figure 4.3 Feature map of fire hearths, pits, and features at East Locus. Also shown are Feature Areas and Quadrants.

Table 2. Feature table with descriptions of pits and features at East Locus.

Feature Area	Feature	Unit(s)	Description	Feature Designation
7Q Hearth Quadrant	Feature 7H-1	7H	Fishing Tackle Kit feature, includes cache of shell fishhooks and blanks, and tools used in the manufacture of hooks. Associated with ashpahtum with basketry impressions.	7H-1
	Pit 7H-A	7H	Small circular pit feature within a larger pit (7H-1). Larger pit feature contains Fishhook Tool Kit.	7H-A
	Feature 7I-1	7I	Fox Burial Feature. Skeletal remains of two foxes, *U. littoralis* buried within a pit.	7I-1
	Pit 7P-A	7P	Circular feature containing charcoal, charred fishbone and shellfish fragments.	7P-A
	Feature 7Q	7Q, 7I, 7R	Oval-shaped pit feature containing abundant faunal material, lithics, and fishhook fragments. Associated with fox burial (7I-1), and small hearth (7Q-H).	7Q-1
	7Q Hearth Feature	7H, 7I, 7P, 7Q	Small circular fire hearth containing charred sea mammal and fish bone.	7Q-H
Hearth Feature 6 Area	Hearth Feature 6	8, 8A 8B1, 8B2, 8C1, 8C2, 8D1, 8E1, 8G1, 8G2, 8H1, 8H2, 8I1/2,	Large circular fire hearth. Level above feature containing cultural consituents: *H. cracherodii*, lithics, sea mammal bone, FAR, fishhooks.	F-6
Hearth Feature 9 Quadrant	Feature 7A-1	7A	Small circular depression found in the northwest corner of unit.	7A-1
	Hearth Feature 9	7, 7A, 7B, 7C, 7E, 7D	Medium sized circular fire hearth.	F-9
Northeast Feature Area	Pit 8A1-A	8A1-A	Small circular pit feature located on the south side of unit.	8A1-A
	Feature 8N-1	8N, 8M, 8P	Land Snail Feature, a cluster of land snails (*Micrarionta* spp.) embedded in well-compacted soil.	8N-1
	Feature 8O-1	8O, 8R	Abalone Feature, a small pit (20 cm in diameter) containing a concentration of H. cracherodii fragments. Found in association with charred bone and shellfish fragments.	8O-1

Feature Area	Feature	Unit(s)	Description	Feature Designation
	Feature 8O-2	8O, 8R	Large circular pit (50 cm in diameter) containing charcoal, charred shell and bone fragments, and a bead blank.	8O-2
Northeast Feature Quadrant	Feature 8T-1	8T	Stacked stone/rock cairn feature, associated with redwood, obsidian, groundstone, flaked stone, sea mammal and fish bone, and an *Olivella* sp. bead. Associated with Pit 8T-D	8T-1
	Pit 8T-B South	8T	Small circular pit feature found on north side of unit.	8T-BS
	Pit 8T D	8T, 8R	Large pit feature containing another discrete feature, 8T-1, a rock cairn/stacked stone feature.	8T-D
	Feature 8V-1	8V	Shallow Trench Feature, associated with two small circular pits to the north and south.	8V-1
	Feature 8V-2	8V	Small circular feature with light-colored soil, possibly a post hole.	8V-2
	Pit 8V-A	8V	Small circular pit feature	8V-A
	Pit 8V-B North	8V	Small circular pit feature	8V-B
	Feature 8W-1	8W	Fishhook Kit Feature within Pit 8W-C.	8W-1
	Pestle Feature 8W-2	8W	Pestle Feature within Pit 8W-C.	8W-2
	Feature 8W-3	8W	Light Soil Feature, area of light-colored sand within Pit 8W-C.	8W-3
	Pit 8W-C	8W	Large pit feature that contains other discrete features, including a Fishhook Kit Feature (8W-1), Pestle Feature (8W-2), a light soil feature (8W-3), and a small circular pit (8W-CW).	8W-C

Feature Area	Feature	Unit(s)	Description	Feature Designation
	Pit 8W-C West	8W	Small circular pit feature within Pit 8W-C.	8W-CW
	Pit 8X-E	8X, 8B107	Half eliptical-shaped pit feature found on the east wall of units.	8X-E
	Double Dog Burial	8T, 8V, 8W, 8X	Dog Burial feature with two fully articulated dogs (*C. familiaris*)	DDB
Northwest Feature Area	Pit 7K-A	7K, 7J	Pit feature (7K-A) associated with a cluster of 17 Toshaawt Stones (Feature 7J-1)	7K7J-A
	Feature 7L-1	7L	Bird Bone Cluster Feature, (*Phalacrocorax* spp, *Pelecanus* spp.)	7L-1
	Feature 7M-1	7M	Large (approx. 30 cm in diameter) circular depression containing charcoal, shellfish, and bone.	7M-1
	Feature 7M-2	7M	Small circular pit feature	7M-2
	Feature 7N-1	7N, 7O	Pit feature contatining charcoal, charred shellfish and fishbone fragments, lithics, tarring pebbles with asphaltum, and a modified shell.	7N-1
Southeast Feature Area	Feature 8J-1	8J	Oval-shaped depression found in the northwest corner of unit.	8J-1
	Feature 8L-8K	8L, 8K	Small circular feature with dark soil and ash.	8L8K-1
	Feature 8S-1	8S	Small circular pit with a cache of Morning Glory (*C. macrostegia*) seeds.	8S-1
	Feature 8S-2	8S	Canoe Effigy Feature or re-caulking tool.	8S-2
	Feature 8S-3	8S	Metavolcanic handaxes	8S-3
	Feature 8U-1	8U	Small circular pit containing ochre, tarring pebbles, calcite, iron, concretions, charred faunal remains.	8U-1
	Feature 8U-2	8U	Small circular pit feature	8U-2
Southwest Feature Area	Feature 7A1-1	7A1	Course-Grained Sand Feature, found in northeast corner of unit.	7A1-1

Feature Area	Feature	Unit(s)	Description	Feature Designation
	Pit 7B1-B	7B1	Medium-sized pit feature found in the southwest corner of unit.	7B1-B
	Hearth Feature 7C1-1	7C1	Small fire hearth in the southeast corner of unit, associated with a coarse-grained sand feature (7C1-2)	7C1-1
	Feature 7C1-2	7C1, 7A1	Large pit feature found on east side of units, associated with Hearth Feature 7C1-1.	7C1-2
	Feature 7R-1	7R	Fishing Kit Feature, includes fishhooks and fragments.	7R-1
	Feature 7S-1	7S	Fox Burial Feature	7S-1
	Pit 7S-A	7S	Small circular pit feature	7S-A
	Pit 7T-B	7T	Small circular pit feature	7T-B
	Pit 7T-C	7T	Small circular pit feature found in northeast corner of unit.	7T-C
	Pit 7U-A	7U	Small circular pit feature found on west wall of unit.	7U-A
	Pit 7U-B	7U	Small circular pit feature found in southeast corner of unit.	7U-B
	Pit 7U-C	7U	Small circular pit feature found on east wall of unit.	7U-C
	Feature 7V-1	7V-1	Tarring Pebble Feature, cluster of tarring pebbles.	7V-1
	Feature 7W-1	7W, 7X	Fishing Kit Feature, includes fishhooks and fragments.	7W-1
	Pit 7X-A	7X, 7B1	Large pit feature found on west side of unit.	7X-A
Triple Dog Burial Area	Dog Burial 2009	7E1	2009 Dog Burial Feature, two fully articulated small dogs (*C. familiaris*)	7E-1
	Feature 7I1-1	7I1, 7H1	Disarticulated Dog Feature, includes disarticulated remains of a small dog (*C. familiaris*)	7I1-1

Feature Area	Feature	Unit(s)	Description	Feature Designation
	Feature 7K1-1	7K1, 7J1	Disarticulated Dog Feature, includes disarticulated remains of a small dog (*C. familiaris*)	7K1-1
	Triple Dog Burial	7E1, 7D1, 7G1, 7F1, 7J1	Triple Dog Burial Feature, includes remains of three small dogs (*C. familiaris*).	TDB

All excavated soils were collected into liter-graduated buckets to maintain soil volume. Volume of excavated soils was recorded for each stratigraphic level and screened through 1/8” mesh. Soil samples and numerous radiocarbon samples were collected for each strata and feature. Strata and features were characterized by soil type, color, and archaeological contstituents. Soil type was characterized using texture descriptions for perceived percentages of sand, silt and clay, and soil color was determined with a Munsell Soil Color Chart.

Several datum locus markers were established over the course of the field seasons, and existing datums had to be re-located as the loci expanded. The locations of the last remaining datum markers were collected via GPS during the field season of 2010, and those data were used to construct the GIS model employed in this study (Figure 4.4). Depths of excavations were recorded using line-levels attached to datum stakes with known elevation.

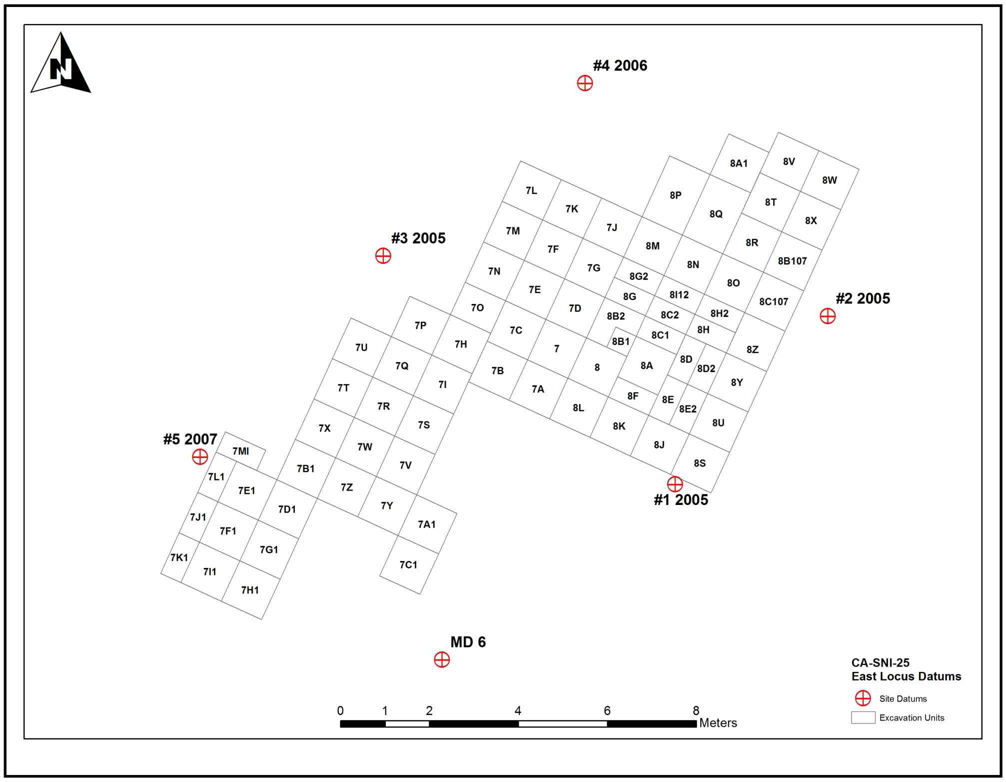

Figure 4.4 East Locus datum locations.

Materials collected from the 1/8” screens were sorted into general categories (e.g. bone, shell, lithic), and bagged and labeled accordingly. Formal artifacts were separated and, if found *in situ,* provenience data was recorded. Screen residuals were collected and bagged separately. All materials were then further processed and analyzed in the field laboratory on San Nicolas before being transferred to the labs at HSU and CSULA.

It is important to note that intrasite spatial analysis utilizing GIS requires data collected from large-scale open excavations. CA-SNI-25 offers a unique opportunity to examine artifact and feature distributions using this technology, and this thesis is intended to open the door for more research employing these techniques and others yet to be conceived.

GIS in Archaeology

Over the last 50 years archaeologists have developed and applied methods of spatial analysis to their research to more fully understand the contextual relationships between the distributions of sites, features, and artifacts (Hodder and Orton 1976; Dacey 1973; Bartlett 1974; Whallon 1973, 1974). Spatial statistics were developed by and borrowed from the fields of human geography and plant ecology (Clark and Evans 1954; Cox 1981; Getis 1964; Getis and Franklin 1987; Getis and Ord 1992; Hodder and Orton 1976; Ord 1975; Pinder et al. 1979). Spatial statistics, as opposed to non-spatial statistics rely on measures of distance between features and allow for the analysis of features in contextual relation to one another. Data are treated as geographic phenomena in a statistical sense (Mitchell 2009), and patterns of distribution can not only be visually observed, but statistically quantified. Such patterns may then be identified as clustered, dispersed, or randomly distributed (Hodder and Orton 1976; Mitchell 2009). Archaeologists began applying these methods to better interpret spatial distributions of archaeological phenomena in both time and space (Bartlett 1974; Dacey 1963, 1973; Hodder and Orton 1976; Whallon 1973, 1974).

As the use of computers and data processing technologies developed the analysis of very large data sets became attainable. This enabled researchers to apply the use of computer programs to run the complex mathematical operations that were previously performed by hand. Until this time, complex statistical analysis of large sets of data was difficult, if not impossible (Connoly and Lake 2006; Wheatley and Gillings 2002).

Recently, the introduction of GIS software products has increased the potential for applying spatial statistics in archaeological research. Over the last decade, the use of GIS has become commonplace. The software has been innovated to a user-friendly platform that is Windows based and accessible to an intermediate computer user. The early editions of this technology required a background in computer programming and were available only to the ardent specialist. Currently, the consumer software available is less expensive, efficiently designed, and widely used by novices and experts alike. ArcGIS 10.2, a product of Environmental Systems Research Institute (ESRI), performed all of the operations and analyses conducted in this study.

Despite the ease of access to GIS products there is still a significant learning curve associated with the application of these methods. Furthermore, most users employ the visualization capabilities of the software to produce maps and graphics, and the data management capabilities for storage and access of data. Relatively few studies fully utilize the analytical capabilities of the software (Kvamme 1999; McCoy and Lagefoged 2009; Lawson 2007).

This is not to imply that the spatial statistics performed by GIS software are revolutionary in any way. In fact, the operations offered by a GIS are nothing new, and are not intended as a replacement for non-spatial statistics performed by other software programs (Sharon et al. 2004). Rather, I demonstrate that GIS can be used in tandem with non-spatial statistics and other forms of analysis as a method for testing and confirming hypotheses. The intent of this thesis is to utilize GIS to enhance non-spatial statistical methods on data that are the subject of ongoing research currently being conducted on San Nicolas. I further contend that these methods may be effectively used in archaeological research elsewhere on the Channel Islands.

Spatial Analysis Methods

For the purposes of this thesis I constructed a map series of the site showing distributions and statistical clustering of excavated data using ArcGIS spatial autocorrelation and hot spot analysis. The excavated data analyzed include: circular shell fishhooks, sandstone saw tools, flaked and ground stone tools of local and exotic materials, pigments, and quartz and calcite crystals. I examine the spatial association of these artifacts and materials in context with pit features, hearths, dog burials, and other "ideological features" (Hale 1995) (Figure 4.5). The materials are displayed in a series of GIS base maps for analysis and presentation. The base maps utilize the analog survey data collected in 2004 combined with GPS coordinates of datum points and unit locations collected in the field in 2010. Locational data were collected in 2010 using a Trimble GeoX with a Zephyr antenna, providing an accuracy of ± 11 cm after differential correction. I tied-in datum points from the 2004 survey (Merrill 2004) with additional coordinates of unit corners and feature locations to increase the accuracy of the field data (Figure 4.6).

Figure 4.5 View of Features at East Locus: *clockwise from upper left:* stacked stone feature (8T-1), view of pit features within Southwest Feature Area, and Dog Burial Feature.

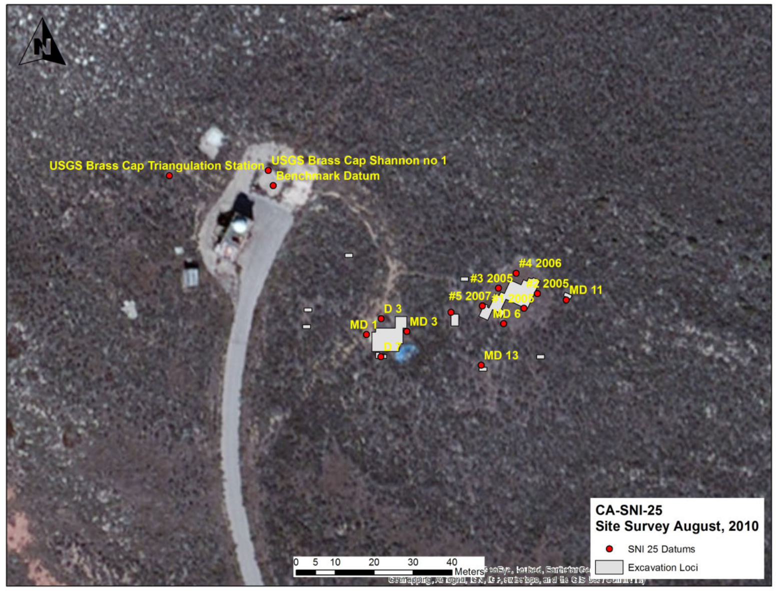

Figure 4.6 GPS Survey, August 2010: *(left)* Photo of data collection in the field, *(right)* aerial view of survey area.

I combined the 2004 survey data with recent georeferenced data by calculating the offset coordinates, thus converting the original analog data to a digital format. This process produced a base map showing the datum points and the outline of unit grids in each loci. The unit grids were digitized using the Delta XY editing function creating individual polygons of exact size. The result is direct representation of loci grids with accurate unit dimensions. The data were summarized into the unit areas, which are generalized to the unit grids of each respective loci. Data summarized into units (mostly 1x1 m) in this way are treated in the same manner as population data in census tracts. Distance is measured from the unit centroid, and must be analyzed in the context of scale, which in this case, is on the loci level (Mitchell 2009).

Once the locational data were reconciled and fully digitized I visually analyzed the spatial distributions and conduct statistical operations using the ArcGIS 10.2 spatial statistics toolbox. Data visualization consists of displaying the summarized data in distribution maps of features across each loci. Data may then be symbolized and displayed stratigraphically. Statistical operations included Moran's *I* spatial autocorrelation and Getis-Ord Gi* hot spot analysis (Getis and Ord 1992; Hodder and Orton 1976; Mitchell 2009).

Spatial autocorrelation is an operation that shows statistical clustering at defined distance intervals. Hodder and Orton (1976) discuss early applications of spatial autocorrelation and describe the method in terms of scale and measure of distance between features (see also Whallon 1973, 1974). Spatial autocorrelation statistics, such as Moran's *I* and Geary's *C*, are based on measurements of Euclidean distance between neighboring features in the dataset (Hodder and Orton 1976; Mitchell 2009). In ArcGIS, the Moran's *I* spatial autocorrelation tool is designed to run at different parameters to determine the distance interval (Mitchell 2009). Replicative studies conducted informally show debris fields from various tool manufacturing activities at approximately a 2 m radius (Kendig et al. 2011; Smith, personal communication, 2010). Thus, the expected distance interval is around 2 meters. The results from the spatial autocorrelation met my expectations. Most of the distance intervals are set between 2 - 2.5 meters (Figure 4.7).

Hot spot analysis is based on the Getis-Ord-Gi* statistic (Getis and Ord 1992; Mitchell 2009). This analysis shows the patterns and locations of high and low values of statistical clustering based on the distance interval defined by the spatial autocorrelation tool. The values of clustering are actually a z-score that is produced as a result of the operation (Mitchell 2009). A statistically positive z-score will render visual clustering of features on the map, and small or negative z-scores will show areas with little or no clustering. (Figure 4.7)

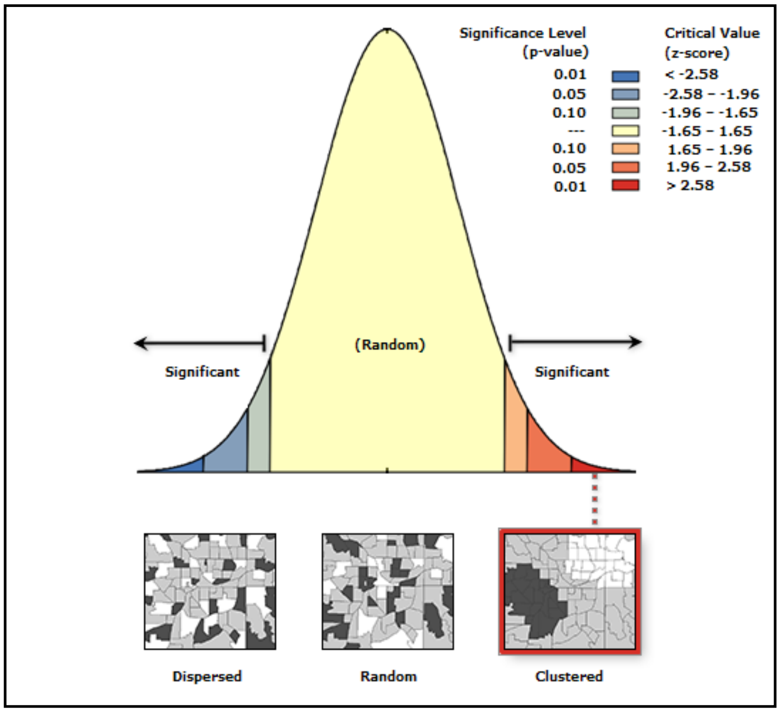

Figure 4.7 ESRI Spatial Autocorrelation z-score illustration. This illustration shows the curve of the z-scores and how they are visually rendered in the hot spot maps. Areas of significant clustering are shown in red, and areas of dispersed clustering are displayed in blue.

Both statistical operations are based on Euclidean distance and nearest neighbor statistics that imply association between features. Conceptually similar to nearest neighbor statistics these operations are based on the notion that things that are close to one another are more related than things that are farther apart (Clark and Evans 1954; Dacey 1963, 1973; Getis 1964; Getis and Franklin 1987; Getis and Ord 1992; Mitchell 2009). Other authors have described the problems and limitations of nearest neighbor statistics in archaeological research (Merrill 2004; Merrill and Read 2010). I will argue, however, that the application of spatial statistics in archaeology is useful, especially when combined with multiple lines of contextual evidence such as comparative analysis of ethnographic and ethnohistoric accounts, replicative experiments, non-spatial statistics, high-precision radiocarbon dating, and other methods that suggest relationships between variables.

Materials Analyzed

To explore the designation and use of space at CA-SNI-25 I analyzed several types of materials that represent different activities. I selected materials and artifacts that represent both utilitarian and ceremonial activities. This allowed me to identify use and activity areas on an intrasite level. The comparison of spatial relationships between sandstone saws, fishhooks, and lithics will help to better define areas of utilitarian space, while the spatial associations of ochre and clear crystals help to define ceremonial space at East Locus.

First I explore the distributions of sandstone saw abraders and circular shell fishhooks. Previous studies suggest that the saws were used in the production of shell fishhooks (Kendig et al. 2011; Guttenberg et al. 2013; Smith et al 2015). My previous work has helped demonstrate the associations between the two items by showing that both saws and hooks share a spatial relationship (Guttenberg et al. 2013). The areas at East Locus that show higher density of saws and hooks likely represent areas of fishhook manufacture. To better define these areas of utilitarian tool use and production I analyzed a sample of lithic materials. I focus on the distribution of formal tools such as projectile points and bifaces, and incorporate a sample of local and imported lithic debitage and reduction cores. This allows me to compare the distributions of both local and extra-local lithic materials from the sample of formal artifacts, cores, and debitage.

To identify ceremonial space at East Locus I also incorporate my previous research by examining the distribution of red ochre (Guttenberg et al. 2013). Red ochre found in context with features thought to be ceremonial in nature, such as cache pits and dog burials, implies that pigments were used in religious practice. I augment this analysis by examining the spatial distributions of quartz and calcite crystals at East Locus. Knierim has explored the use of calcite and quartz in ceremonial context at CA-SNI-25 (Kneirim et al. 2012). By comparing the spatial signatures of both red ochre and crystals in context with features associated with religious practice I am able to infer and delineate areas of ceremonial space at East Locus.

In the following sections I provide the descriptions and attributes of the materials I analyzed for this thesis.

Lithic Materials

The lithic assemblage at CA-SNI-25 consists mostly of metavolcanic and metasedimentary expedient tools, flakes, cores and debitage. Locally obtained sandstone was also used to produce a wide range of groundstone items including bowls, mortars, and pestles (Hudson and Blackburn 1987; Thomas-Barnett 2004). However, most of the formal lithic artifacts were produced from imported toolstone such as Monterey chert, Franciscan chert, steatite, serpentine, and obsidian. I have selected a sample consisting of all formal artifacts produced from both local and imported toolstone, extra-local debitage, reduction cores of local lithic material, and sandstone debitage and fragments. To effectively compare the distributions between the local and extra-local toolstone I first must describe their source and attributes.

Local Toolstone

The lithic materials readily available on San Nicolas Island occur primarily as metavolcanic and metasedimentary cobbles outcropping from an Eocene-era conglomerate bed (Vedder and Norris 1963). As previously stated, cobble sources on San Nicolas occur mostly along beaches and are also found weathering out of drainages and inland blowouts (Clevenger 1982; Taylor 2012). The locally derived toolstone is not as fine-grained as obsidian and chert making it poorly suited for the production of formal tools. However, metavolcanic and metasedimentary toolstone was widely used in the manufacture of expedient tools (Figure 4.8). Clevenger (1982) describes the split cobble reduction sequence as the method of flake stone tool production on San Nicolas. The preliminary analysis of the collection of metavolcanic and metasedimentary reduction cores at CA-SNI-25 reveals patterns of flaked tool production consistent with Clevenger's reduction sequence (Taylor 2012) (see Appendix A.1).

Figure 4.8 Local Lithic Toolstone, *(l)* Example of cobbles that served as raw materials for production of expedient tools; *(r)* example of flakes and expedient tools of local lithics.

As previously discussed, sandstone comprises much of the islands geologic composition (Vedder and Norris 1963). Sandstone was widely used for groundstone tool production on San Nicolas (Hudson and Blackburn 1983; Thomas-Barnett 2004), and is found throughout the archaeological record on the island (Figure 4.9). San Nicolas Island sandstone is often highly indurated, dense and extremely hard (Thomas-Barnett 2004), making it useful as a raw material for both groundstone and expedient flake stone tools

(Kendig et al. 2010). Constant cortical weathering of sandstone shingles within the island’s surf zone produces an abundance of naturally polished sandstone cobbles thought to be used in the production of groundstone artifacts, and the sandstone saws discussed in this thesis (Kendig et al. 2010; Rogers 1930). I incorporate all sandstone artifacts, debitage, and fragments into my analysis of local toolstone at CA-SNI-25 (see Appendix A.2 and 3).

Figure 4.9 Sandstone Artifacts, *from left*: sandstone bowl, sandstone pestle.

The artifacts referred to as sandstone saws have been extensively studied (Kendig et al. 2011; Guttenberg et al. 2013; Smith et al. 2014). Malcolm Rogers first described artifacts as stone saws in his field notes on San Nicolas Island (Rogers 1930). The saws are lenticular in shape and often appear to have visible use wear, residue, or other evidence of utilization (Figure 4.10). For this thesis I limit my analysis of sandstone saws to their spatial distribution in relation to shell fishhooks and features at East Locus. There were 74 saws and fragments collected from excavations at East Locus (Appendix A.4).

Figure 4.10 Sandstone saws with use-wear and residue.

Extra-local Toolstone

The presence of extra-local lithic material at CA-SNI-25 is significant because it is indicates that residents of Tule Creek Village participated in the widespread network of trade and exchange that occurred throughout the Southern California Bight in the Late Holocene. Imported lithic materials such as chert (Monterey, Franciscan, and Cico chert), chalcedony, obsidian, steatite, and serpentine, are all found at East Locus. The characteristics and possible source of each of these materials is presented next.

Flaked stone artifacts and debitage of imported toolstone found at CA-SNI-25 are primarily chert and obsidian. Chert is a fine-grained cryptocrystalline and siliceous sedimentary rock that is found in beds or bands in rock units such as the Monterey and Franciscan formations. Monterey banded chert varies in color from tan to light or dark brown with its characteristic white banding. Monterey chert generally occurs along the

California coast extending from north of the San Francisco Bay area to Oceanside (Cannon 2006:81). The closest sources of Monterey chert to San Nicolas occur on Santa Cruz Island and the Palos Verdes Peninsula. Franciscan chert varies in color from green to red and occurs along the coastal zone from the Santa Barbara region to Oregon (Cannon 2006:81). Cico chert is a chalcedonic chert found on San Miguel Island and has a distinctive translucent appearance varying in color from white, gray, buff, or brown (Erlandson et al. 1997).

Obsidian is a black or dark colored volcanic glass that is excellent for tool making. Obsidian may be dated or sourced through geochemical analysis, which makes its appearance in the archaeological record invaluable. Obsidian found at CA-SNI-25 has been sourced to the Coso Volcanic Field south of the Owens Valley, approximately 360 km (220 mi) from San Nicolas Island (Cannon 2006:81; Rick et al. 2001). Chert and obsidian represent approximately 80% of the extra-local debitage sample from East Locus (Figure 4.11; Appendix A.5).

Figure 4.11 Extra-local Lithics and Artifacts: *(l)* example of extra-local flakes and debitage, *(r)* extra-local formal artifacts, *from left*: steatite doughnut stone, Monterey chert projectile, Franciscan chert projectile, Monterey chert biface, serpentine pendant.

Imported lithic material was also used for the manufacture of groundstone artifacts such as beads, bowls, pendants, and effigies (Cannon 2006:81). Steatite and serpentine artifacts and fragments are found on San Nicolas Island. Steatite is a soft and malleable metamorphic rock that is widely used for carving effigies, arrow straighteners, and ornaments. Its fine-grained, talc-rich composition also allows the material to transfer heat well, making the stone useful for cooking implements, such as comals (Cannon 2006; Hudson and Blackburn 1987; Scalise 1994). Scalise (1994) describes two varieties of steatite obtained by the Nicoleño from Santa Catalina Island, course-grained and fine-grained (Scalise 1994:65). The softer, course-grained steatite was used in the manufacture of bowls, comals, and arrow shaft straighteners. The fine-grained steatite has greater hardness and density, making it better suited for beads, effigies, and ornaments (Scalise 1994:65). Steatite varies in color from pale green to deep emerald green, but may also be lighter gray with inclusions of white veins.

Serpentine is a mineral that composes serpentinite, a metamorphic rock that has also been found at CA-SNI-25 in the form of beads, effigies, ornaments, and groundstone ceremonial objects (Cannon 2006:81; Kneirim et al. 2011). The source of serpentinite is primarily in Franciscan Formation geologic units on the coastal mainland, however, some potential sources have been reported on both the northern and southern Channel Islands (Cannon 2006; Howard 2000; Rosen 1979:28). Serpentinite is generally green in color and relatively soft and easy to carve, making it well suited for the manufacture of ornaments and effigies. A total of 8 serpentinite items, and 24 steatite items, including both artifacts and fragments, have been recovered from excavations at East Locus and are included in my sample (see Appendix A.6).

Circular Shell Fishhooks

As previously discussed there has been abundant research into the production of fishhooks at CA-SNI-25, particularly in context with the sandstone saw abraders (Guttenberg et al. 2013; Kendig et al. 2010; Smith 2013; Smith et al. 2015). For this thesis I incorporate the data and results of these previous studies into my analysis of spatial context of artifacts and features at East Locus.

The raw material used for fishhooks is generally red abalone (*Halitotis rufescens*), which is common in the deeper waters around San Nicolas. Hooks are also crafted from black abalone (*Haliotis cracherodii*), mussel (*Mytilus californianus*), and Norris top-snail (*Norrisia norrissi*), (Strudwick 1986) (Figure 4.12). There are recovered from East Locus. A total of 275 circular, or incurved shell fishhooks, fragments, and fishhook blanks were recovered at East Locus, indicating that there was an intensive deep-water fishing industry employed at the site (Smith 2013)(see Appendix A.7).

Figure 4.12 Production sequence for shell fishhooks.

Red Ochre, Quartz, and Calcite Crystals

Red ochre, quartz, and calcite crystals are naturally occurring minerals that are found in sedimentary deposits on the island (Vedder and Norris 1963; Willams 1994). Quartz appears as cobbles in the Poway River conglomerate beds, and vein quartz and calcite are abundant in the sandstone bedrock throughout the island. Numerous outcrops of red ochre and other pigments such as limonite and kaolinite are also found scattered throughout the island. The minerals involved in this study are all easily found and collected on San Nicolas Island (Williams 1994). Kneirim posits "The presence of ochre and crystals are often indicators of religious practices at archaeological sites as well. Rock crystals, both modified and unmodified, have been found in countless ritual contexts throughout the world (see Geiger and Meighan 1976; Levi 1978; Brady and Prufer 1999; Hardy 2000; Koerper et al. 2002; and Thompson 2005). I believe that the distribution of these minerals in the archaeological contexts at East Locus provides some insight into the designation of ritual and ceremonial space.

A significant amount of red ochre was recovered from excavations at CA-SNI-25, and ochre stained soils were observed during excavations. Red ochre is commonly used as a pigment by various Native American cultures, and often appears in archaeological contexts and ethnohistorical accounts throughout Southern California (Hale 1995; McCawley 1996). Red ochre derives its color from the mineral hematite, which is a form of iron oxide (Figure 4.13). For use as a pigment, it is often ground in small mortars and mixed with other liquid materials, such as blood or animal fat, as a binder. This gives the mixture an adhesive quality and allows it to be applied to various surfaces (McCawley 1996:139). My sample of red ochre from East Locus consists of 1,113 chunks and fragments of ochre, totaling 1085.13 (g) (see Appendix A.8). I employ both total count and weight of the ochre sample in my analysis, which allowed me to discern variations in the use of ochre at East Locus.

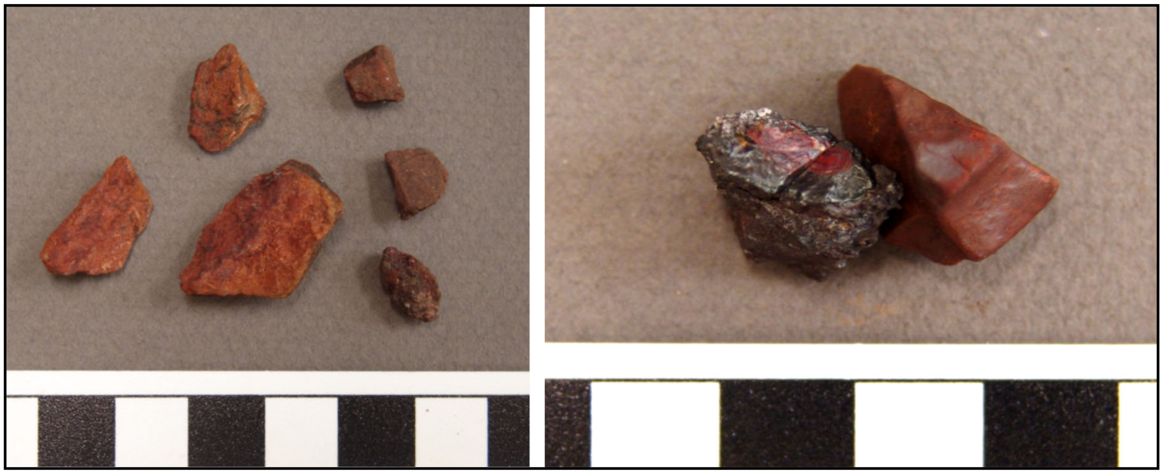

Figure 4.13 Red Ochre recovered from CA-SNI-25.

Quartz and calcite crystals were also recovered during excavations at CA-SNI-25 and observed to be located in context with various pits and features at East Locus (see Figure 4.14). Unmodified quartz and other types of clear and colored crystals occur in numerous cultural contexts in the Southern California Bight, as well as worldwide (Koerper et al. 2002; Levi 1978; McCawley 1996; Meighan 1959; Perry 2013; Williams 1990). Perry (2013) describes "shamanic toolkits" found on the Channel Islands as containing quartz crystals (see Figure 4.15 *a* and *b*). These toolkits were commonly used for healing, controlling weather, predicting future events, and ensuring safe travel (Perry 2013). Knierim further states "the Lemon Tank site (CA-SClI-1524) on San Clemente Island (Hale 1995) contains many ritual deposits comparable to that of East Locus. Among these, the numerous dog, fox, and raptor burials are perhaps the most recognizable similarities, but the various refuse pits and religious paraphernalia, including crystals, ochre, and steatite artifacts…" (Kneirim personal communication, 2014). Because of these data and accounts, I considered the distributions of quartz and calcite crystals at East Locus in my analysis. The quartz sample includes 603 pieces of debitage and fragments/shatter, totaling 978.36 (g) (see Appendix A.9). There are 24 calcite fragments in the sample, totaling 47.50 (g). I also analyzed the crystals by weight. (see Appendix A.10).

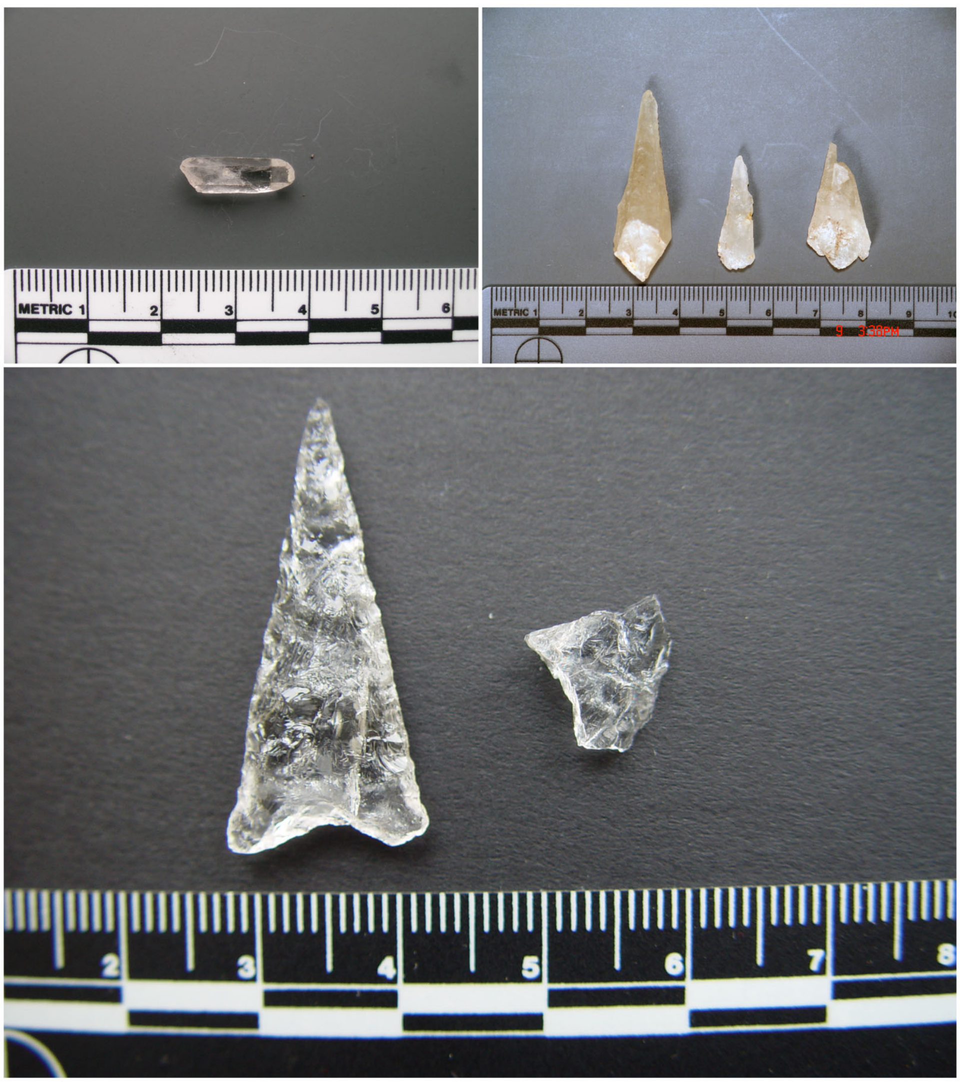

Figure 4.14 Quartz and Calcite, *from top left*: milky quartz crystal, calcite crystal, quartz projectile point with debitage.

Figure 4.15 (a) Photo of Possible Shamanic Toolkit, *from left*: *H. cracherodii* pendant, comorant beak, incised cormorant tarsometatarsus (*Phalacrocorax* sp.), quartz crystal. This kit also contained an iron concretion, or *Toshaawt* stone (see below).

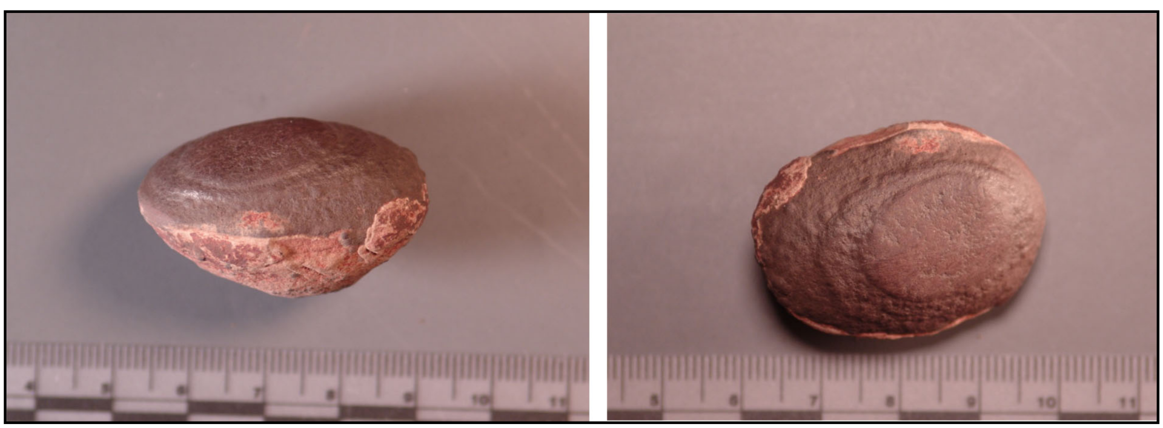

Figure 4.15 (b) Toshaawt Stone, example of an iron concretion, or *Toshwaat* stone, recovered from CA-SNI-25.

These materials, and the methods used to analyze them, are selected to visually explore the vast amount of data excavated from CA-SNI-25. The numerous features discovered at East Locus, and the abundance of valuable data available for analysis, present a unique opportunity to shed light on the nature of human behaviors at Tule

Creek Village. In the following chapter, I present the results of the GIS analysis. My results show variations in the use of space at East Locus, particularly in terms of differences between utilitarian and ceremonial activity areas.

CHAPTER 5

Results

My sample from CA-SNI-25 is ideal for intrasite GIS analysis. Large, open-area excavations allow for spatial dissection of the site across a temporal plane. Good preservation, excellent stratigraphic integrity, and numerous radiocarbon dates provide a solid foundation for spatial studies. By examining the distribution of artifacts and pigments I highlight the utility of intrasite GIS as a tool to understand a variety of past cultural phenomena.

For instance, I examine the distribution of sandstone saws relative to shell fishhooks and hook making debris to confirm spatially what has been suggested experimentally about the use of sandstones saws as an abrader for manufacturing shell fishhooks (Kendig et al. 2010; Guttenberg et al. 2013). Documenting the spatial distribution of saws and hooks and analyzing their clustering across the site allows me to make inferences about the organization of shell fishhook production, one of the most important technological innovations of the Late Holocene. To examine the role of pigments and crystals within a ceremonial context, I follow the distribution of ochre, quartz, and calcite crystals relative to ceremonial features such as pits, hearths, dog burials, and balancing stones. Understanding the distribution of ochre and crystals at East Locus allows me to address questions about how these materials were used in the past and how they were incorporated into ritualized activities, topics of global significance considering the great antiquity of pigment use by humans. The application of these methods to data sets collected sometimes over 100 years ago and to museum, university, and government collections worldwide will be explored in further detail in the discussion section, but first I present the results of my study at CA-SNI-25.

The results of my study were produced through a visual, quantitative, and contextual interpretation of the GIS map series I constructed for East Locus. The map series illustrates distributions and densities of materials by total sum of count (n) and weight in grams (g) per excavation unit. Density is calculated by soil volume as Σ (n) or (g)/m^3. I also produced maps depicting spatial clustering of artifacts and materials shown as hotspots. The comparison of distributions, densities, and spatial clustering of the artifacts and materials discussed in Chapter 4 revealed an interesting trend that suggests a separation in space between utilitarian tools and materials, and materials associated with ceremonial or sacred activity. This trend is especially interesting when considered in proximity to features, particularly the four hearth features. Overall, there appears to be a distinction between the activities that occurred around each of the hearth features, indicating possible designated use or activity areas. Additionally, spatial patterning is observed around many of the other various features described in the previous chapters (Table 2). These results help to characterize and better interpret the purpose of some of the features and the behaviors that may have been associated with them.

The first phase of my analysis consisted of displaying the summarized data for each of the artifact and material types in distribution and density maps for visualization of the features across East Locus. The data were symbolized and displayed stratigraphically. Despite the ability to compare the distributions of materials across the locus, it is difficult to quantify any patterns. The density maps do perhaps allow for a more accurate interpretation of the distributions of artifacts and materials across the locus, yet observations must remain generalized, and are limited to the "eyeballing" of distributions on the site map (Wheatley and Gillings 2002:142).

The second phase of my study was an exploratory data analysis using spatial autocorrelation and hot spot rendering of the pairs of artifacts and materials. These results allow for quantitative analysis of the spatial relationships between the pairs of artifacts and materials. The patterns are still compared visually, but they are rendered quantitatively. Some of the artifacts and materials demonstrated either minimal or no significant clustering when using the autocorrelation tool. In these cases I still ran the hot spot tool that produced a slightly different result. The Getis-Ord-Gi* statistic is different than spatial autocorrelation, and despite a random distribution result demonstrated through autocorrelation, the hot spot analysis may show some positive clustering of artifacts or materials that I believe to be useful in comparison. I followed this approach with my other samples that showed minimal clustering with the autocorrelation tool. For consistency in these cases I applied a 2 m distance interval to the parameters used to conduct the hot spot analysis. For example, very few of the materials and artifacts had positive clustering in Stratum I. I ran the hot spot tool nonetheless, and had some results showing positive clustering of some items in this stratum. I believe this approach is consistent with the methods used for my 2013 study (Guttenberg et al. 2013).

In the third phase of my study I interpreted the contextual relationships between the four artifact and material pairs, and how they possibly relate to one another based on their observed proximity to different types of features, such as fire hearths, cache pits, and dog burials. In each of the following sections I examine each of the artifact and material pairs in this manner. I then summarize these results at the conclusion of this chapter, and provide additional contextual analysis in Chapter 6.

Fishhooks and Sandstone Saws

The visual analysis of the map series depicting fishhook and sandstone saws shows the greatest distribution and densities of hooks and saws occur in stratum II. As stated in Chapter 3, Stratum I is characterized by wind-blown sand accumulated over the most recent deposits at the site, and is likely highly disturbed. Stratum II is largely intact, and these results are consistent with the complexity of materials and features observed in this stratum throughout the site (Cannon 2006). Fishhook production materials in Stratum I are observed on the northwest side of the large and medium sized hearth features on the northwest side of East Locus (Figure 5.1) The distribution of saws in Stratum I shows a similar pattern as saws are moderately distributed by total count, and generally appear within units containing features. The greatest density of saws appears north of Hearths F-6 and F-9. This is consistent with the density and distribution of hooks in Stratum I. A moderate density of saws is observed in both the Southwest Feature Area and Northeast Feature Quadrant of East Locus in Stratum I (Figure 5.1b).

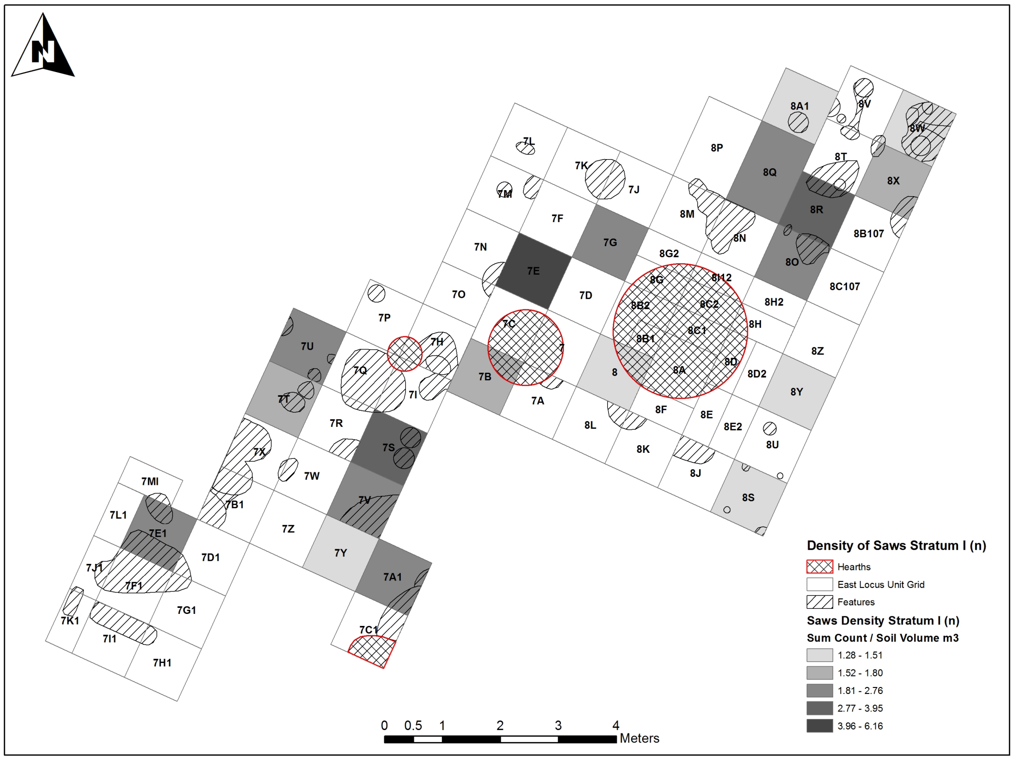

Figure 5.1 (a) Density of fishhooks in Stratum I.

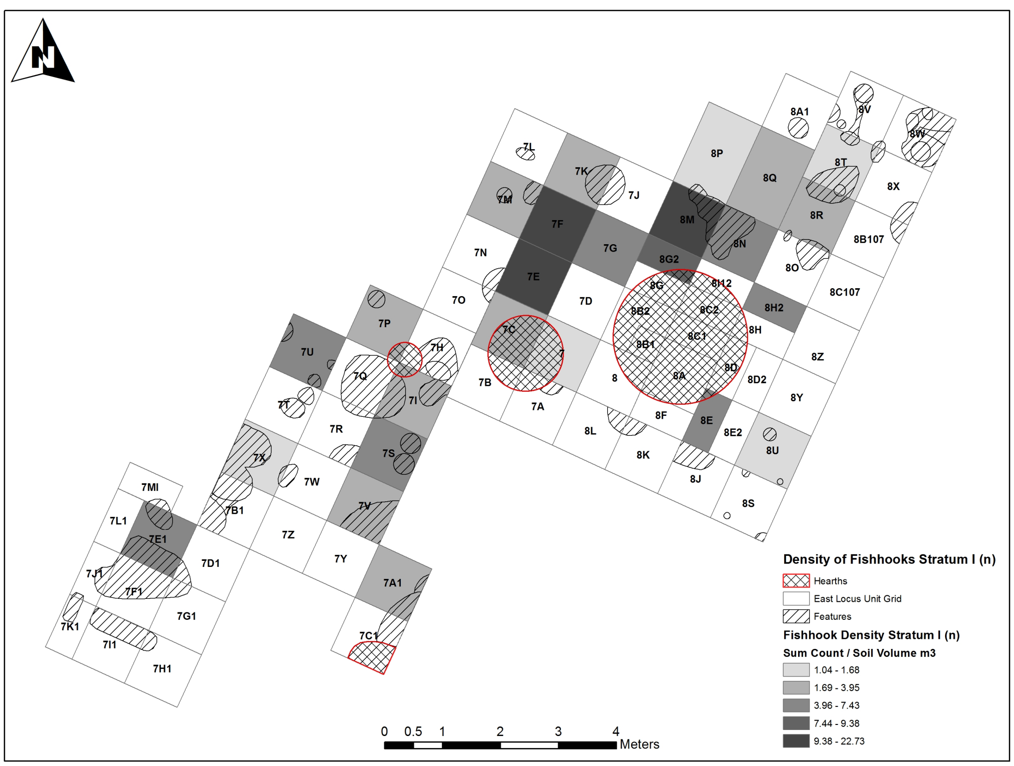

Figure 5.1 (b) Density of sandstone saws in Stratum I.

In Stratum II fishhook production appears to be centered around the 7Q Feature Quadrant, and in the Southwest Feature Area of East Locus (Figure 5.2a). Moderate densities of hooks also appear in association with the Northeast Feature Quadrant, and the southeastern side of Hearth F-6. Hook materials are also found within nine features at East Locus, with the greatest distribution observed in Pit 7Q-1, and Features 7K7J-A, 8T-D (Figure 5.3a).

As expected, the distribution and density of saws in Stratum II are seen in relative association with fishhooks, as both artifacts are generally found around hearths. All three hearths in the array show a great density of saws, particularly on the east side of Hearth F-6, north of Hearth F-9 (Figure 5.2b). Saws are also observed in great density in the southwest section of the unit grid in Units 7Z and 7Y, and around Features 7A-1, 7X-A, and Feature 7W-1, the latter of which is described in the field notes as a fishing kit feature. Saws are also found in three features, Features 7Q-1, 7X-1, and Pit 8T-D (Figure 5.3b). Two of these features, Pit 7Q-1 and Feature 8T-D also contained fishhooks.

The quantitative analysis of fishhooks and sandstone saws at East Locus showed relatively positive clustering patterns that help to confirm the functional linkage between the saws and fishhook production presented by Kendig et al. (2010). However, these results differ slightly from the 2013 study of the same materials (Guttenberg et al. 2013), which is due largely in part to a change in sampling. Saws in that study were analyzed in the aggregate and shown to cluster within all strata. The smaller sample size of saws when analyzed stratigraphically produced a more detailed comparison that provided some different results. The autocorrelation function indicated random distribution of both materials in Stratum I, and positive statistical clustering of fishhooks in Stratum II at a

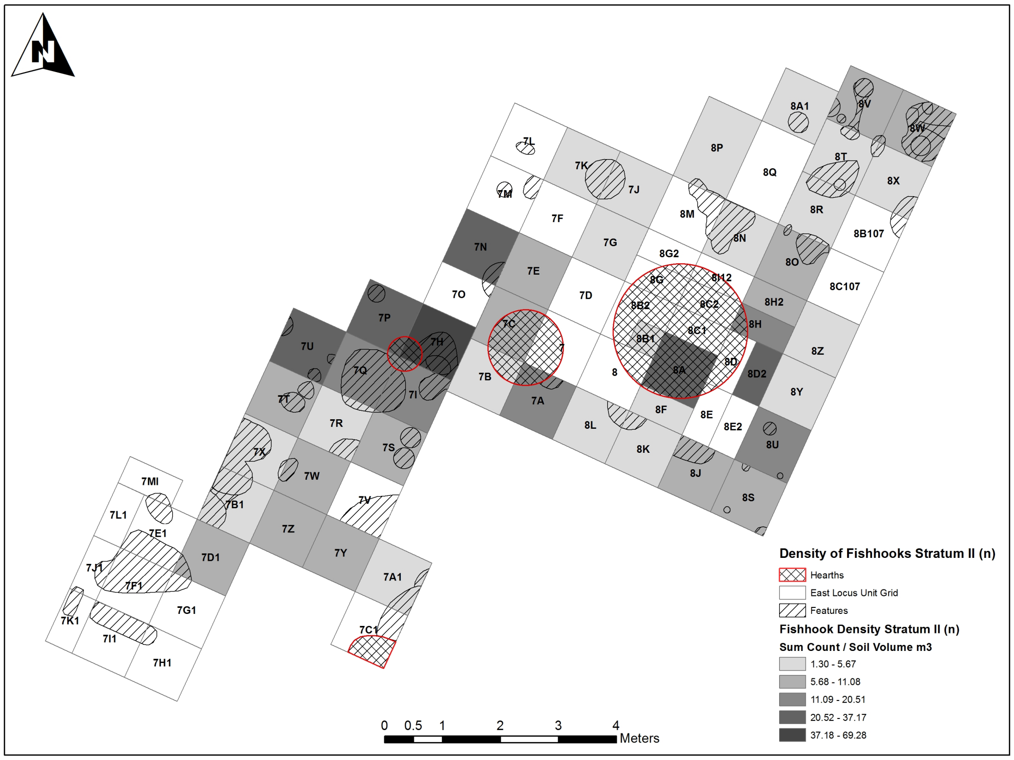

Figure 5.2 (a) Density of fishhooks in Stratum II.

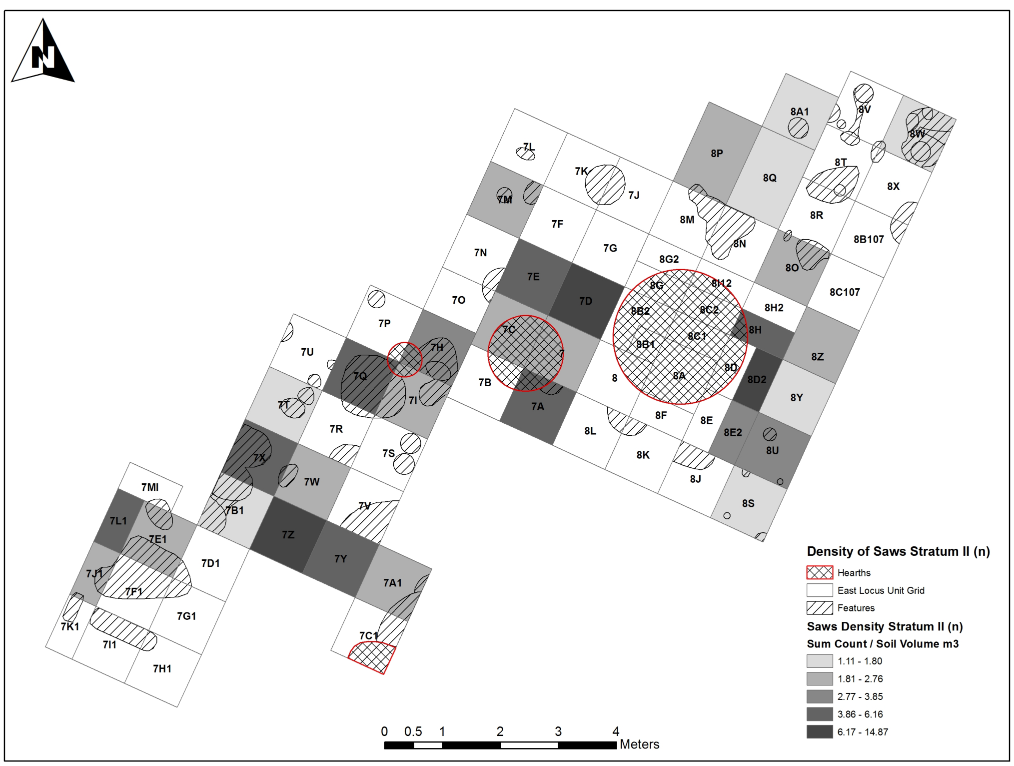

Figure 5.2 (b) Density of sandstone saws in Stratum II.

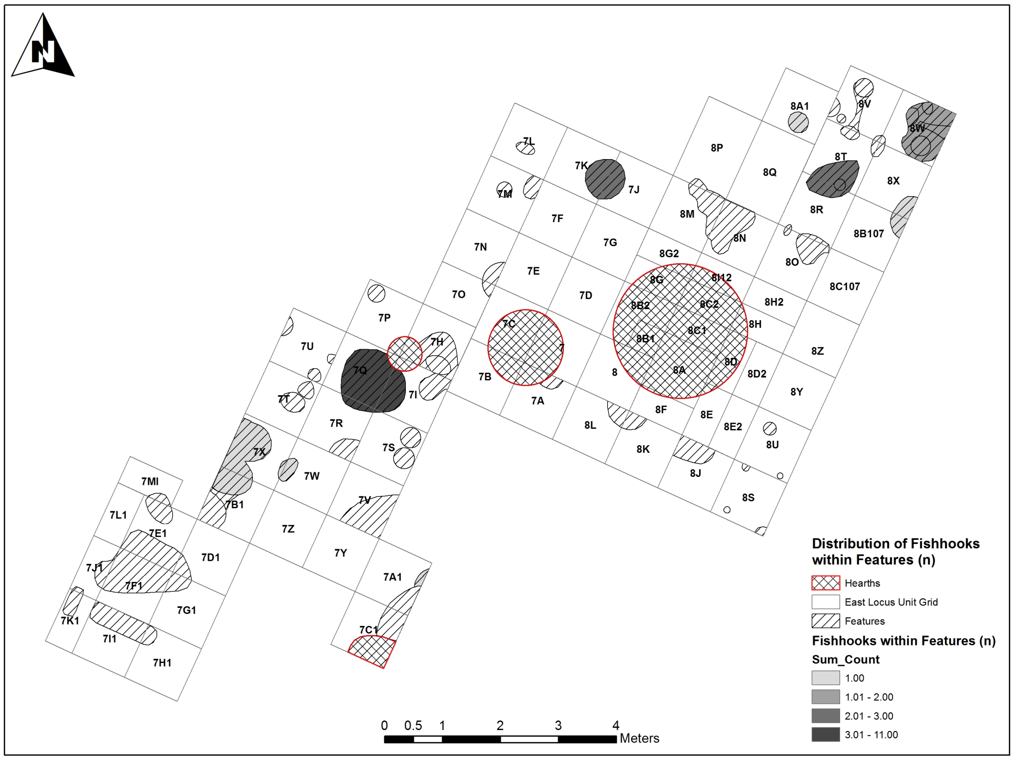

Figure 5.3 (a) Distribution of fishhooks within features.

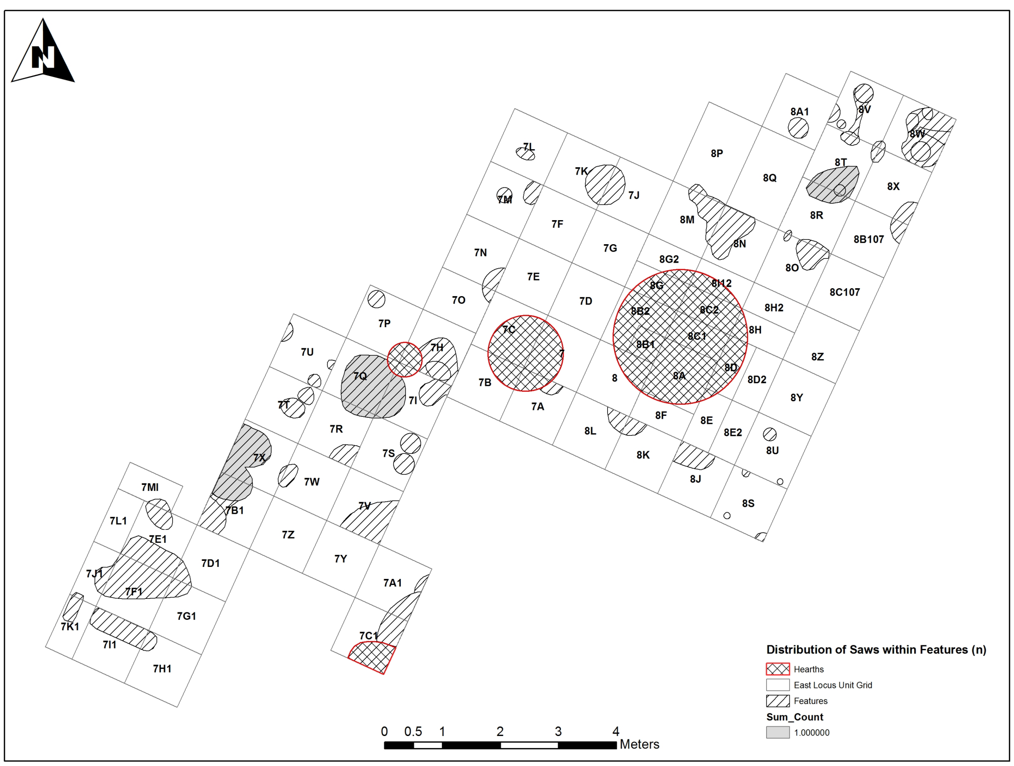

Figure 5.3 (b) Distribution of sandstone saws within features.

distance interval of 2 m. Sandstone saws however are randomly distributed in both strata.

The hot spot map of saws in Stratum I shows positive clustering, z = >2.0, on the west side of the northeast feature area in units 8A1, 8Q, and 8O (Figure 5.4a). There is also some moderate clustering on the northwest side of Hearth F-6, and the southwest side of Hearth F-9. Fishhook hot spots (z = >2.0) occur in the northwest corner of East Locus in units 7M, 7K, and 7G, with moderate clustering observed in the general area north of the fire hearths (Figure 5.4b). In Stratum II saws are observed clustering in the southern section of the southwest feature area in units 7W, 7Z, and 7B1 (Figure 5.5a). The hot spot renderings of fishhooks in Stratum II show the location of hook hot spots to occur within and around the 7Q Hearth Quadrant (Figure 5.5b). There is also moderate clustering of hooks on the southeast side of Hearth F-6, and in the Northeast Feature Area.

The clustering pattern of fishhooks and saws between strata supports a spatial and contextual relationship between the two artifacts. Kendig and others (2010) have reported a significant correlation between the saws and hooks and here I show that the two items are clustered in roughly the same sections of the East Locus unit grid in both Stratum I and Stratum II. These patterns confirm my expectation that I would have both items clustered together, thus allowing me to assert with more confidence that the saws and hooks were related in utilitarian use.

Figure 5.4 (a) Hot spots of sandstone saws, Stratum I

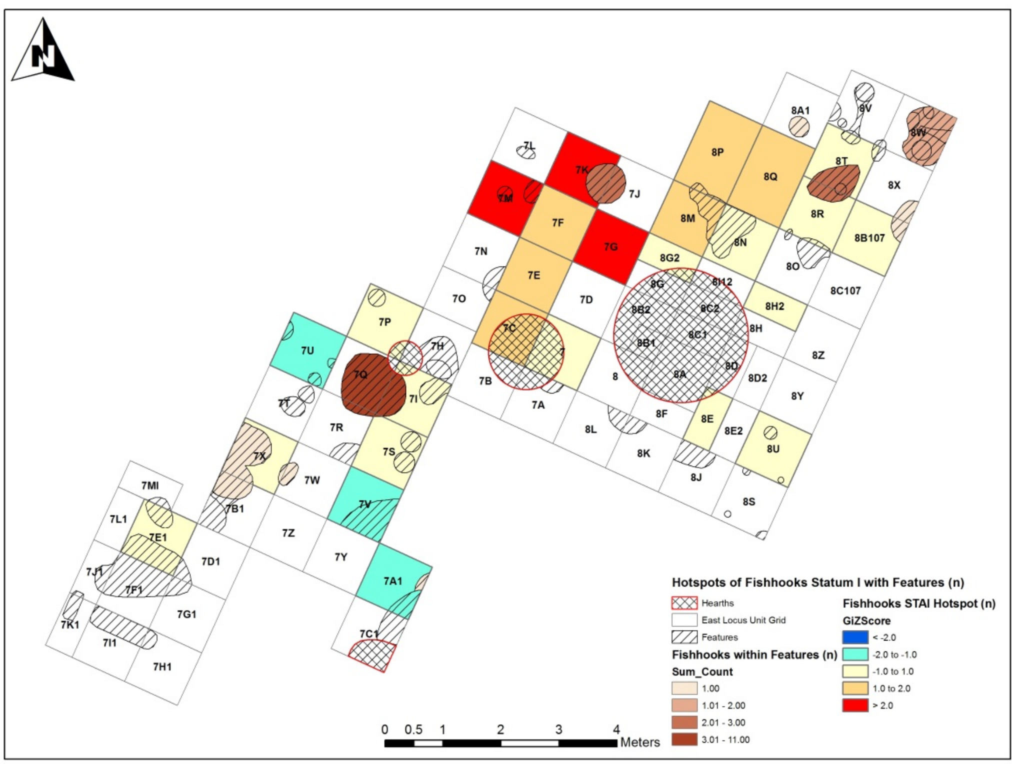

Figure 5.4 (b) Hot spots of fishhooks, Stratum I

Figure 5.5 (a) Hot spots of sandstone saws with features, Stratum II

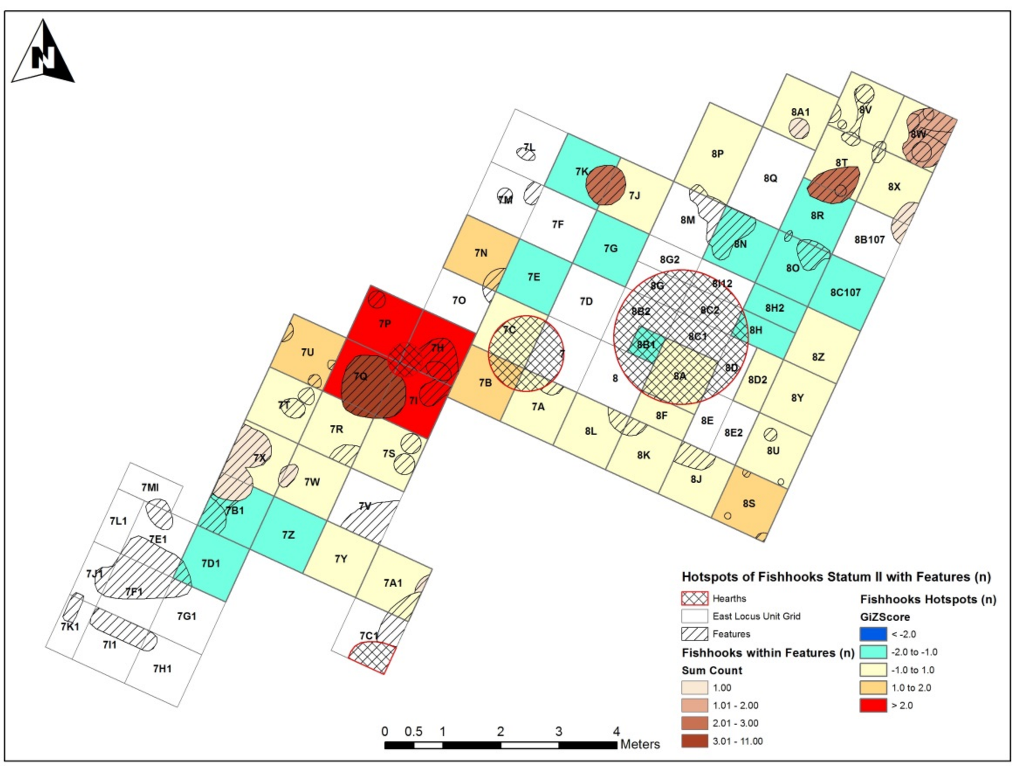

Figure 5.5 (b) Hot spots of fishhooks with features, Stratum II

Formal Local and Extra-local Lithic Artifacts

The next pair of artifacts I compare are formal lithic tools and ornaments manufactured from either local toolstone found on San Nicolas, or extra-local toolstone imported from other islands or the mainland. In Stratum I artifacts made from local toolstone appear widespread across East Locus but occur in greatest density on the north side of both large hearth features, F-6 and F-9, in the Northeast Feature Quadrant, and within the Southwest Feature Area (Figure 5.6a). Extra-local lithic artifacts in Stratum I are not as widespread, and occur in greatest density on the east and west side of Hearth F-6, and the north/northeast side of Hearth F-9 (Figure 5.6b).

In Stratum II, the overall trend of artifacts found in association with the hearth features continues. Here, artifacts of local materials appear in great densities on the east/southeast and west side of Hearth F-6, and around both smaller hearth features to the west. A large density of local lithic artifacts is also observed in the southwest section of East Locus below the Southwestern Feature Area and in association with the 7C1-1 hearth feature (Figure 5.7a). Extra-local lithic artifacts in Stratum II are mostly observed on the southeast sides of the 7Q Hearth Quadrant and Hearth F-6 (Figure 5.7b). Large densities are also found on north of Hearth F-9, and in association with the Northeast Feature Quadrant.

Local lithic tools occur within seven pits and features: 8T-D, 8A1-A, 7X-A, 7Q-1, 8X-E, 7N-1, and 7A1-1. The overall trend here is that the greatest distribution of local lithics within features is observed in the Northeast Feature Quadrant, and the Southwest Feature Area, with a moderate distribution within the 7Q Hearth Quadrant (Figure 5.8a). Extra-local lithic artifacts are found within three features, 8T-D, 8W-C, and 7Q-1. This correlates with the distribution of local formal artifacts within features, as both classes are associated with the 7Q Hearth Quadrant and the Northeast Feature Area (Figure 5.8b).

The exploratory data analysis of formal tools shows some variation stratigraphically as clustering of local lithic artifacts occurs on the north side of East Locus in Stratum I, and on the south side of the locus in Stratum II. Formal artifacts made from imported lithics also cluster on the north side of the hearths in Stratum I, and are observed clustering on the west side of the unit grid in Stratum II. The results from the autocorrelation tool show the local lithic tools are statistically clustered by both weight and total sum at a distance interval of 2.5m in Stratum II. Extra-local lithic tools are randomly dispersed in both strata, likely a result of a small sample size. The hot spot maps of Stratum I show both local and extra-local lithics clustered in the center of the unit grid and mostly associated with the F-9 and F-6 hearth features (Figures 5.9a, 5.9b).

In Stratum II, moderate clustering ($z = 1.0 – 2.0$) of local lithic tools is observed on the southeast side of Hearth F-6, and the Southwest Feature Area (Figure 5.10a). In these sections, several adjoining units show clustering, possibly indicating domestic activity areas. Clustering of extra-local lithics in Stratum II is seen in the 7Q Hearth Quadrant, with a single hot spot ($z = >2.0$) in Unit 7P (Figure 5.10b). Units 8U and 7R both share moderate clustering of local and extra-local formal lithic tools in this stratum which is interesting. Both units contain features and are in proximity to a fire hearth.

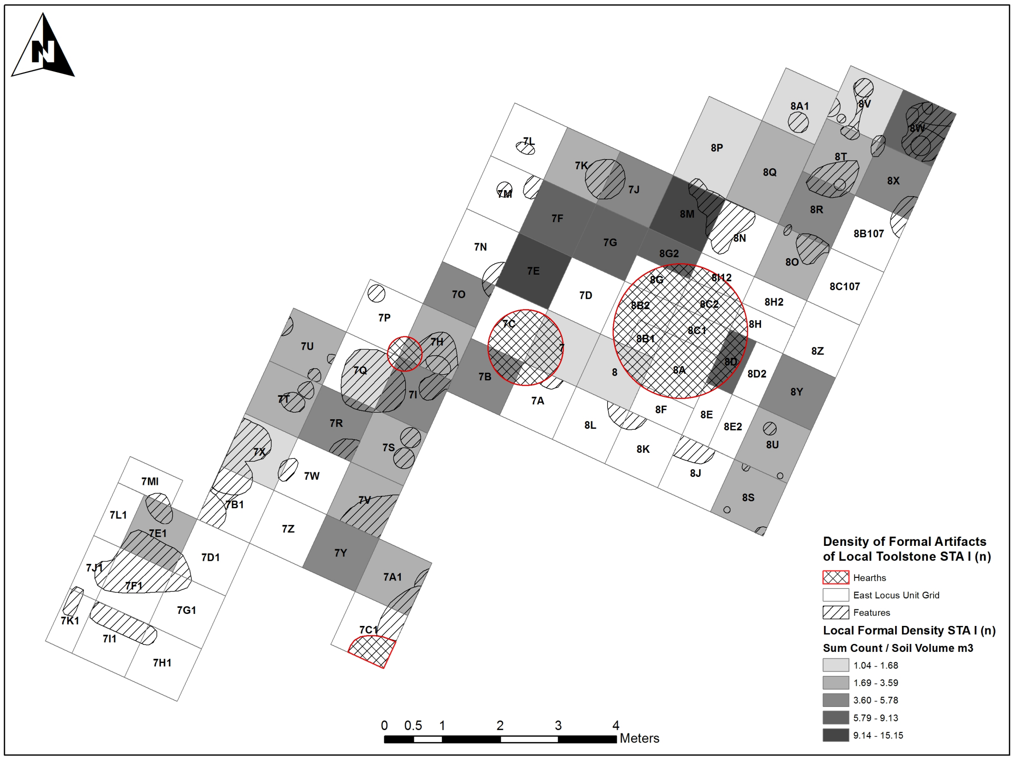

Figure 5.6 (a) Density of local lithic artifacts in Stratum I.

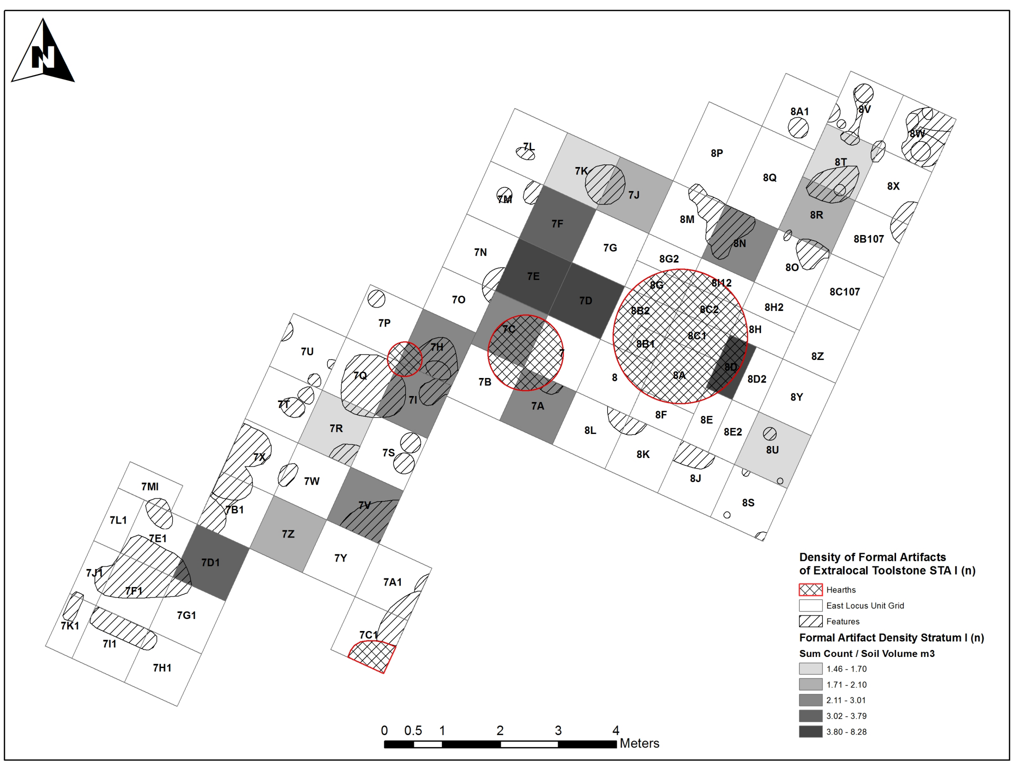

Figure 5.6 (b) Density of extra-local lithic artifacts in Stratum I.

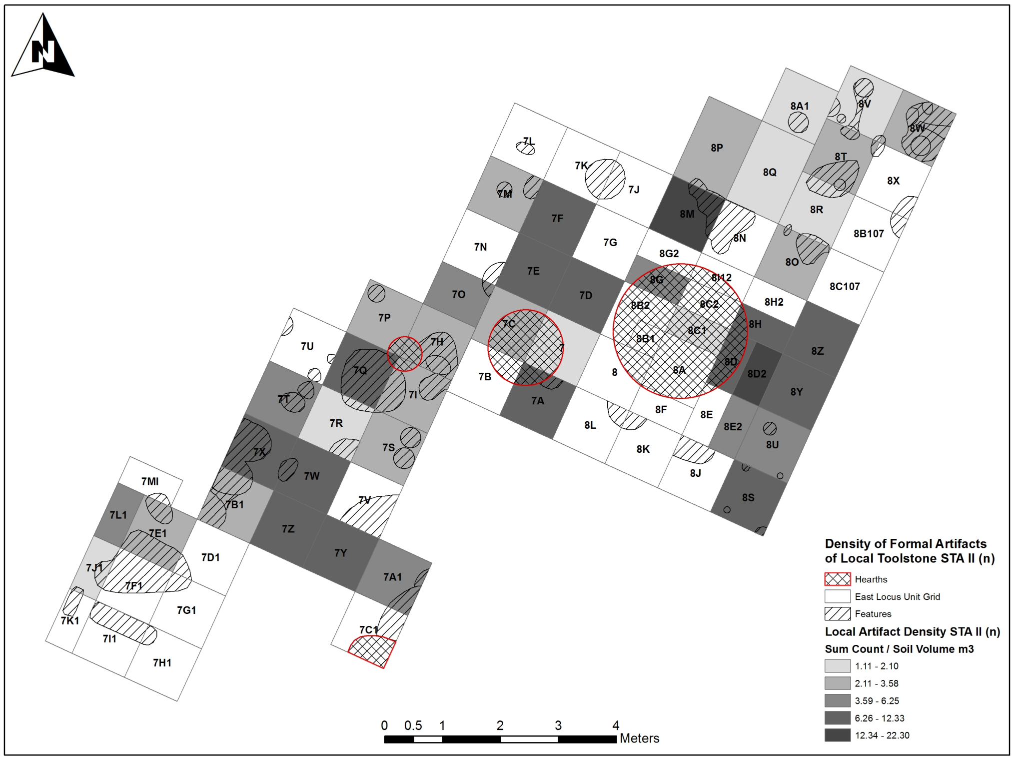

Figure 5.7 (a) Density of local lithic artifacts in Stratum II.

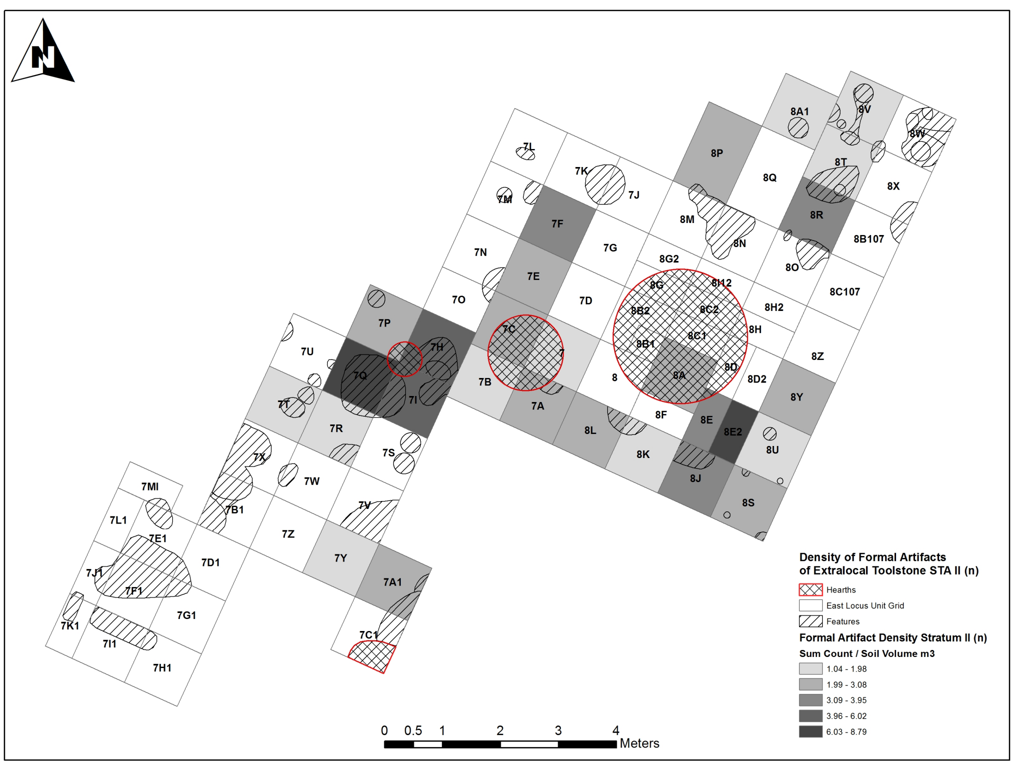

Figure 5.7 (b) Density of extra-local lithic artifacts in Stratum II.

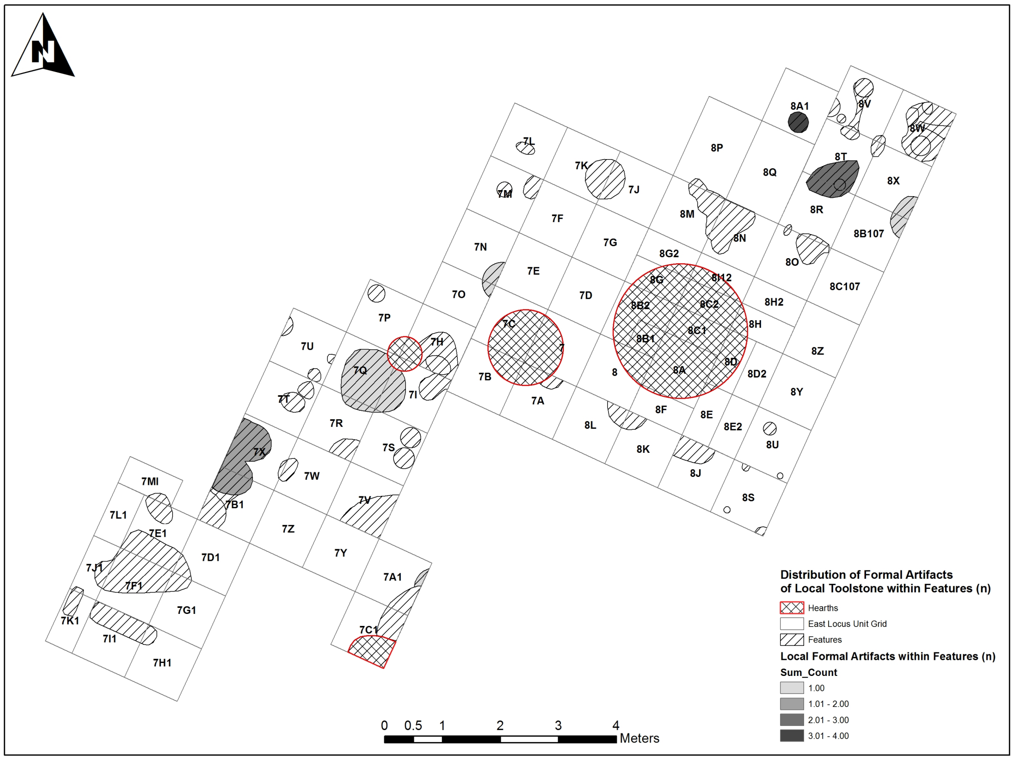

Figure 5.8 (a) Distribution of local lithic artifacts within features.

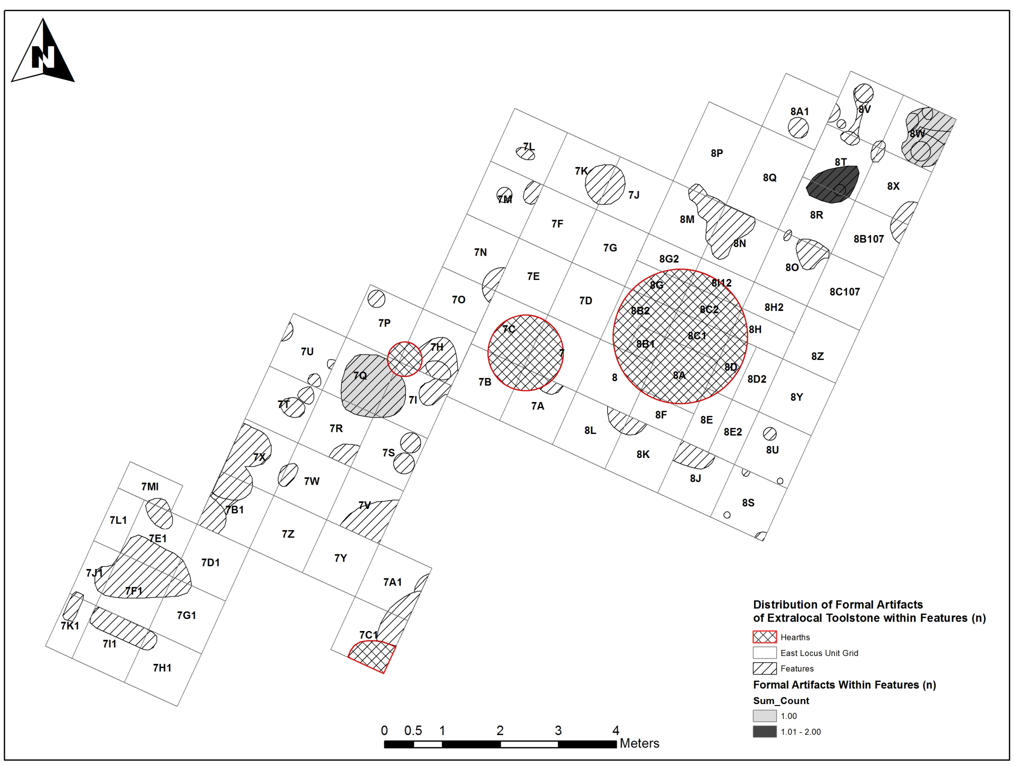

Figure 5.8 (b) Distribution of extra-local lithic artifacts within features.

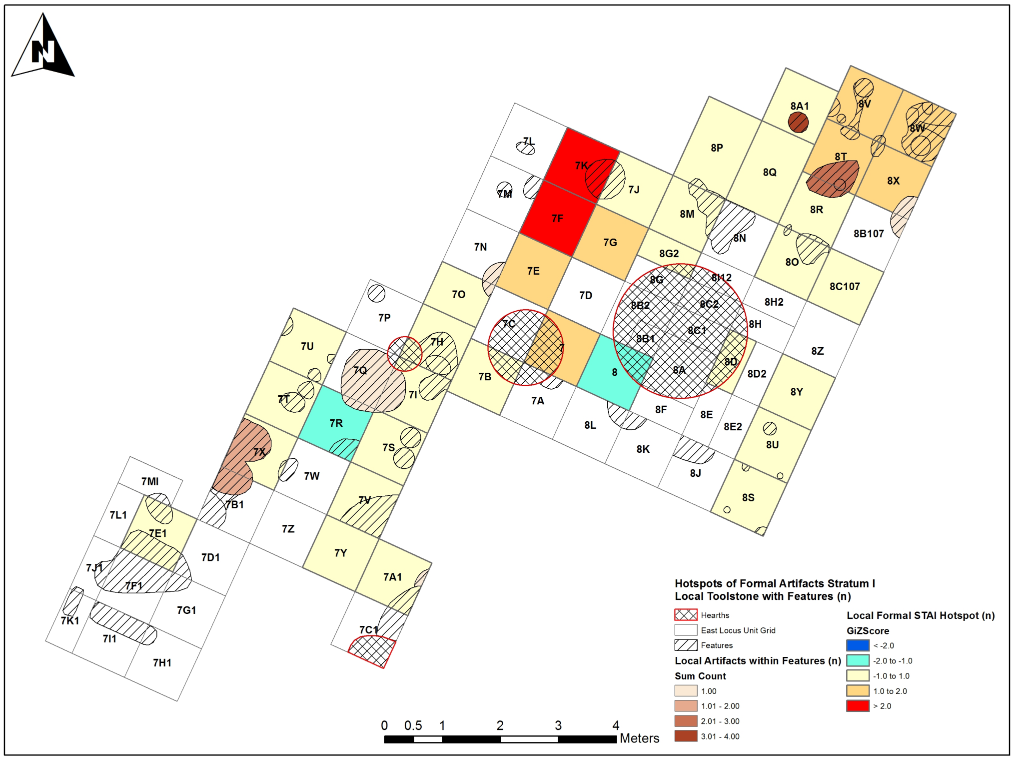

Figure 5.9 (a) Hot spots of local lithic tools with features, Stratum I.

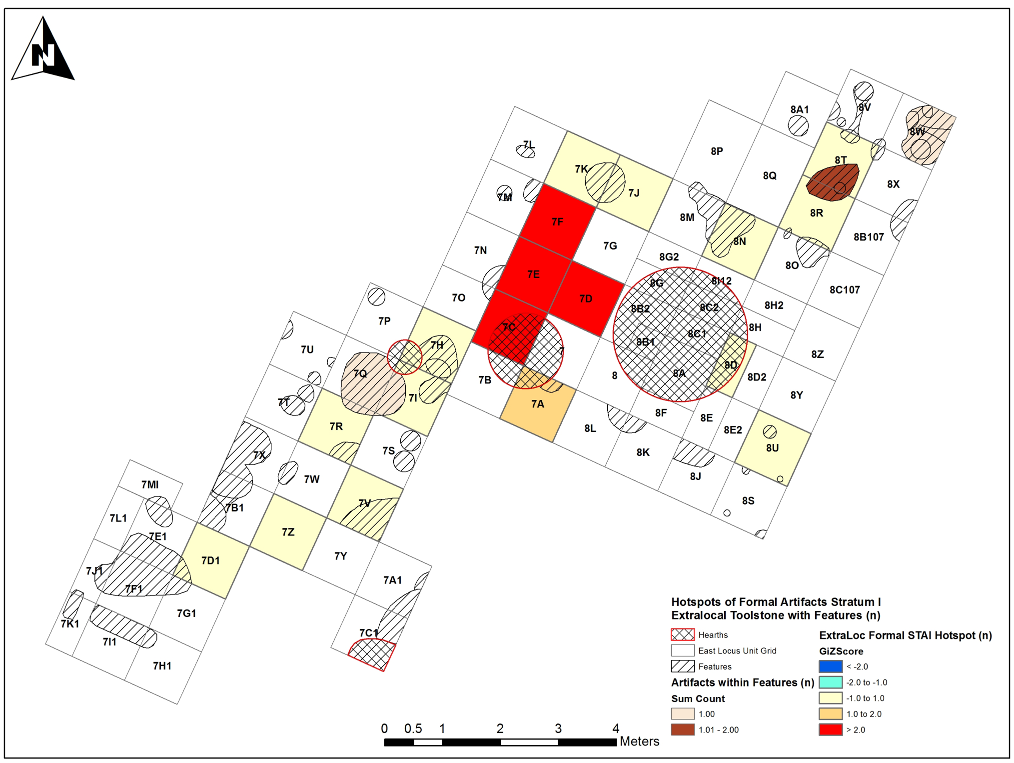

Figure 5.9 (b) Hot spots of extra-local lithic tools with features, Stratum I.

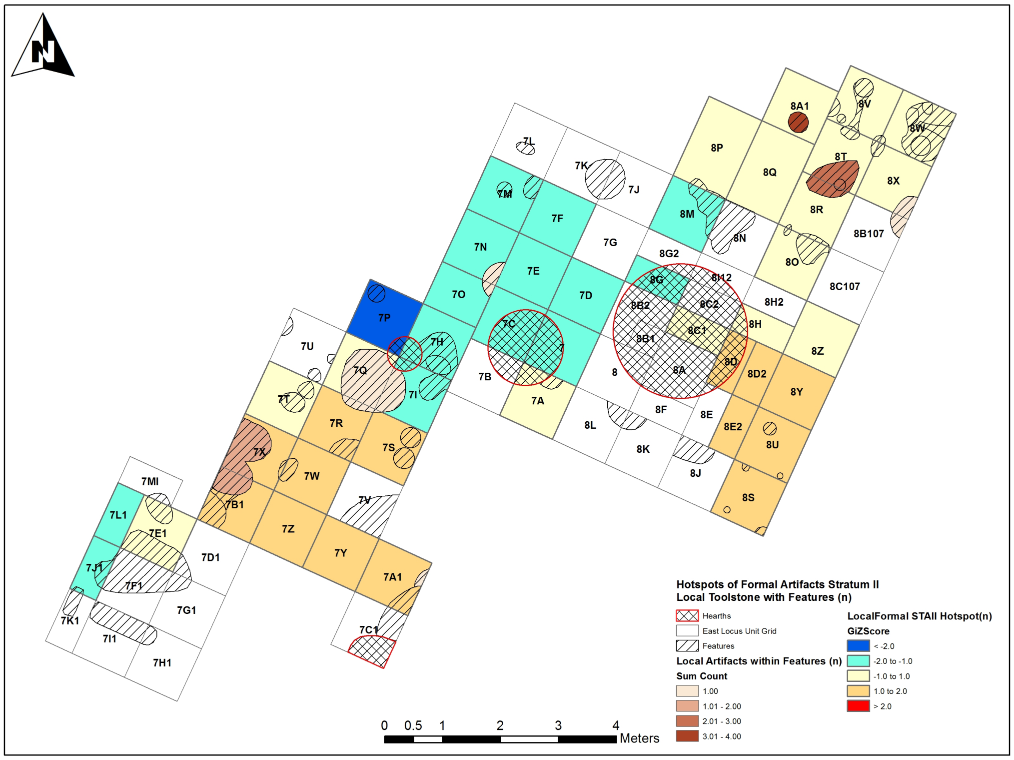

Figure 5.10 (a) Hot spots of local lithic artifacts with features, Stratum II.

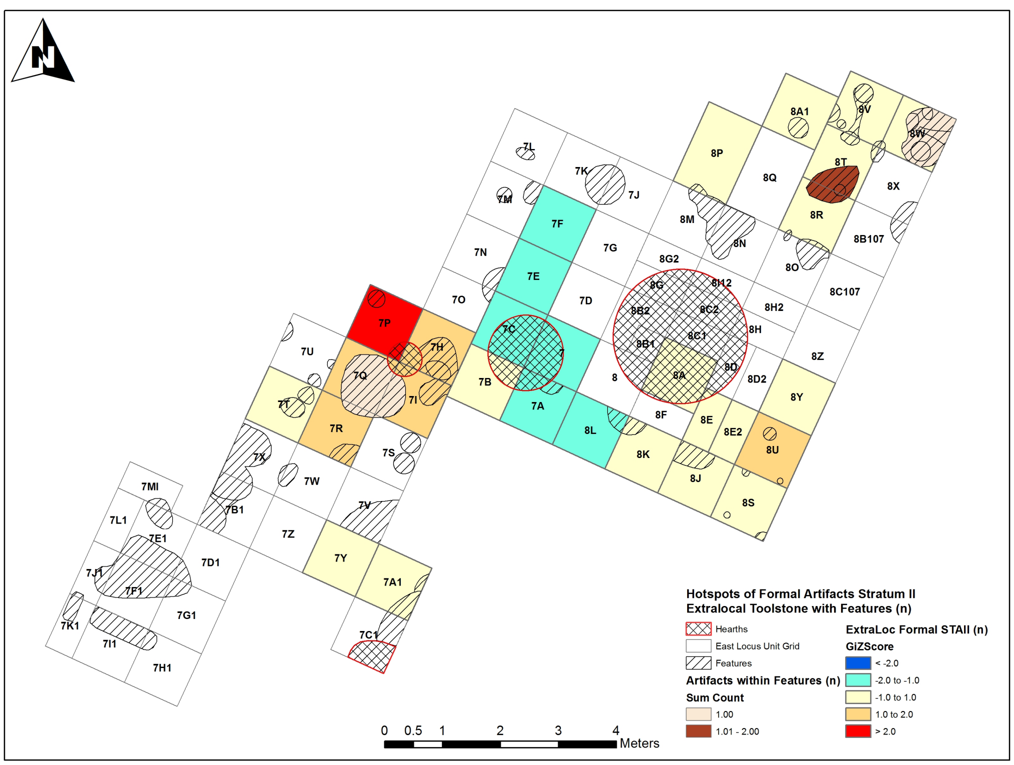

Figure 5.10 (b) Hot spots of extra-local lithic artifacts with features, Stratum II.

The comparative spatial signatures of the two lithic material classes do share some proximity within the same areas of East Locus in both strata. In Stratum I, both sets of artifacts cluster on the north side of the F-9 fire hearth. In Stratum II clustering occurs within the Southwest Feature Area and in association with the 7Q Hearth Quadrant, as well as Hearth F-6. I believe that the clustering of these materials represents the location of activity areas, and these spatial and temporal changes must be considered in context with the fire hearths and other features, such as 7Q-1. The spatial and temporal variations in the use of lithic tools in context with the three main fire hearths illustrates a potential chronology for the hearth features, and suggests that each hearth may be associated with distinctive events, or periods of time.

Local and Extra-local Lithics: Cores and Debitage

My local toolstone debitage sample is comprised of sandstone debitage and metavolcanic, metasedimentary, and quartzite reduction cores. Visually the distribution and densities of these materials in both total sum and weight in Stratum I share similar patterns in that they are mostly associated with the array of hearth features. The greatest distribution and density of reduction cores in Stratum I appear on the northwest side of Hearth F-6, and on the north side of Hearth F-9. Sandstone debitage in Stratum I generally appear in five unit quadrants at East Locus (Figure 5.11a). Sandstone flakes and fragments are observed in the Northeast Feature Area, the adjacent quadrant of units immediately north of Hearth F-6, the quadrant on the north side of Hearth F-9, the 7Q Hearth Quadrant, and the quadrant on the east side of the Triple Dog Burial (Figure 5.11b). Overall, a similar trend between the distribution and density of local debitage is apparent. Production and use of local lithics in Stratum I appear in context with both the array of hearth features, and the units within the Northeast Feature Quadrant.

Extra-local lithic debitage in Stratum I is limited in distribution and density to the units around Hearth F-9, the 7Q hearth feature, and Units 7E1 and 7D1, which are located on the north side of the Triple Dog Burial (Figure 5.11c). Although the densities and distributions of extra-local lithics in this stratum are low, the bulk of the imported debitage is still found in the same sections of East Locus as local lithics.

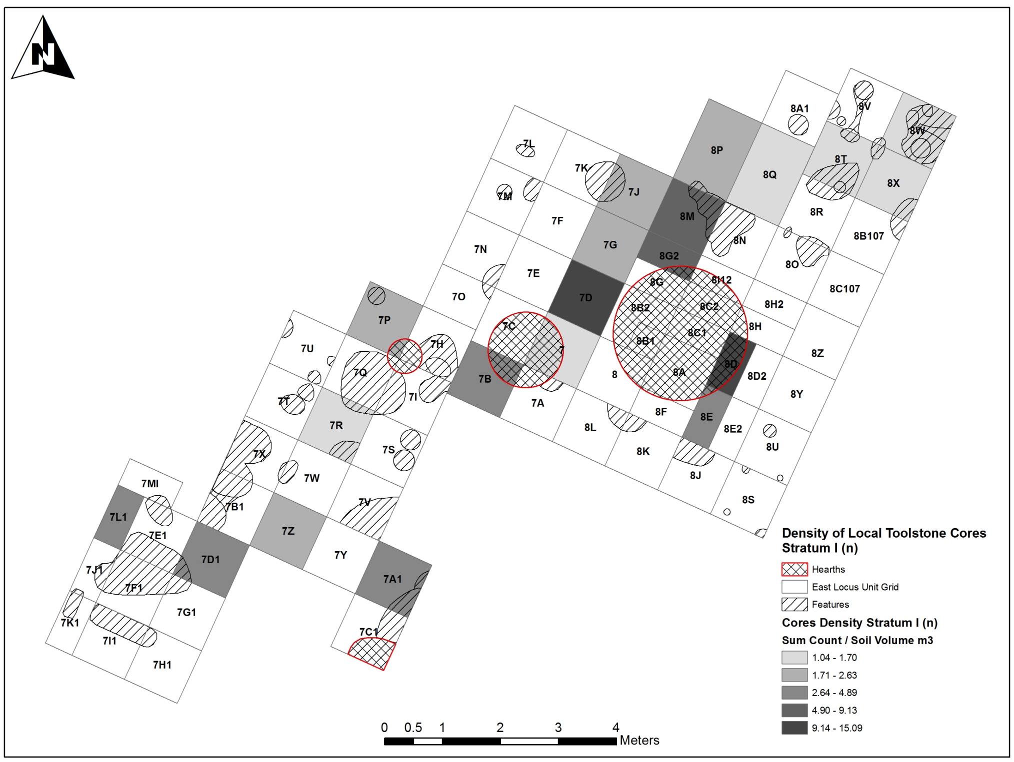

Figure 5.11 (a) Density of local toolstone reduction cores in Stratum I.

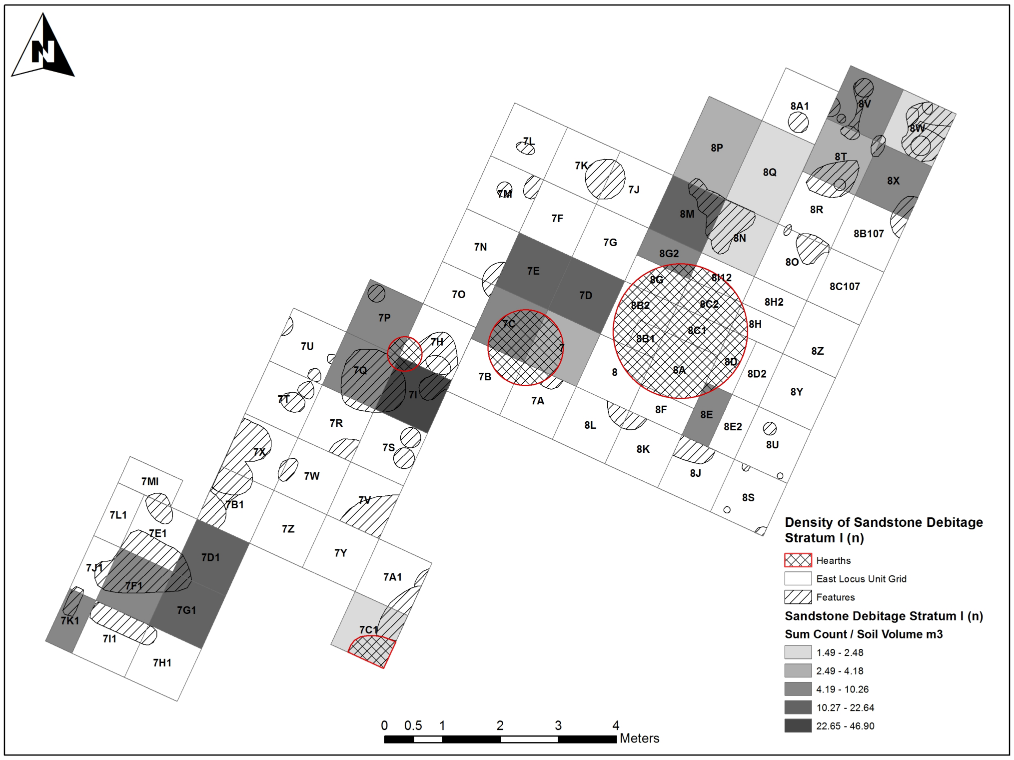

Figure 5.11 (b) Density of sandstone debitage in Stratum I.

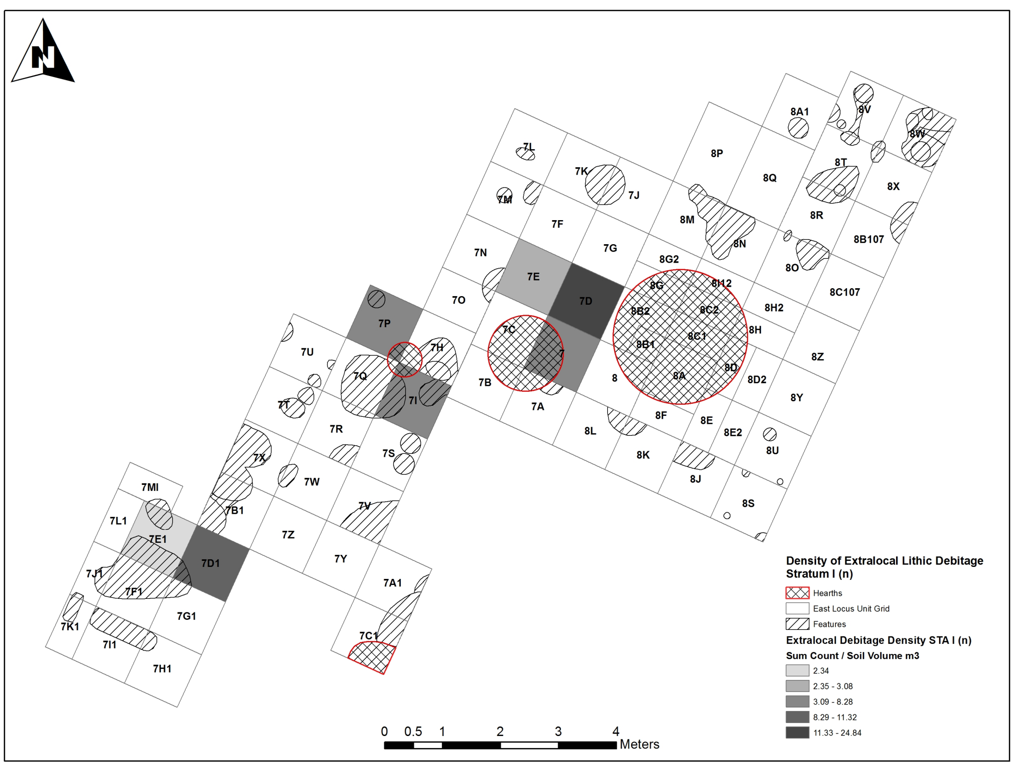

Figure 5.11 (c) Density of extra-local debitage in Stratum I.

In Stratum II reduction cores and sandstone debitage and fragments are mostly found in close proximity to the hearth features and feature areas on the northern and southern extents of the locus. The greatest density of cores occurs on the north and east sides of Hearth F-6, and in the four units surrounding Hearth F-9 (Figure 5.12a). There is also great density in proximity to the small hearth within the 7Q Hearth Quadrant, and in the southwest band of units situated northeast of the Triple Dog Burial. This band of units is within the southwest feature area and is also in proximity of the hearth feature 7C1-1. Core density does vary slightly between total count and weight, but this extent of the difference is difficult to assess through visual inspection. The density of sandstone in Stratum II occurs mostly around the fire hearths and the two feature quadrants on the northeast and southwest of East Locus, and varies little by weight or total count (Figure 5.12b). Sandstone debitage is found in three features, the Triple Dog Burial, Double Dog Burial, and Feature 8T-north, with the highest density by total sum seen within the two dog burials.

Extra-local debitage in Stratum II is limited to four distinct unit quadrants at East Locus: the Northeast Feature Quadrant, the quadrant north of Hearth F-9 (Units 7, 7C, and 7E), the 7Q Hearth Quadrant, and the quadrant on the east side of the Triple Dog Burial (Units 7D1, 7G1, 7F1, and 7E1)(Figure 5.13). Although the density of imported lithics varies little by total count and weight within the excavation units, it varies significantly within features. For example, the greatest density of exotic debitage within units occurs within the 7Q Hearth Quadrant. Here, debitage is also observed in great density by total count within Feature 7Q-1. However, I observe higher density by weight within the Triple Dog Burial feature. Figure series 5.13 shows the comparative densities of extra-local debitage within units and features in Stratum II.

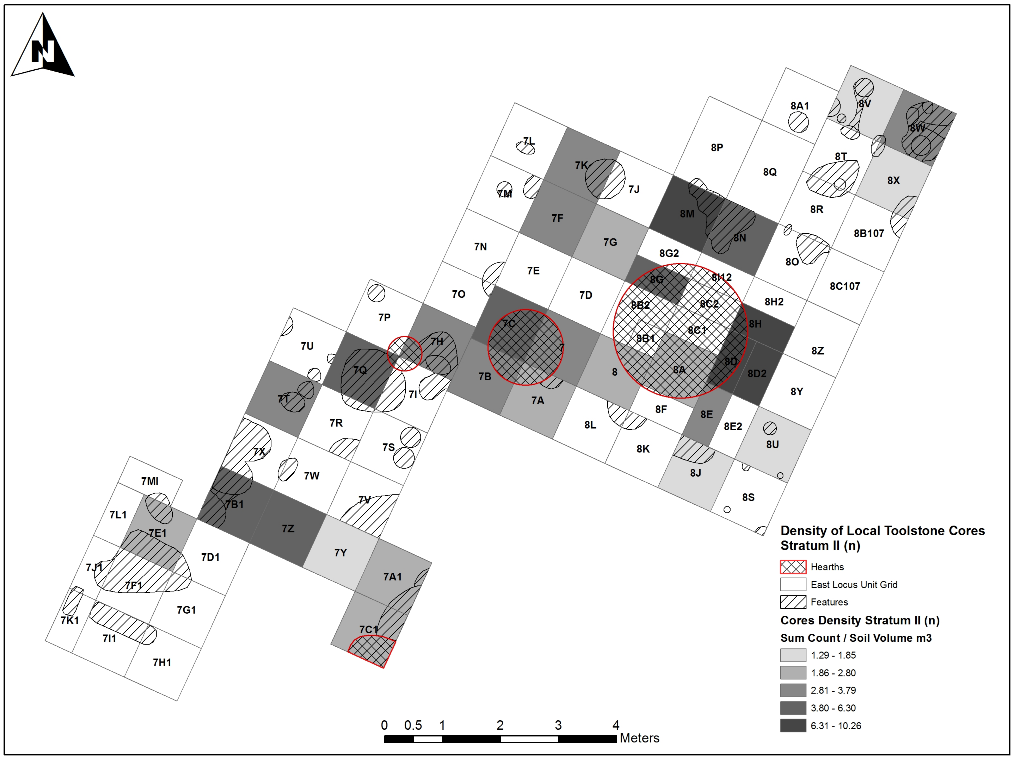

Figure 5.12 (a) Density of local toolstone reduction cores in Stratum II.

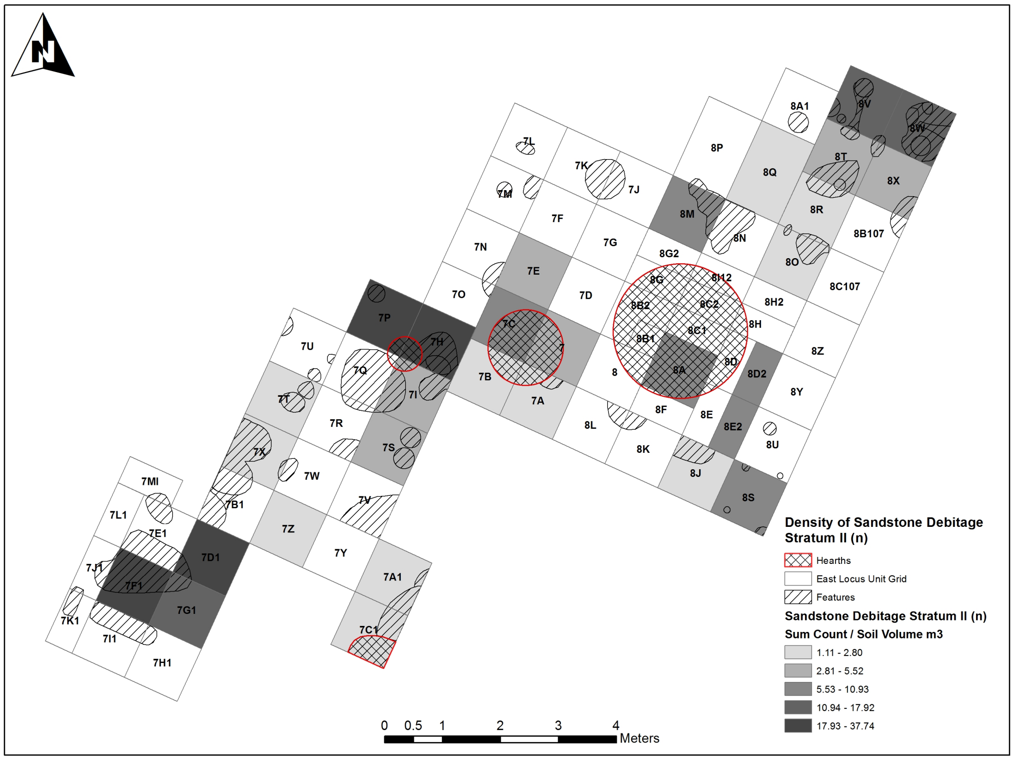

Figure 5.12 (b) Density of sandstone debitage in Stratum II.

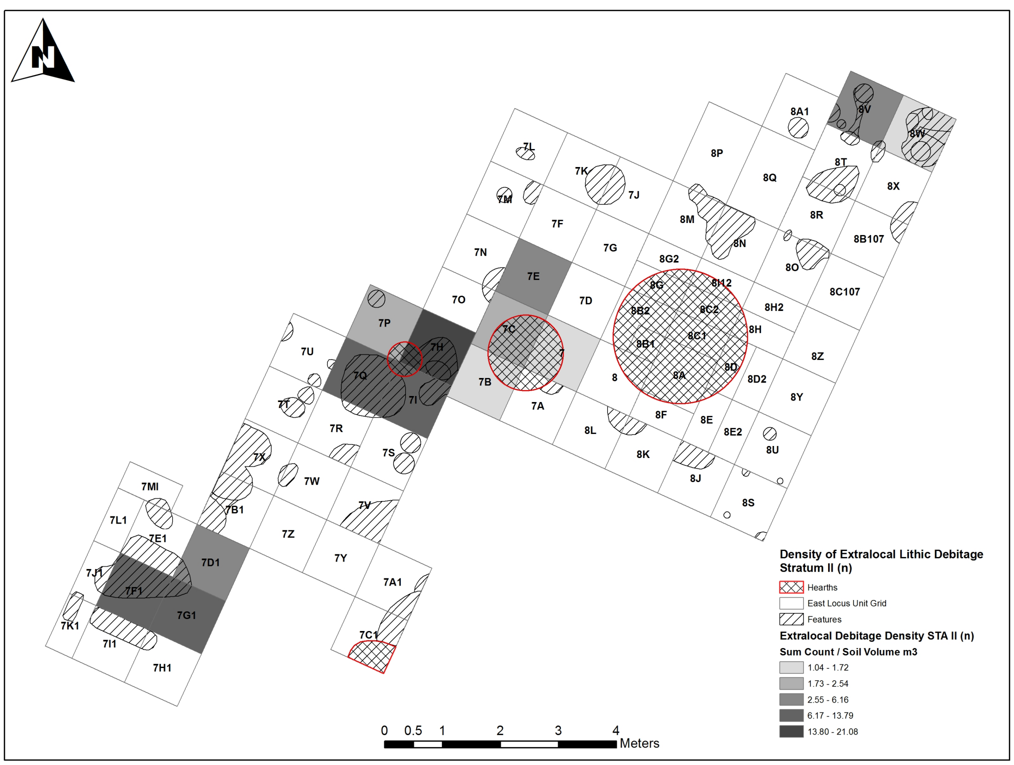

Figure 5.13 (a) Density of extra-local debitage by total sum in Stratum II.

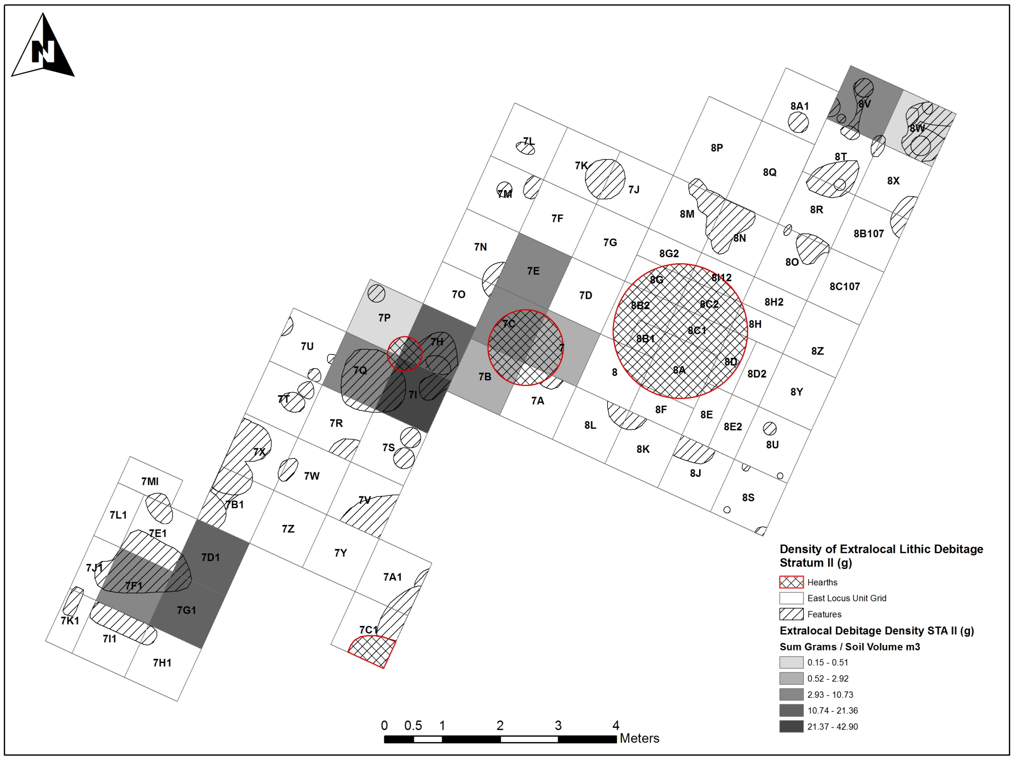

Figure 5.13 (b) Density of extra-local debitage by weight in Stratum II.

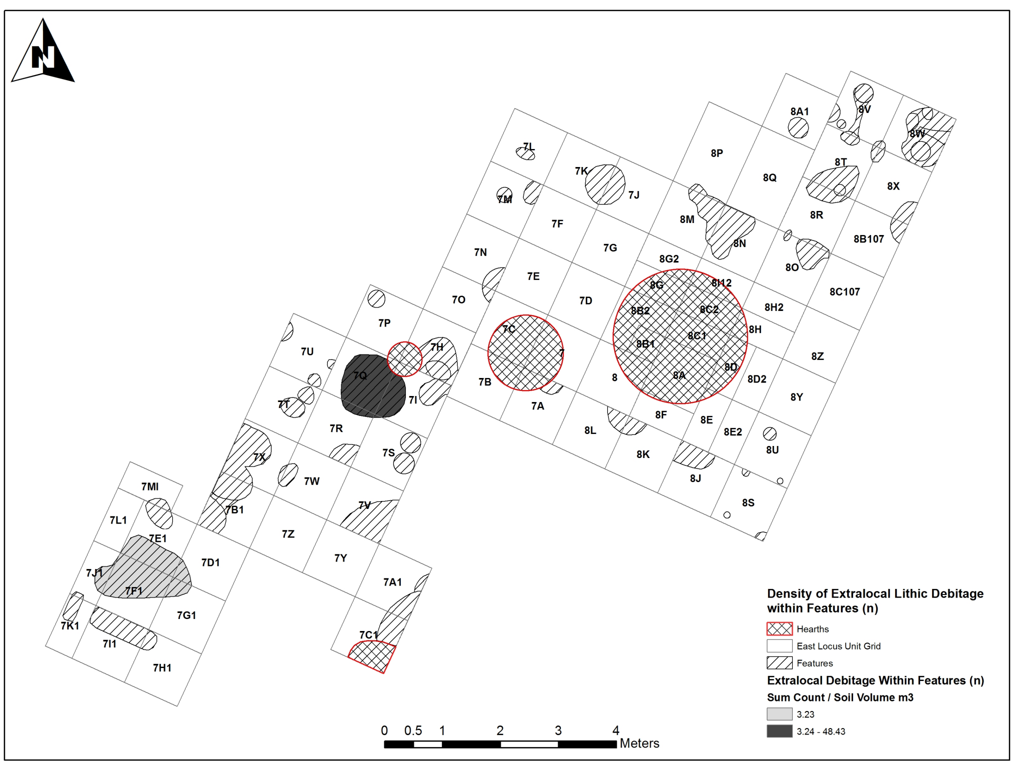

Figure 5.13 (c) Density of extra-local debitage by total sum within features.

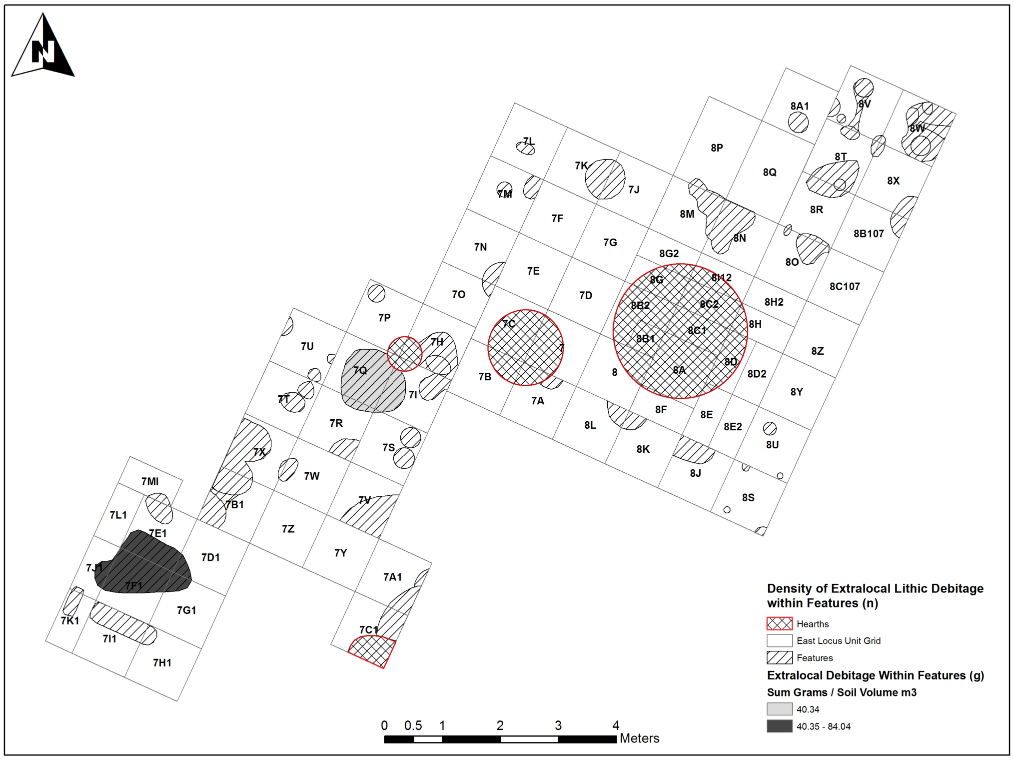

Figure 5.13 (d) Density of extra-local debitage within features, by total weight.

My exploratory analysis of cores and debitage shows some interesting differences in clustering between the local materials (reduction cores and sandstone debitage), as well as differences between local vs. extra-local debitage. Of the classes of toolstone found locally on San Nicolas, clusters of sandstone debitage are observed at the northern and southern-most extents of East Locus, while the clusters of reduction cores are seen around the F-9 hearth, and along the southern section of the Southwest Feature Area (Figure 5.14). In comparison, the debitage clusters of imported toolstone occur in the 7Q Hearth Quadrant (Figure 5.14). I find this interesting because it suggests differential uses of lithic materials across the various sections of East Locus, and further supports a wide range of activities occurring in discrete areas at the site.

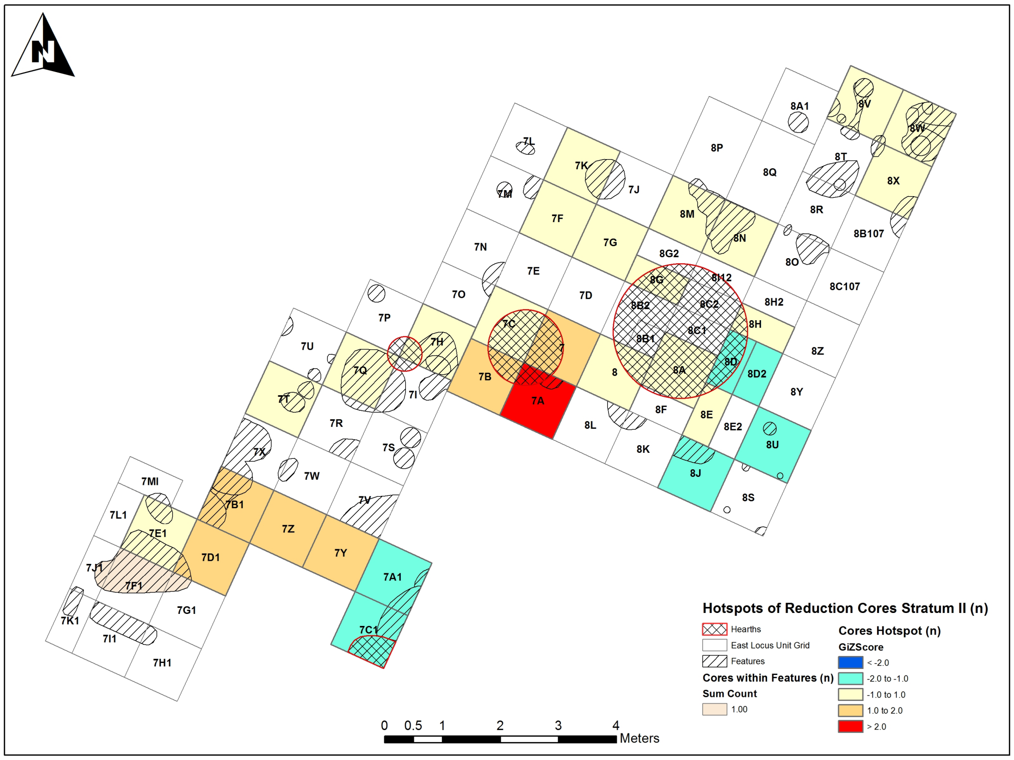

Figure 5.14 (a) Hot spots of local toolstone reduction cores. Map shows hot spot in Unit 7A and moderate clustering in the F-9 Hearth Area and Southwest Feature Area.

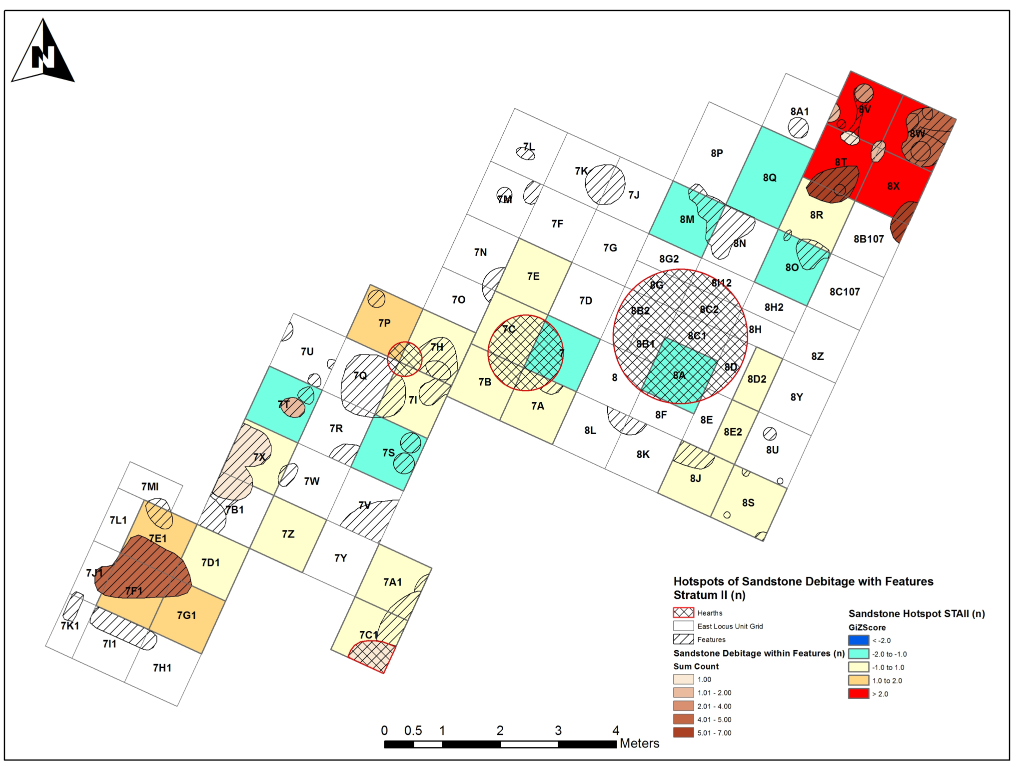

Figure 5.14 (b) Hot spots of sandstone debitage.

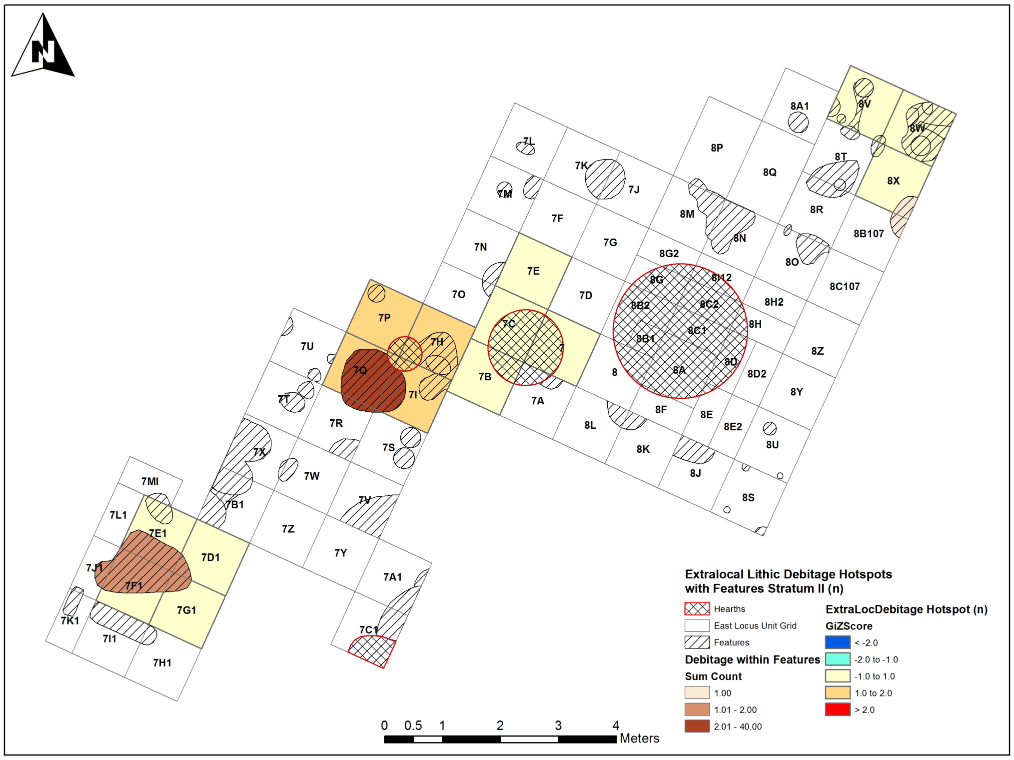

Figure 5.14 (c) Hot spots of extra-local debitage. Map shows moderate clustering of debitage in the 7Q Hearth Quadrant.

The spatial autocorrelation of sandstone debitage indicated that sandstone exhibits statistical clustering by both weight and total sum at a distance interval of 2 m in Stratum II. The autocorrelation operation results showed metavolcanic, metasedimentary, and quartzite cores are randomly dispersed in both strata. Extra-local debitage however demonstrated moderate clustering by total sum in Stratum II.

The hot spot maps shown in Figure 5.14 show the comparative hot spot locations of the core and debitage samples. Here, the single hot spot (z = >2.0) of local toolstone reduction cores is seen in Unit 7A, on the southeast side of Hearth F-9. Moderate clustering (z = 1.0 – 2.0) of cores is observed around F-9, as well as on the northeast side of the Triple Dog Burial in Units 7D1, 7B1, 7Y, and 7Z. Hot spots of sandstone debitage occur in all four units of the Northeast Feature Quadrant, with moderate clustering (z =

1.0 – 2.0) around the TDB, as well as on the northwest side of the 7Q Hearth Quadrant (Figure 5.14b). Lastly, moderate clustering (z = 1.0 – 2.0) of extra-local lithic debitage occurs in the 7Q Hearth Quadrant.

The spatial variations and differential clustering of these materials in Stratum II allows me to make some interesting contextual comparisons. Here we see remarkable differences in clustering, with all three classes of lithics located around different features (Figure 5.14). Local toolstone reduction cores have two discrete areas of statistical clustering, around the F-6 fire hearth, and the southern band of units in the Southwest Feature Area above the Triple Dog Burial. When I compare that pattern with the spatial signatures of formal artifacts made from the same materials it becomes apparent that the areas of stone tool production are not entirely associated with activity areas where the finished tool was used. For example, based on the clustering of reduction cores around the F-9 fire hearth, and the lack of formal tools in that same quadrant, it appears that stone tool manufacture occurred around that hearth feature, while the finished product was used in other discrete activity areas at East Locus.

The spatial clustering of extra-local debitage is intriguing as well. Imported lithic debitage also occurs among the feature areas on the northeastern and southwestern sections of East Locus, but it is most heavily clustered around the 7Q Hearth Quadrant, and on the west side of Hearth F-9. These spatial signatures are consistent with the patterns shown for formal artifacts made from imported lithic material; however, there is an absence of formal tools in the Southwestern Feature Area. Remarkably, the abundance of extra-local debitage in these clusters occur within features, 7Q-1 and the Triple Dog Burial. It is interesting that lithic material acquired through trade with neighboring communities would be intentionally placed in a pit feature and a multiple dog burial. I will further explore that notion and other contextual associations in the following chapter.

Red Ochre, Quartz, and Calcite Crystals

My visual analysis of ochre and quartz distributions and densities in Stratum I show both materials distributed in abundance on the northeast side of the hearth features. Quartz appears in greater distribution and density than ochre in this stratum, with an abundance of quartz crystals located on the north side of Hearth F-9, and the northwest side of Hearth F-6 (Figure 5.15 a and b). Quartz also appears in proximity to the 7Q hearth feature, and in context with features in both the Southwest Feature Area, and the Northeast Feature Quadrant. The density of ochre in Stratum I appears less associated with the hearth features, and in closer proximity to pits and features in the northwest section of the unit grid, as well as within the Northeast Feature Quadrant, the 7Q Hearth Quadrant, and the Southwest Feature Area (Figure 5.15 c and d). Calcite crystals occur sporadically in Stratum I, and are limited to Unit 7D, which is located between Hearths F-6 and F-9, Unit 7K, and Units 7Y and 7A1.

In Stratum II, both ochre and quartz appear widespread across the East Locus unit grid. Both materials are found around Hearths F-6 and F-9, as well as the Triple Dog Burial and Double Dog Burial (Figure 5.16). With both ochre and quartz occurring in such widespread distribution, it is difficult to visually identify patterns. Ochre exhibits a wider range in density than quartz in both measures (weight and total sum), with the areas of greatest density occurring north and east of the hearth array, and the Northeast Feature Quadrant (Figure 5.16 c and d). The differing densities of ochre by weight compared to total sum suggest larger chunks of raw material when considered in total grams. The smaller range in density of quartz may indicate less size differential of quartz in both raw material form and artifacts. Quartz is found in greatest density by total sum on north side of East Locus, around Hearth F-6, and in the Southwest Feature Area, particularly in Units 7Z, 7Y, and 7A1, and within the Triple Dog Burial. This is generally consistent with the density of quartz by weight, however, greater densities in this measure occur on the north and east sides of Hearth F-6, Unit 7U and in the Northeast Feature Quadrant (Figure 5.16 a and b). Calcite in Stratum II is found on the east side of East Locus and appears in greatest density on the east side of Hearth F-6, and Unit 8X, within the Northeast Feature Quadrant (Figure 5.17 a and b).

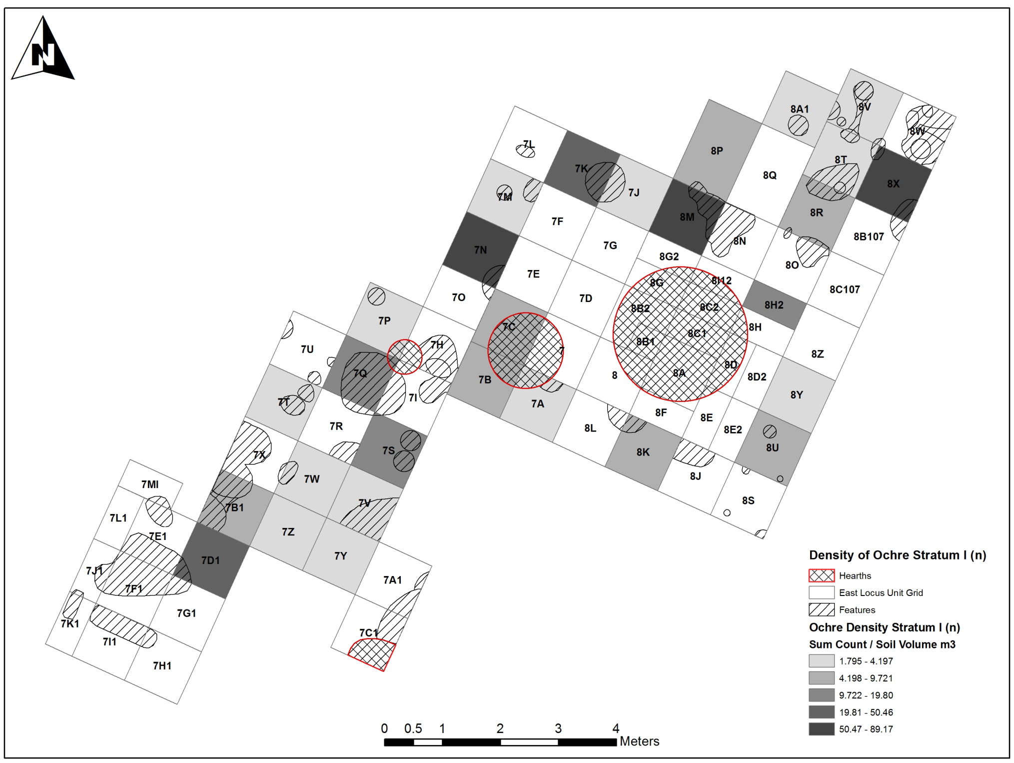

Figure 5.15 (a) Density of red ochre in Stratum I.

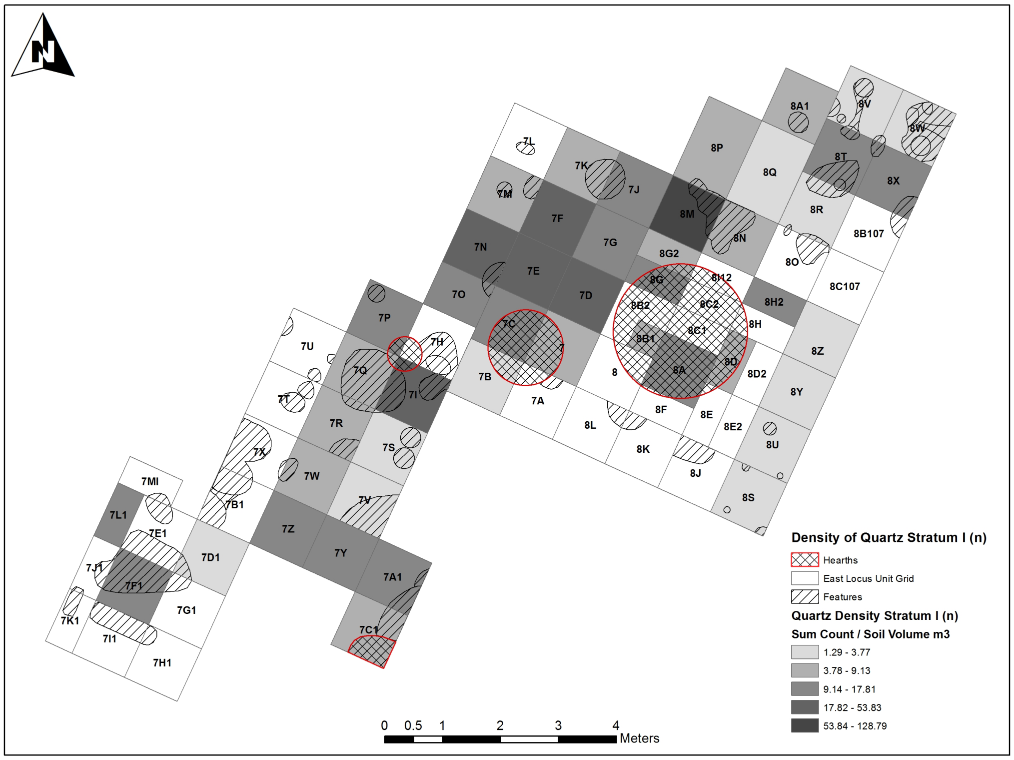

Figure 5.15 (b) Density of quartz crystals in Stratum I.

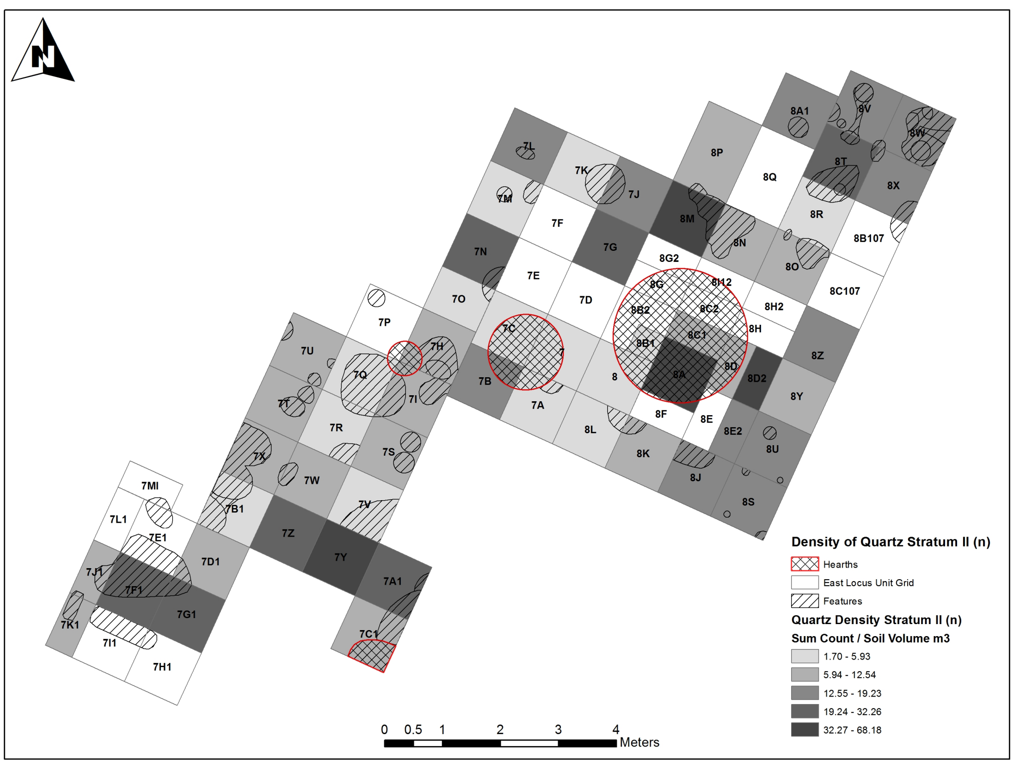

Figure 5.16 (a) Density of quartz crystals by total sum, Stratum II.

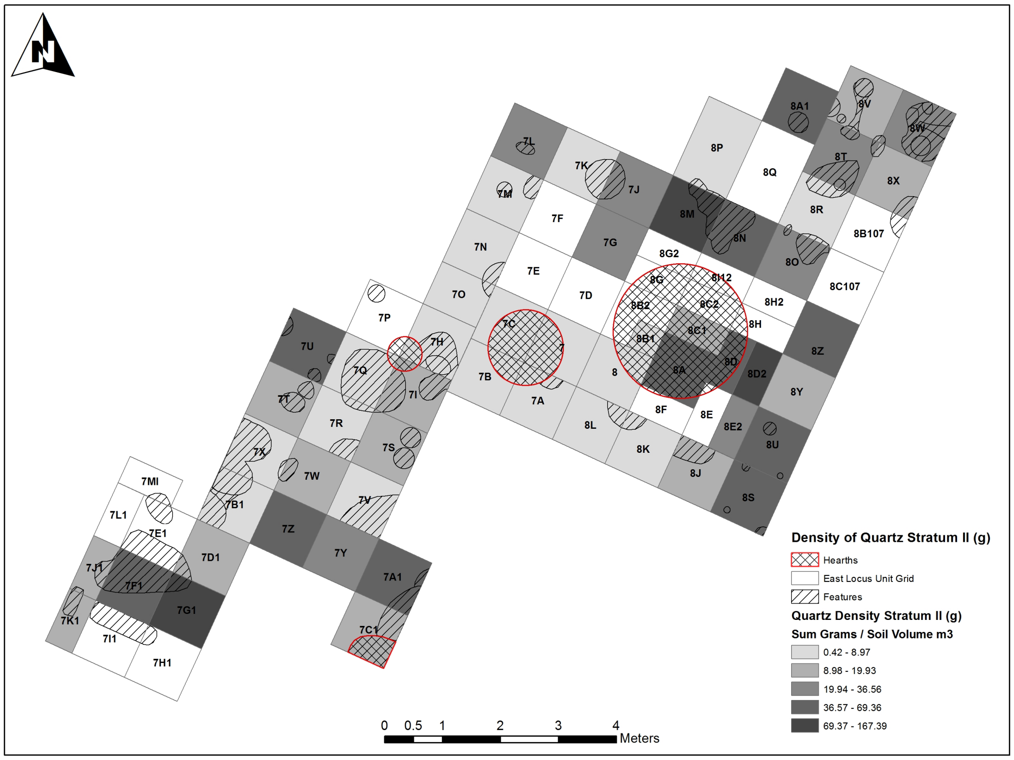

Figure 5.16 (b) Density of quartz crystals by weight, Stratum II.

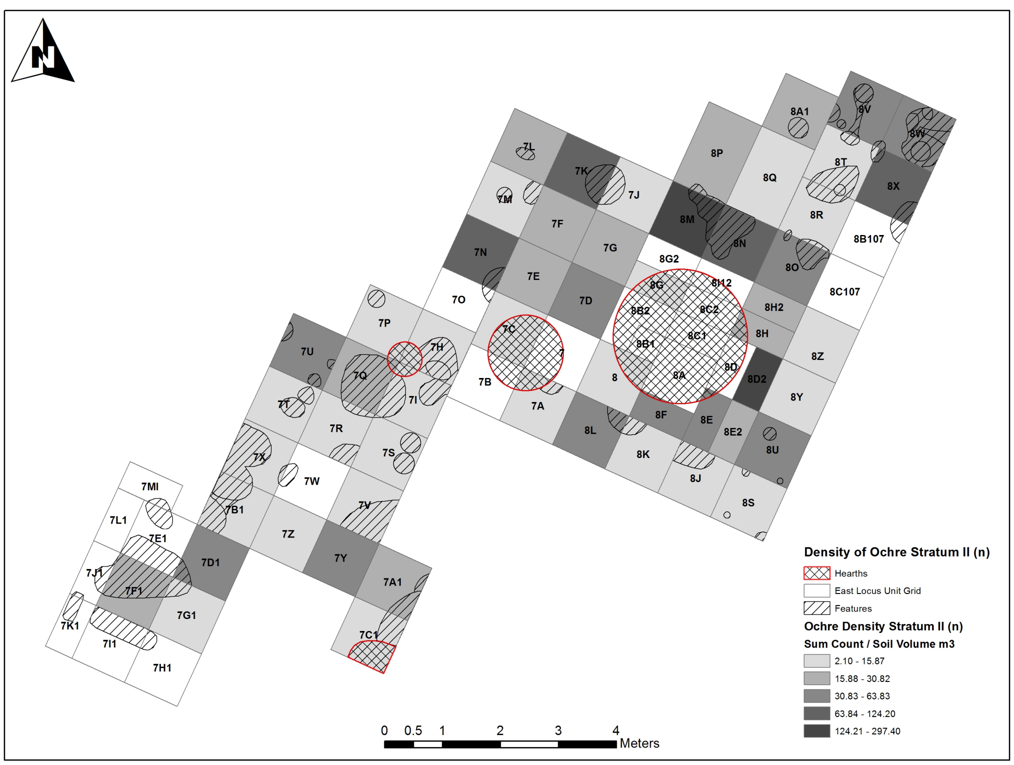

Figure 5.16 (c) Density of red ochre by total sum, Stratum II.

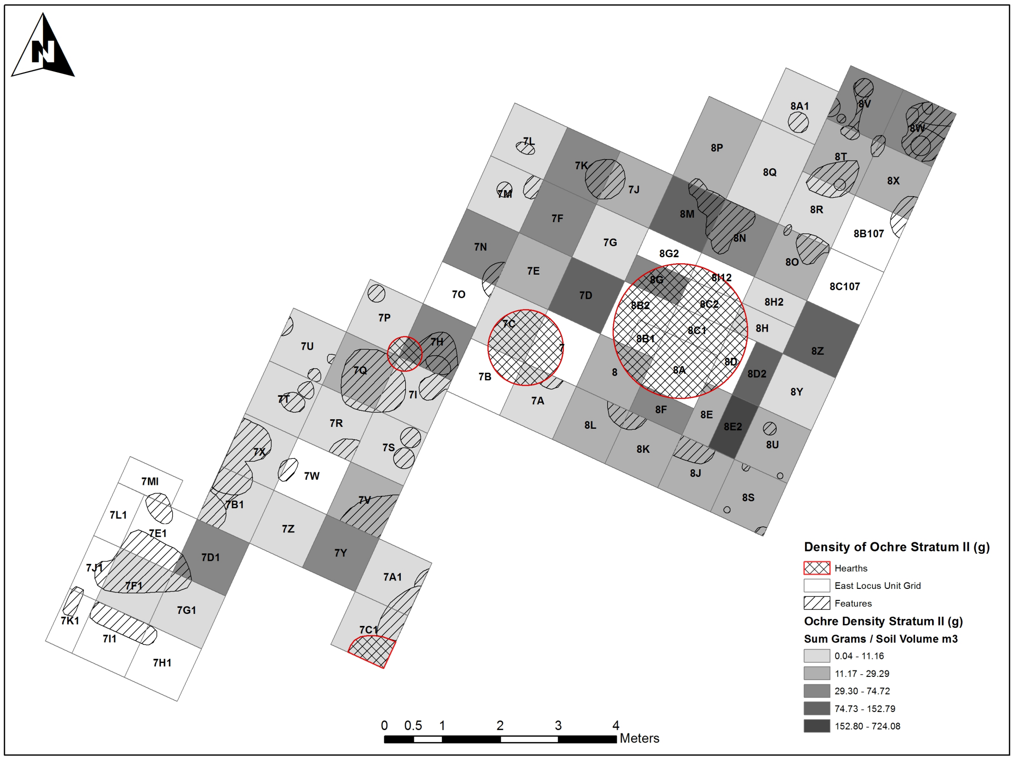

Figure 5.16 (d) Density of red ochre by weight, Stratum II.

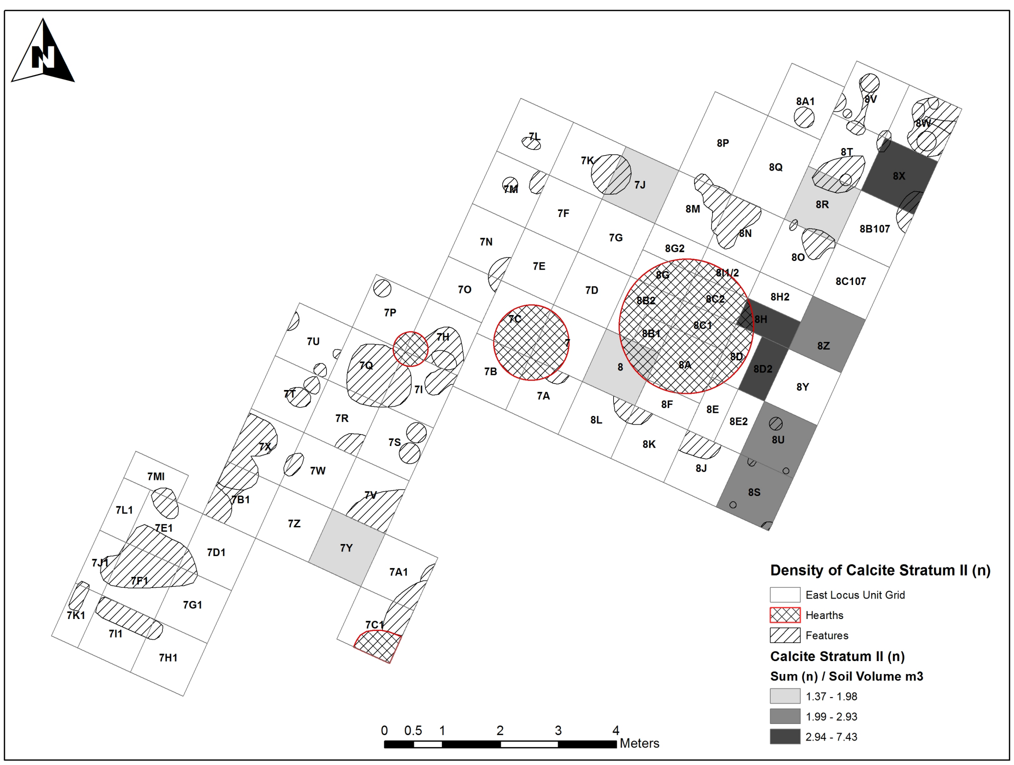

Figure 5.17 (a) Density of calcite crystals by total sum, Stratum II.

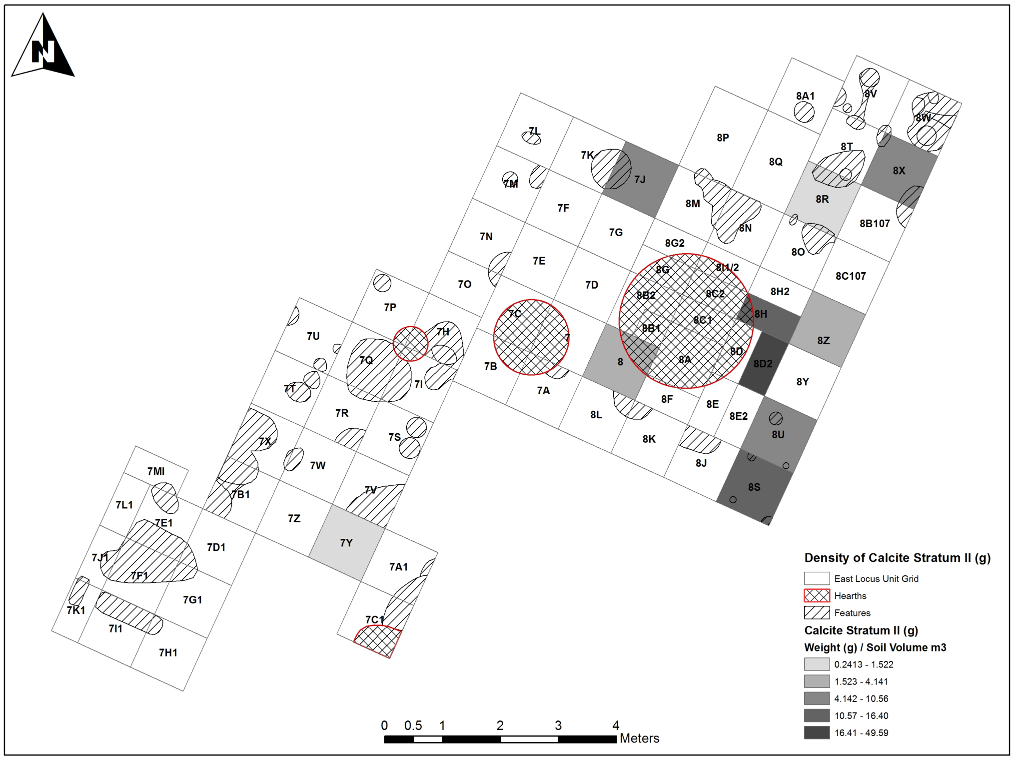

Figure 5.17 (b) Density of calcite crystals by weight, Stratum II.

Figure 5.18 (below) shows the distributions of ochre and quartz within features. Ochre is found in greatest distribution within the upper levels of the F-6 hearth feature, and features 8N-1, 8T-BS, and the Double Dog Burial. Red ochre is also observed in a disarticulated dog burial (7I1-1) and fox burial feature (7I-1)(Figure 5.18a). Aside from the absence of quartz in the levels above the F-6 hearth, this pattern is generally consistent with the distribution of quartz within features, although crystals were also found within the Triple Dog Burial. Despite the lack of quartz within the F-6 feature, it does appear in association with the large hearth in the density maps of quartz in Stratum II (Figure 5.16).

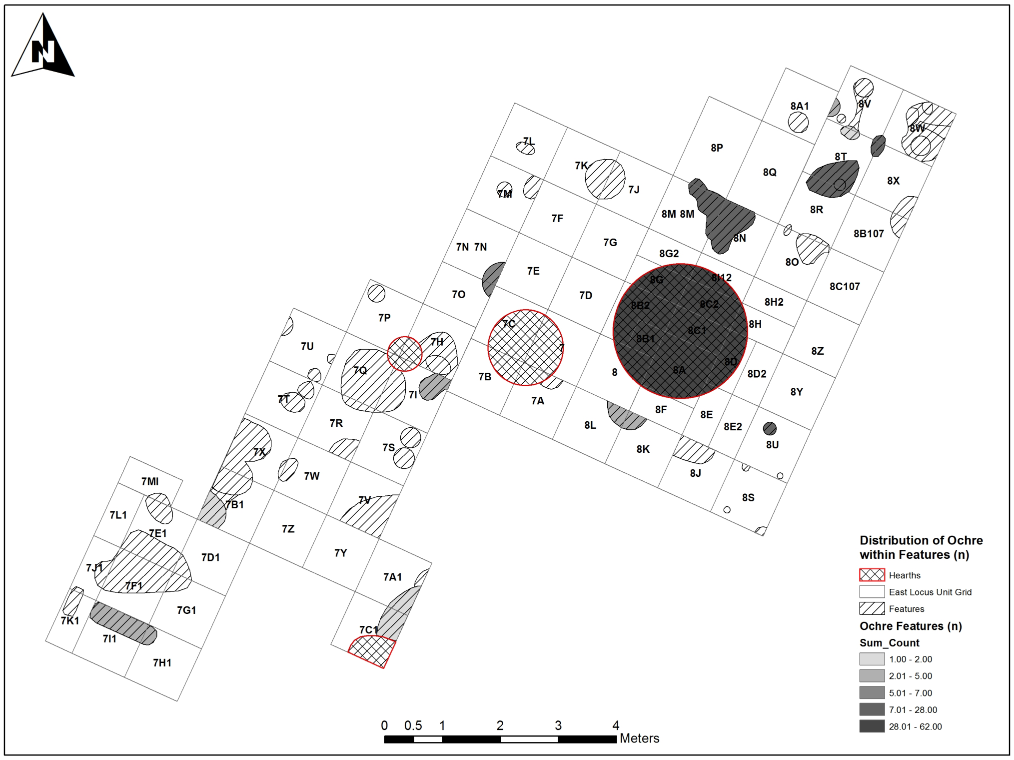

Figure 5.18 (a) Distribution of red ochre within features. Greatest distribution of ochre is observed in the units encompassing the F-6 Hearth Feature.

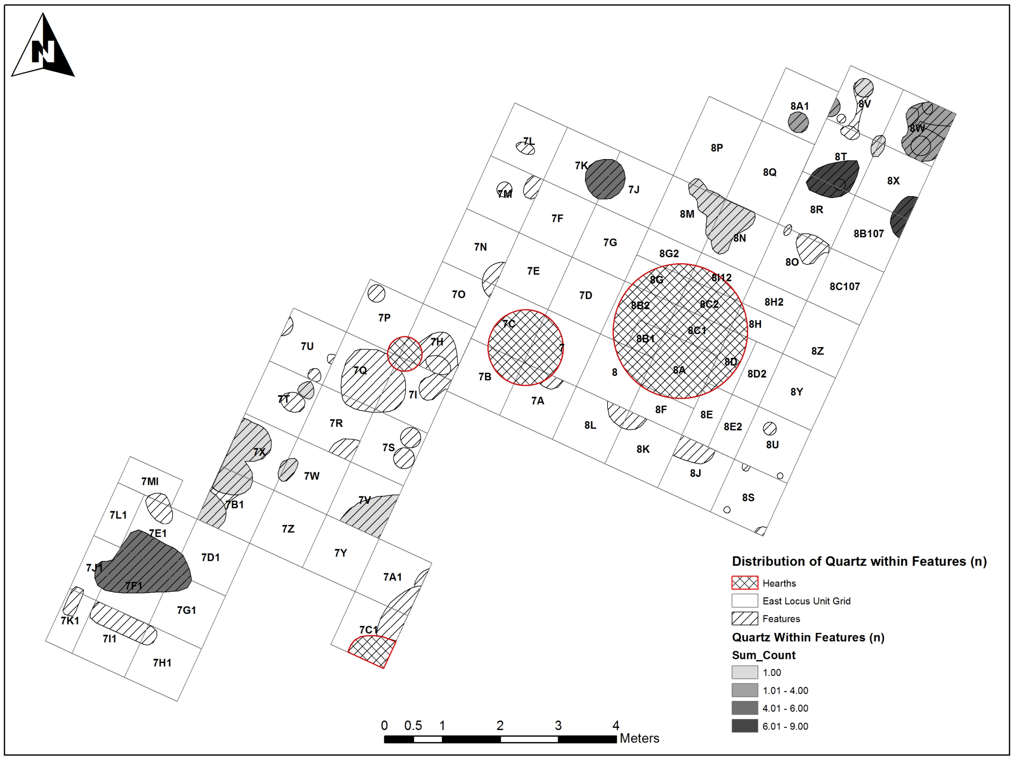

Figure 5.18 (b) Distribution of Quartz Crystals within Features. Greatest distribution of quartz occurs in the features within the Northeast Feature Quadrant and the Triple Dog Burial.

In the exploratory analysis of these data I observed significant clustering for red ochre, quartz, and calcite crystals. The clustering of ochre at East Locus was analyzed based on both weight and total count of individual pieces. The spatial autocorrelation operations performed for the ochre indicated statistical clustering in Stratum II at a distance interval of 2.5 m. However, the distribution by weight is randomly dispersed. Quartz showed identical clustering patterns with ochre in in Stratum II as it was statistically clustered by total sum at 2.5 m, and was randomly dispersed by weight. Calcite was random in both strata by total sum and weight, a result likely due to a much smaller sample size than the other two materials.

In Stratum II, the hot spots of red ochre and quartz are observed in remarkably identical spatial patterning with one another (Figure 5.19 a and b). I believe this to be extraordinarily significant, particularly when considered in context with the various features present in the areas of statistical clustering. Numerous hot spots (z = >2.0) of ochre occur by total count in the area around the Northwest Feature Quadrant (Figure 5.19a). The same result is true for quartz (Figure 5.19b). Here, a total of ten units show significant statistical clustering of both materials, and four units show moderate statistical clustering of both quartz and red ochre. When observing clustering of both materials by weight, the same pattern emerges, but in a different section of East Locus. Hot spots of ochre and quartz by weight in Stratum II occur on the southeast side of Hearth F-6, although the spatial pattern here is not as exact as the clustering of the measure by (Figure 5.16 b and d). Here, I show a total of eight units that have significant hot spot clustering of red ochre by weight (z = >2.0), and a total of six units that exhibit moderate clustering (z = 1.0 – 2.0). Spatial clustering of quartz is observed in a curiously similar pattern. A total of six units display significant hot spot clustering of quartz by weight (z = >2.0), while five units show moderate statistical clustering (z = 1.0 – 2.0) (Figure 5.19). Although the spatial patterning of both ochre and quartz do not match identically unit-to-unit when considered by weight as they do by total sum, I consider the overall patterning of both measures to be a strong correlation between the use of two materials.

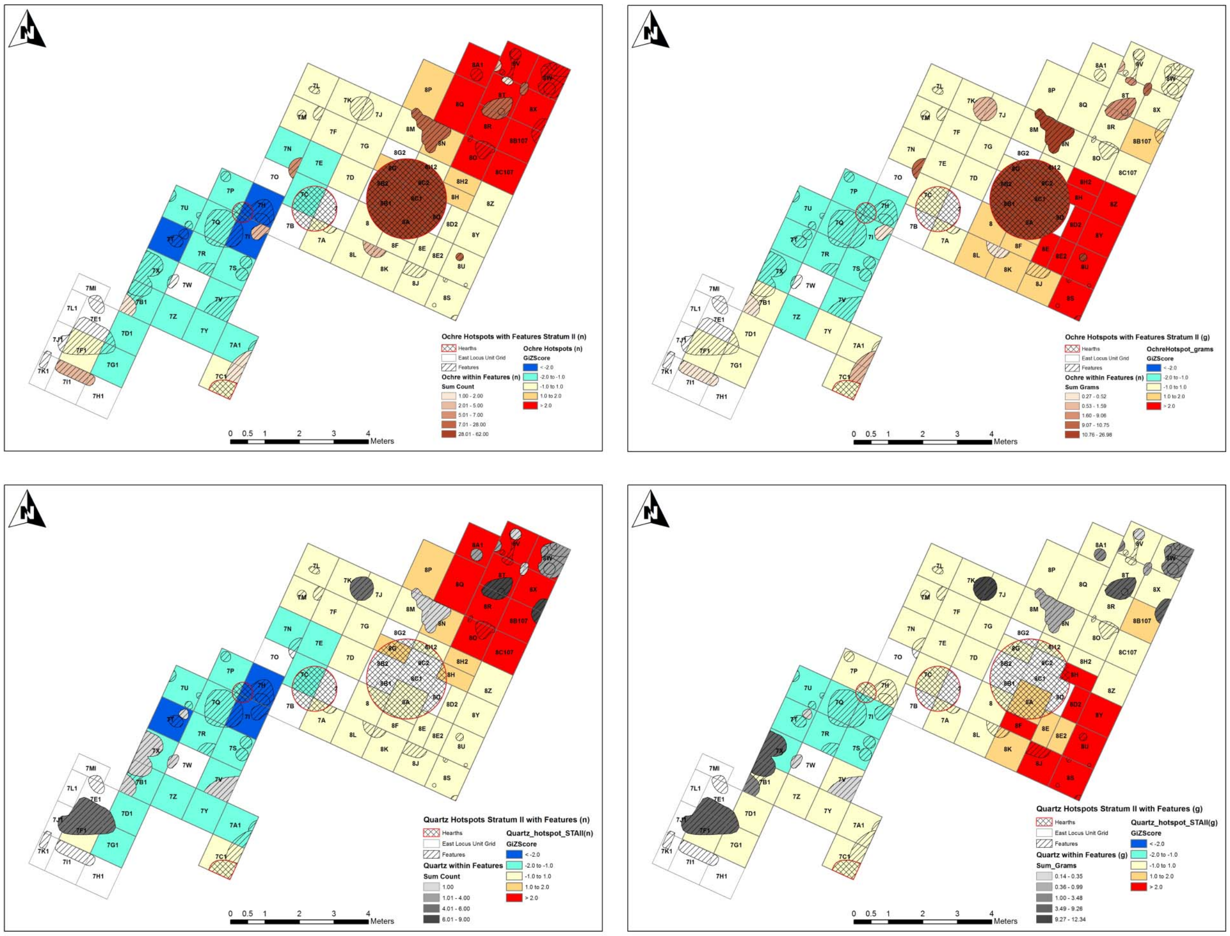

Figure 5.19 (clockwise from upper left): Comparative hotspots of red ochre by *(a)* total count, and *(b)* weight, hotspots of quartz crystals by *(c)* total count, and *(d)* weight.

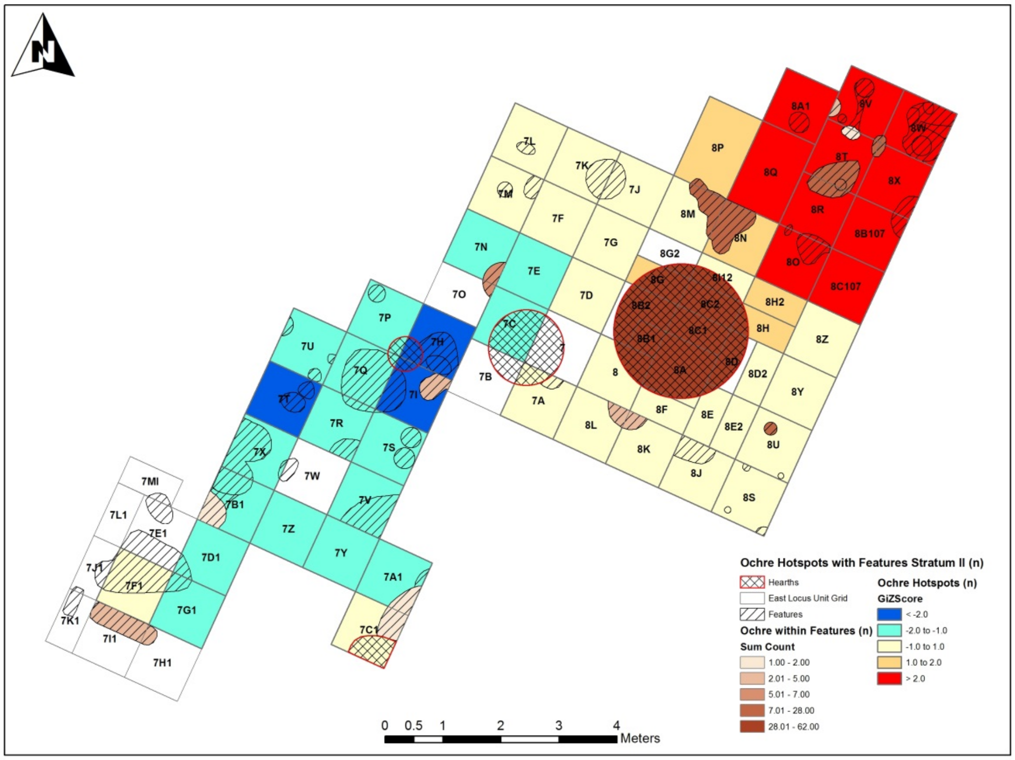

Figure 5.20 (a) Hotspots of red ochre by total sum in Stratum II.

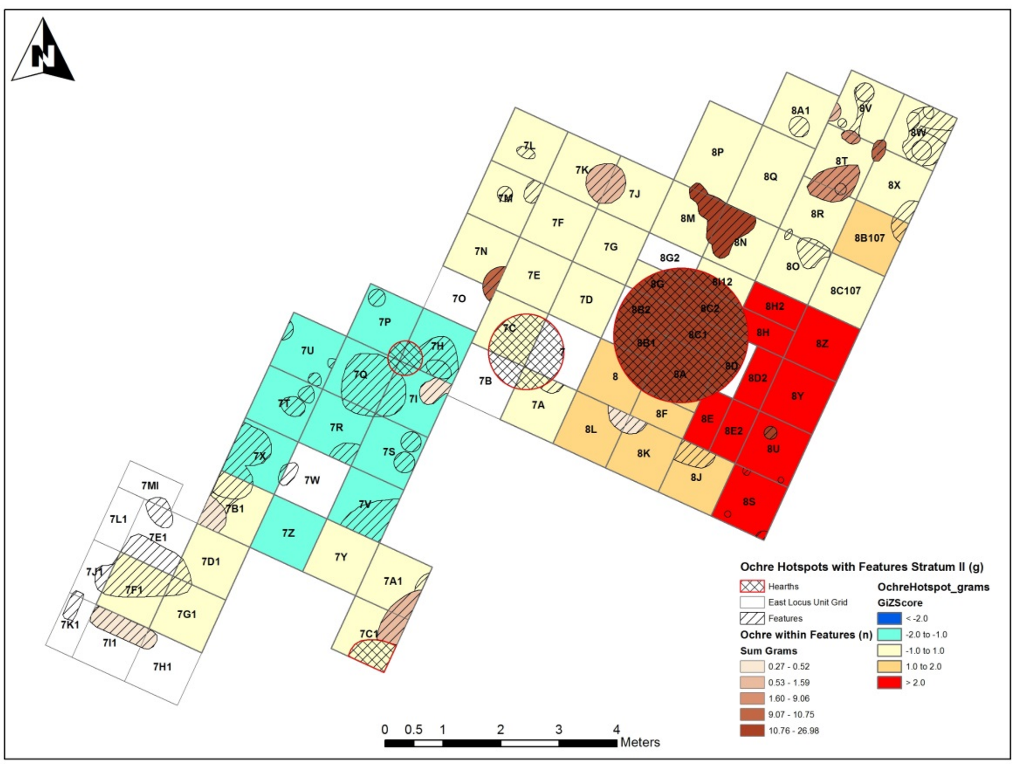

Figure 5.20 (b) Hotspots of red ochre by weight, in Stratum II.

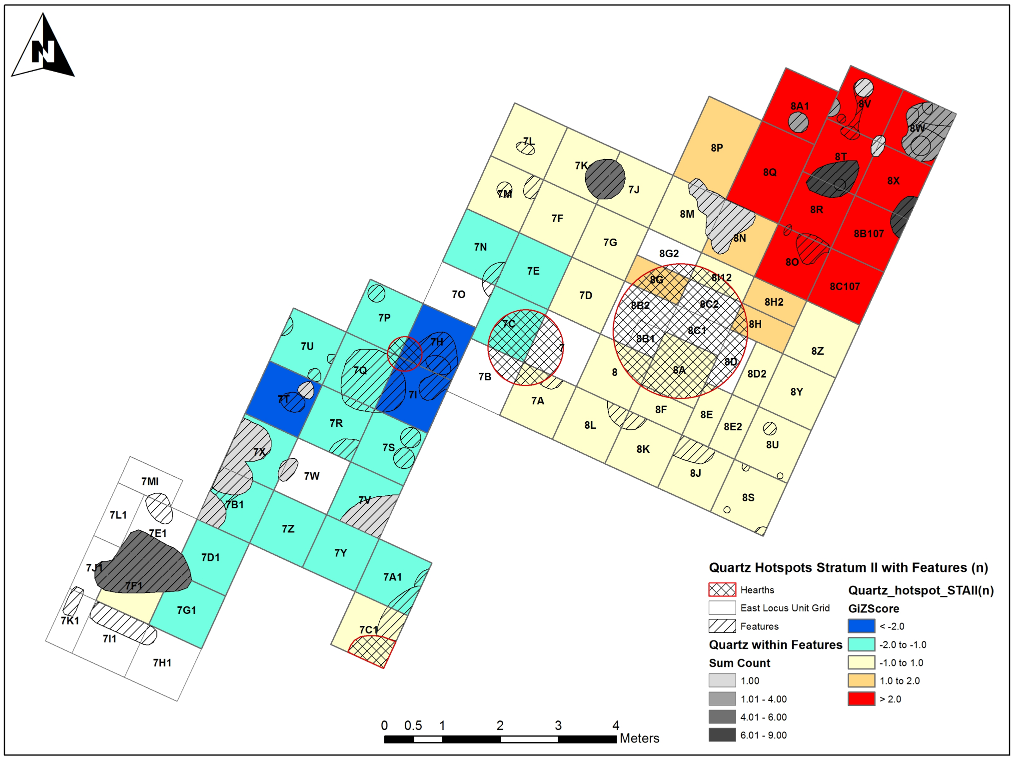

Figure 5.21 (a) Hotspots of quartz crystals (n), in Stratum II.

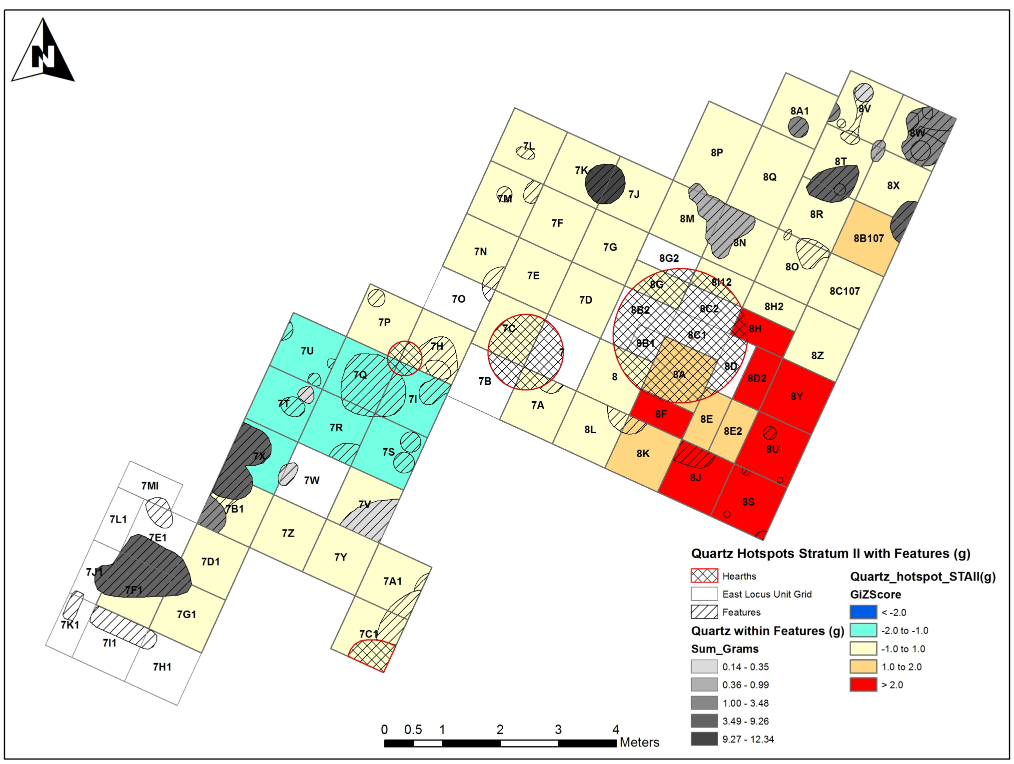

Figure 5.21 (b) Hot spots of quartz crystals (g), in Stratum II.

Calcite in Stratum II is seen in moderate clustering total sum (z = 1.0 – 2.0) in the area around the Northeast Feature Quadrant and southeast of Hearth F-6. Hot spots of calcite by weight also appear on the southeast side of F-6 in Units 8U and 8S (Figure 5.22 a and b). I consider the patterning of hot spots of calcite crystals, although modest and generated from a small sample, to support the overall spatial signatures of ochre and quartz.

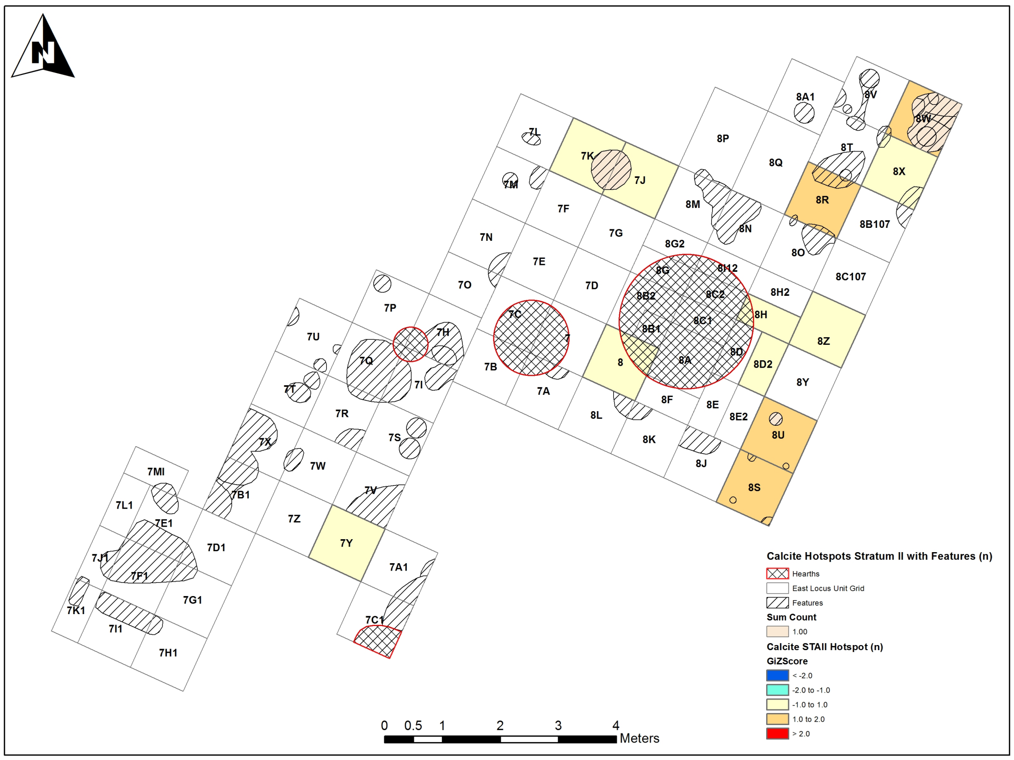

Figure 5.22 (a) Hotspots of calcite crystals, showing clustering by total count. Moderate clustering is observed in the Southeast and Northeast Feature Areas.

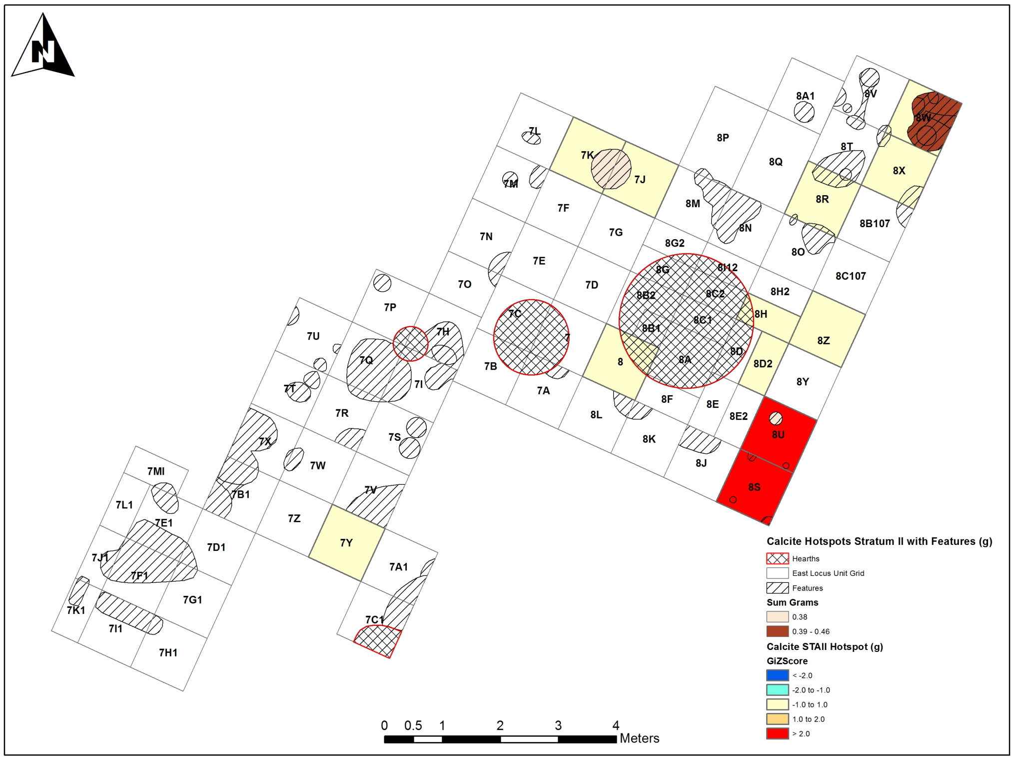

Figure 5.22 (b) Hotspots of calcite crystals, showing clustering by weight. Hotspots are observed in the Southeast Feature Area.

The spatial correlations between ochre, quartz, and calcite are apparent from the hot spot renderings. I believe the contextual associations of these materials is more intriguing, particularly when I consider their direct proximity to features. The hot spots of red ochre and quartz at East Locus showed identical clustering in areas around features believed to be associated with ceremonialism, such as the fire hearths, pits, and dog burials (Cannon 2006; Guttenberg et al. 2013). I believe my results fully support Knierim's assertion that this triumvirate of raw materials was used in ceremonial practice at CA-SNI-25.

In summary, my results show some consistent trends in the spatial patterning of the artifacts and materials that represent my sample. As I further analyze the contextual associations between the clusters of artifacts and materials and the numerous features at

East Locus, I see a clear distinction between the spatial signatures of utilitarian artifacts, and raw materials associated with ceremonial practices. The spatial signatures of the artifacts and materials themselves suggest that there was an organized and clearly defined designation of space at East Locus. Furthermore, these spatial signatures also help shed light on the nature and character of the various pits and features that characterize the site.

CHAPTER 6

Discussion

In this chapter, I interpret the spatial signatures of artifacts and materials analyzed from CA-SNI-25 in terms of my research goals presented in Chapter 1 including: the organization of utilitarian and ceremonial space at East Locus, inter-island and inter-regional economic exchange and social interaction, and the application of this methodology throughout southern California. I also discuss the interpretation of spatial signatures in the archaeological record in the broader context of human behavior. I interpret the linkages between the artifacts and materials within the organized space of East Locus and discuss the overall spatial organization of the site, which ultimately is the living connection to the people who created it.

My approach to using intrasite GIS provided a visual and interactive platform conducive to spatial studies in archaeology. By digitizing spatial data from field notes and sketches, transit surveys and maps, and other analog forms, combining these with new georeferenced points, reconciling scales, and analyzing the distribution of archaeological finds, I created a powerful tool for examining the archaeological record. The correlations of saws relative to hooks, imported lithic material relative to local toolstone, and ochre and crystals relative to ceremonial features were clear and made visible by GIS analysis. Although connecting spatially associated artifacts, saws/hooks for example, into a functional linkage requires a variety of descriptive and analytical approaches, the results of my intrasite GIS analysis suggest it is effective at finding and displaying in-ground relationships. Documenting and analyzing *in situ* spatial associations of objects and features form the basis for making behavioral inferences about how people organized and divided up their space to perform individual, social, and communal activities.

Kendig et al. (2010), for example, suspected an association between saws and hooks based on field observations and literature searches and tested it with a series of replicative experiments, use-wear analysis, non-spatial statistics, and other analytical studies. The intrasite exploratory analysis described above strengthens the hypothesis that these two artifact types share not only a spatial association but a functional one as well. Cannon (2006) presented evidence of canoe trade and social ties with other islands and the coastal mainland by discussing the presence and significance of imported lithic materials at CA-SNI-25. My research expands upon this by demonstrating that extra-local toolstone clearly had a different value than the local toolstone based on it’s distribution around fire hearths and the ceremonial features such as dog burials. The use of ochre and crystals has been linked to religious practice on neighboring San Clemente Island (Hale 1995; Hardy 2000; Perry 2013), and I have shown these materials to be linked in spatial association at East Locus.

The results of my research confirm hypotheses about the association of sandstone saws and shell fishhooks, the importance of interregional trade and interactions, and the role of ochre and crystals in ceremonial contexts. Returning now to the research questions outlined at the beginning of this thesis, the results of my spatial analysis confirms assumptions about the archaeological record at CA-SNI-25:

The spatial patterning of features, artifact types and materials at CA-SNI-25 does indicate a separation between utilitarian and ceremonial space at East Locus. The comparison between the spatial signatures rendered for the utilitarian tools and those rendered for ochre and clear crystals show a distinct delineation between areas of use. Hot spots for utilitarian items, such as circular shell fishhooks, sandstone saws, and other formal tools made from local toolstone, are seen to generally cluster in the Southwestern Feature Area and on the southeast side of the largest of the fire hearths (Feature F-6).

Distributions of lithic debitage and household debris around hearth features have been explored through other methods of spatial analysis. Binford (1983) employed ethnographic analogies from Nunamuit Eskimo groups to model debris patterns around various types of fire hearths (Carr 1991:230-40). In this contextual analysis, debitage and faunal remains were shown to occur in various "drop and toss zones" around hearths, and the varying patterns of the debris zones offered different contexts for the activities surrounding the hearths (Binford 1983, Carr 1991). This approach may also be applied to the patterns rendered in the hot spot maps showing clusters of lithic tools and tool-making debris in context with the three hearth features in the center of East Locus. The spatial signatures do indicate that utilitarian tools share a spatial association, and the contextual interpretation provides a frame of reference for their functional linkage.

In comparison, the examination of red ochre and clear crystals across the site clearly demonstrated a remarkable association between the two materials, as their spatial signatures are nearly identical. The clustering and contextual association of quartz and ochre with the ceremonial features in both the Northeast and Southwest Feature Areas of the locus suggest a direct linkage of pigments and clear crystals to organized and repeated ritual activity. My exploratory analysis also showed some interesting characteristics and raised questions about differences in the distribution of small fragments compared to weight. My results suggest that although the use of ochre and crystals at East Locus was widespread, there was significant clustering of pigment, quartz and calcite together and in context with the fire hearths, dog burials, cache pits, stacked stones, and other ceremonial features.

The presence and spatial pattering of exotic materials obtained through trade with other islands and the mainland confirms that CA-SNI-25 may have served as a hub for economic exchange and social interaction on San Nicolas during the late Holocene. Evidence of regional canoe trade at CA-SNI-25 is apparent by the presence of extra-local lithics obtained from other islands and the mainland. My results show that these imported materials are not widely distributed across the site, but occur mostly around the 7Q Hearth Quadrant and the ceremonial features in the northeast and southwestern sections of the site. This suggests to me that social activities and practices associated with inter-island exchange are possibly contextually related to the ceremonial features. Martz (personal communication, 2014) is exploring the possibility that a feature found at CA-SNI-240, a site in close proximity to SNI-25, is a ceremonial cache associated with shamanism and canoe trade. This notion is interesting considering the clustering of exotic materials obtained through canoe trade and their spatial association with numerous pits and features at East Locus. Perry (2013) describes shamanic toolkits on the Channel Islands containing quartz crystals, charmstones, stone pipes, raptor claws and other such ritual paraphernalia as requiring "necessitated access to different local and imported resources" (Perry 2013:141). This appears consistent with the character of some of the features observed at East Locus, as well as the feature at SNI-240 described by Martz. To me this suggests that many of the pits and features at East Locus may be associated with a common ritualized practice of creating such offerings in the form of talismans in order to control the weather, ensure safe travel over water, and predict or influence future events.

My focus on the potential use of sandstone saws in fishhook manufacture has additional implications to the emergence of regional trade and inter-island social interaction. The introduction of the circular shell fishhook on San Nicolas and other Channel Islands was a significant factor in the rise of social and economic complexity observed in the archaeological and ethnographic record (Arnold 2001; Kennett 2005; Strudwick 1986). The innovation of the incurved fishhook expanded production of deep water and kelp bed fisheries utilized by Native Americans occupying the Channel Islands as well as the coastal mainland. The development of this technology was related to reliance on fishing as an effective subsistence strategy and contributed to other cultural developments observed in the archaeological record on San Nicolas and the other islands.

Evidence of benthic fish remains and ceremonial feasting at CA-SNI-25 suggests an increased production from fishing harvests and a potential for food surplus (Bartelle et al. 2010). Martz (2005) argues that this development parallels a rise in population levels and densities on San Nicolas Island. Furthermore, this technology is believed to have set the table for the development of craft specialization, the accumulation of personal wealth, and elite-based social stratification. These developments go hand-in-hand with the emergence of the plank canoe as a vehicle of food procurement, trade, and travel between the islands and the mainland, perhaps the most significant factors influencing the rise of social complexity documented throughout coastal and insular southern California (Arnold 1992, 1993, 1995, 2001a, 2001b).

My analysis of intrasite spatial patterning at CA-SNI-25 does reveal a signature for ceremonial activity that can be applied to other late Holocene sites throughout southern California. The results show clustering of red ochre and quartz around ceremonial features and demonstrate the significance of pigments and crystals in Nicoleño cosmology. The spatial signatures of these materials offer a quantitative result that can be correlated with a contextual association to make inferences about sacred practice and ritual activity on neighboring islands and the coastal mainland. In the case of East Locus, I had numerous features and fire hearths to use as context with the spatial signatures. In the absence of such features, perhaps the signatures themselves may provide context for other associations and linkages that have yet to be revealed.

Inter-Island Implications

There are many implications for further research using GIS elsewhere on the Channel Islands. The application of GIS exploratory analysis allows for the visual display of spatial patterns that are not immediately apparent in large data sets. Furthermore, intrasite GIS provides a definitive direction for additional research on previously analyzed data. It may also prove useful to combine this type of intrasite approach with a regional landscape analysis to examine source locations of materials and networks of trade and exchange. For instance, the spatial patterning of exotic trade materials on an intersite scale may shed light on the nature and flow of trade goods between the islands and the mainland (Arnold 2001, Cannon 2006, Rick et al. 2001, Vellanoweth 2001).

Sites on the Channel Islands that were excavated before the development of GIS could benefit from the application of the methods used in my study. If sites excavated many years ago have not been analyzed or only partially analyzed, then intrasite GIS can be used to predict and guide fruitful avenues of research. Sites such as Lemon Tank (CA-SCLI-1524) and Eel Point (CA-SCLI-43) on San Clemente Island and the El Montón site (CA-SCRI-333) on Santa Cruz Island are good candidates for intrasite spatial analysis using GIS and updated georeferenced data.

The Lemon Tank site, for example, has excellent potential for exploratory analysis in comparison to the Tule Creek site. Both sites are roughly contemporaneous and have produced an abundance of data indicative of ceremonial activity. Hale (1995) has documented numerous features at the Lemon Tank site found within a ceremonial complex similar to those at East Locus, including dog burials, caches of ochre and seeds, artifacts made of exotic stone such as chert and steatite, hearths, and fishing kits. Most of these features exist within a ceremonial enclosure, which Hale has posited as similar to those described in the *toloache* ceremony, or boys' puberty rite. Such ceremonial complexes are characteristic of Chinigchinich, a religion practiced by southern California peoples (see Boscana 1933; DuBois 1908; McCawley 1996). A similar sacred enclosure, or *yovaar,* is described at the Ithmus Cove site (CA-SCAI-39) on Santa Catalina Island in the ethnohistoric account of Sebastian Vizcaino's 1602 expedition (McCawley 1996). I have considered these possibilities as well at East Locus. The abundance of comparable features and artifacts between Lemon Tank and East Locus, coupled with a spatial analysis of both sites would undoubtedly shed new light on possible religious links between the island peoples as well as reinforce those links with their mainland neighbors.

Perry describes archaeological evidence of ritual activity on the northern islands from a landscape perspective (Perry 2007), ideal for using GIS at a regional scale. Sacred locales and shrines are viewed as part of a geographic and cultural landscape. Perry (2013) also describes intrasite ritual correlates on San Clemente Island similar to what we observed at CA-SNI-25. My intrasite spatial analysis at CA-SNI-25 could provide insight to archaeological signatures of ritual activity that can be applied elsewhere on the Channel Islands.

Teeter et al. (2013) have also applied GIS to map indigenous trail systems across Santa Catalina Island. Using ethnographic data and a digital elevation model to produce a least cost path, the authors propose that trails functioned as more than just conduits of goods and information but also maintained social bonds, alliances, and a geographic connection to sacred locales. Both this research on Santa Catalina Island and Perry's work on Santa Cruz Island are excellent examples of regional landscape approaches that can be used in tandem with intrasite GIS analysis to map out ancient landscapes, both small and large. Understanding patterns of personal and social space on the Channel Islands requires both intrasite and landscape approaches, which are not mutually exclusive but complimentary.

CHAPTER 7

Conclusions

In this thesis I used an intrasite methodology to shed light on the use of space at a Late Holocene village site on San Nicolas Island. I employed GIS to model a ceremonial complex at CA-SNI-25, and through a series of operations that rendered spatial clusters tied to specific behavioral activities inferred by materials observed in the archeological record. By applying contextual association to these patterns in relation to the multiple features and fire hearths that characterize the site, I was able to define distinct sections of East Locus where utilitarian and ceremonial activities were likely to have been practiced.

Used in conjunction with other archaeological approaches, intrasite GIS analysis provides another analytical tool for the archaeologist to use to understand the past. In this case I focused on both utilitarian and ceremonial contexts to examine how material remains clustered in the archaeological record at CA-SNI-25. Shell fishhooks and sandstone saws appear to cluster, as does the presence of crystals and ochre in ceremonial contexts. Additionally the results of my research link San Nicolas to the other Channel Islands by showing that there was trade and social interaction between the residents at CA-SNI-25 and other communities throughout Southern California, and that Tule Creek Village may have played host to visitors from other islands on a regular basis. I have also strengthened the argument that red ochre and clear crystals were used in sacred activity at East Locus, and that these materials were a highly symbolic aspect within a complex cosmology and a highly formalized religious and ritual practice likely associated with a form of Chinigchinich.

There are many unanswered questions regarding the nature of the feature complex at East Locus. For example, what was the purpose of such large fire hearths on an island where fuel for fires is so scarce? Were the hearths a centerpiece for large gatherings where feasting took place when visitors from other islands arrived by canoe? Did they serve as signal fires, clearly visible through the fog by people padding canoes towards Corral Harbor with loads of fish or trade goods? Also intriguing is the unknown significance of the dog burials. Were they laid to rest in honor of their owners, or are their burials associated with shamanic practice or canoe magic? Clearly these phenomena are indicative of a culture exhibiting an elaborate tapestry of complex social, economical, and religious behaviors.

Perhaps one of the least understood aspects about the archaeology of the southern California is the organization and use of space by native peoples in both domestic and ritualized contexts. The types of data necessary for such research demand large contiguous samples, excellent stratigraphic and chronological control, and the application of spatial analysis. It is also necessary to develop frames of reference (Binford 2001) for interpreting the spatial association of objects and features, and linking them to the dynamic behavioral and cultural processes that formed them (Binford 1980, 1983). Data sets derived from experimental, replicative/use-wear, and enthnohistoric approaches as well as computer modeling provide excellent frames of reference and will prove useful on the Channel Islands. Despite the abundance of well-preserved sites on San Nicolas and the other Channel Islands few, however, have been excavated and analyzed utilizing these approaches.

By combining the types of spatial analysis presented in this thesis with existing site specific and regional data (see Perry 2007, 2013) it will be possible to model the use of space by native peoples through time on the Channel Islands. Perry's (2007, 2013) survey and synthesis of ceremonial sites on Santa Cruz Island provides an excellent backdrop against which site-specific spatial data can be compared. Modeling site-specific, island-wide, and regional data regarding the use of space for ceremonial or everyday purposes has the potential to illuminate differential land use patterns and behavioral practices between people of the northern and southern Channel Islands.

I am hopeful that the new directions of intrasite spatial analysis will help to dispel some of the previous critiques of the use of GIS in archaeology. Often cited as over-generalizing and deterministic, GIS analysis has fallen under attack by critics, implying that digital methods of analysis dehumanize human behavior (Connoly and Lake 2006; Kvamme 1999; Lock and Stanic 1995; McCoy 2009:9; Wheatley 2004). Although these authors have valid points, I argue that this technology is seeking to revive and enhance the spatial archaeology of the 1960s and 1970s (Holdaway et al. 2005; Jones and Munson 2005; McCoy 2009; Wheatley and Gillings 2002:236). My approach of integrating intrasite GIS with multiple methods of analysis retains the humanistic component to archaeological research necessary to properly interpret past human behavior (Challis and Howard 2006, Kvamme 2006, Kvamme et al. 2006, Rigaud and Simek 1991).

At some point, I expect that all Channel Island sites will include georeferenced data joined with catalogs and collections, allowing for intra-island and inter-island comparisons. Salient topics of interests such as the development of innovative technologies, trade networks, craft specialization, the rise of social complexity, population demographics, and a host of other questions relevant to both the northern and southern island groups can be integrated. By incorporating northern and southern island datasets we can begin to understand the complexity and dynamics of the prehistoric interactions that took place on San Nicolas Island and throughout southern California.

Implications for Future Research

Although there is great potential for future research using these methods with materials collected from CA-SNI 25 and elsewhere on the Channel Islands, the application of these analytic tools reaches far beyond the regional and cultural boundaries discussed. My analysis of the collection from Tule Creek Village is merely a snapshot of the types of spatial studies that can be employed with the vast data available to explore. For instance, these methods are ideal as part of a more comprehensive lithic analysis. I selected smaller samples of broad lithic categories in order to make some generalized inferences about lithic use, procurement through trade, and tool production. A more detailed examination of expedient and formal tool use, and areas of manufacture would help to better define use and activity areas at the site. A deeper investigation into the fishing industry at CA-SNI-25 can easily be designed using spatial analysis. Smith (2014) explored fishhook production and toolkits used for hook manufacture, and coupling that research with a spatial and zooarchaeological approach could shed light on the various types of methods used to catch specific species of fish within different ocean habitats.

Other possibilities for spatial modeling at CA-SNI-25 include: high resolution modeling of stratigraphy and features based off of the numerous radiocarbon dates available for the site, lithic sourcing and linkages to other Late Holocene villages within the region, bead and jewelry manufacture, bone tool production and use, faunal analysis, and comparative spatial and temporal variations between East Locus and other loci at the site, such as South Locus and Mound B.

Beyond San Nicolas Island and southern California, the possibilities for intrasite spatial analysis are limitless. There is tremendous potential for high-resolution spatial studies of archaeological sites in North and South America, Europe, and the Middle East where large, open block excavations are often conducted as regular practice and produce the abundance of data necessary to conduct an intrasite study. Remote sensing techniques such as LiDAR imagery analysis, magnetometer and ground-penetrating radar surveys, onsite 3-D scanning, time lapse and aerial photography, and other technology are commonly employed in archaeological research, and intrasite spatial studies are an ideal complement to each of these methods.

Much of the groundwork has been laid for these research topics and endless others. The previous research conducted on San Nicolas Island and CA-SNI-25 has provided a strong background, a multitude of data, and excellent opportunities for students to continue to explore the untold prehistory of the island and to contribute to our understanding of the Nicoleño people. I appreciate the opportunity to contribute this research, and I challenge and encourage the students who follow to continue to investigate and analyze these data, and to imagine and innovate new and better methods they use to study the past.

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APPENDIX

Data Tables

Appendix A, Table 1 Local Lithic Reduction Cores.

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Lithic Catalog #
7Q Hearth Quadrant	7	II		Metavolcanic	Tortoise	1	48.30	1608
	7	II		Quartzite	Tortoise	1	93.60	1599
	7	II		Quartzite	Diagonal	1	79.30	1646
	7	I		Quartzite	Cobble	1	159.89	
	7A	II		Porphyritic metavolcanic	Decapitate	1	343.02	1587
	7H	II		Porphyritic metavolcanic	Decapitate	1	171.60	1571
	7P	I		Porphyritic metavolcanic	Tortoise	1	46.80	1604
	7Q	II	7Q-1	Porphyritic metavolcanic	Decapitate	1	75.06	1566
Hearth Feature 6 Area	8	II		Metavolcanic	Tortoise, decapitate	2	147.10	1572 1612
	8	III		Metavolcanic	Tortoise	1	100.70	1627
	8A	II		Porphyritic metavolcanic	Tortoise	1	72.60	1636
	8B	I		Metasedimentary	Unpatterned	1	84.30	1898
	8B	II		Porphyritic metavolcanic	Tortoise	1	201.40	1606
	8B	I		Quartzite	Tortoise	1	110.50	1613
	8D	I		Metavolcanic	Tortoise, unpatterned	2	155.50	1632 1897
	8D	II		Porphyritic metavolcanic	Decapitate	1	62.70	1573
	8G	II		Quartzite	Utilized core tool	1	146.20	
	8G2	I		Metavolcanic	Decapitate	1	55.50	1584

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Lithic Catalog #
	8H	II		Quartzite	Tortoise	1	242.00	1588
	8H	II		Quartzite	Tortoise	1	70.10	1615
Hearth Feature 9 Quadrant	7B	I		Quartz	Tortoise	1	25.45	1596
	7B	I		Quartzite	Tortoise	1	24.50	1640
	7B	II		Quartzite	Tortoise	2	60.80	1607 1624
	7C	II		Metavolcanic	Tortoise	1	10.10	1639
	7C	II		Quartzite	Decapitate	1	147.60	1577
Northeast Feature Quadrant	8T	I		Metavolcanic	Tortoise	1	33.43	1643
	8V		8V-B	Metavolcanic	Tortoise	1	57.30	1595
	8V	II		Porphyritic metavolcanic	Utilized core tool	1	146.20	
	8W	II		Island Chert	Tortoise	1	41.21	1593
	8W	I		Metavolcanic	Tortoise	1	19.45	1642
	8W	II		Porphyritic metavolcanic	Decapitate	1	71.32	1568
	8X	I		Metasedimentary	Decapitate	1	334.70	1586
	8X	II		Metavolcanic	Decapitate	1	143.80	1570
Northwest Feature Area	7D	I		Metavolcanic	Tortoise	1	21.86	1616
	7D	I		Porphyritic metavolcanic	Tortoise	1	18.01	1629
	7D	I		Porphyritic metavolcanic	Decapitate	1	114.05	1576
	7F	II		Metasedimentary	Decapitate	1	118.90	1574
	7G	I		Metasedimentary	Decapitate	1	194.00	1567
	7G	II		Metasedimentary	Tortoise	1	91.80	1623

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Lithic Catalog #
	7J	I		Porphyritic metavolcanic	Tortoise	1	34.10	1641
	7K	II		Porphyritic metavolcanic	Tortoise	1	45.10	1625
	7K	II	7K1-1	Porphyritic metavolcanic	Decapitate	1	52.50	1580
	8M	I		Porphyritic metavolcanic	Tortoise	1	103.60	1617
	8M	II		Porphyritic metavolcanic	Decapitate	1	71.70	1575
	8N	II		Metasedimentary	Unpatterned	1	175.80	1899
	8N	II		Metavolcanic	Tortoise	1	116.40	1591
	8P	I		Porphyritic metavolcanic	Tortoise	2	195.00	1597 1603
	8Q	I		Metavolcanic	Tortoise	1	63.30	1610
Southeast Feature Area	8D2	II		Metasedimentary	Tortoise	1	64.20	1644
	8E	I		Metavolcanic	Tortoise	1	11.70	1638
	8E	II		Quartzite	Tortoise	1	47.30	1594
	8J	II		Metavolcanic	Tortoise	1	178.80	1600
	8U	II		Quartzite	Decapitate	1	65.63	1581
Southwest Feature Area	7A1	I		Metasedimentary	Decapitate	1	62.83	1585
	7A1	I		Metasedimentary	Core tool	1	111.15	
	7A1	II		Porphyritic metavolcanic	Core tool	1	60.90	
	7B1	II		Porphyritic metavolcanic	Tortoise	1	47.60	1630
	7B1	II		Quartzite	Tortoise	1	148.30	1611
	7B1	II		Quartzite	Tortoise	1	22.20	1635

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Lithic Catalog #
	7C1	II		Metavolcanic	Decapitate	1	279.70	1569
	7R	I		Metavolcanic	Unpatterned	1	45.80	1911
	7T	II		Metasedimentary	Tortoise	1	16.30	1614
	7T	II		Porphyritic metavolcanic	Tortoise	1	43.30	1637
	7Y	II		Metasedimentary	Tortoise	1	59.80	1589
	7Z	I		Porphyritic metavolcanic	Tortoise	1	63.00	1619
	7Z	II		Porphyritic metavolcanic	Decapitate	1	66.30	1582
	7Z	II		Porphyritic metavolcanic	Tortoise	1	101.70	1634
	7Z	II		Porphyritic metavolcanic	Decapitate	1	26.69	1578
Triple Dog Burial Area	7D1	I	TDB	Porphyritic metavolcanic	Tortoise	1	60.93	1609
	7D1			Porphyritic metavolcanic	Core tool	1	129.87	
	7E1	II		Porphyritic metavolcanic	Tortoise	1	138.11	1598
	7L1	I		Quartzite	Tortoise	1	40.95	1601
	Total					76	6891.21	

Appendix A, Table 2a Sandstone Debitage and Fragments within Units.

		Stratum I		Stratum II			
Feature Area	Unit	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count (n)	Total Weight (g)
7Q Hearth Quadrant	7H			11	32.01	11	32.01
	7I	17	137.62	2	25.21	19	162.83
	7P	3	8.28	14	48.1	17	56.38
	7Q	2	11.41			2	11.41
Hearth Feature 6 Area	8A			4	14.94	4	14.94
	8B	1	1.07	1	1.06	2	2.13
	8C			2	13.32	2	13.32
Hearth Feature 9 Quadrant	7	4	10.97	5	42.73	9	53.7
	7A			1	2.44	1	2.44
	7B			1	0.3	1	0.3
	7C	4	10.33	3	18.62	7	28.95
Northeast Feature Area	8M	2	6.29	1	2.68	3	8.97
	8N	1	0.69			1	0.69
	8O			1	9.92	1	9.92
	8P	3	8.19			3	8.19
	8Q	2	4.23	1	5.55	3	9.78
	8R			1	58.63	1	58.63
Northeast Feature Quadrant	8T	3	5.91	31	185.31	34	191.22
	8V	5	15.05	23	90.67	28	105.72
	8W	1	140.88	24	87.4	25	228.28
	8X	4	22.07	15	42.52	19	64.59
Northwest Feature Area	7D	5	20.96			5	20.96
	7E	7	32.2	1	2.14	8	34.34

		Stratum I		Stratum II			
Feature Area	Unit	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count (n)	Total Weight (g)
Southeast Feature Area	8D2			1	1.59	1	1.59
	8E	2	5.72			2	5.72
	8E2			2	8.69	2	8.69
	8G2	1	0.88			1	0.88
	8J			1	6.81	1	6.81
	8S			5	30.82	5	30.82
Southwest Feature Area	7A1			1	6.18	1	6.18
	7C1	1	1.35	3	9.94	4	11.29
	7S			1	0.57	1	0.57
	7T			5	7.28	5	7.28
	7X			2	1.86	2	1.86
	7Z			1	11.54	1	11.54
Triple Dog Burial Area	7D1	6	49.16	10	90.64	16	139.8
	7E1	12	38.1			12	38.1
	7F1	3	15.09	9	18.12	12	33.21
	7G1	4	5.78	4	44.14	8	49.92
	7K1	2	1.5			2	1.5
	Grand Total	**95**	**553.73**	**188**	**923.83**	**283**	**1477.56**

Appendix A, Table 2b Sandstone Debitage and Fragments within Features.

		Stratum I		Stratum II			
Feature Area	Feature Designation	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count	Total Weight
Northeast Feature Quadrant	8T-1			4	7.51	4	7.51
	8T-BS			2	1.4	2	1.4
	8T-D			18	167.81	18	167.81
	8V-1			2	3.48	2	3.48
	8V-A			2	3.48	2	3.48
	8V-B			8	5.66	8	5.66
	8W-C			11	21.67	11	21.67
	8X-E			13	29.07	13	29.07
	DDB			3	4.53	3	4.53
Southwest Feature Area	7C1-1			2	7.68	2	7.68
	7T-B			2	1.18	2	1.18
	7T-C			2	1.18	2	1.18
	7X-A			2	1.86	2	1.86
Triple Dog Burial Area	TDB	5	11.3			5	11.3
	7E1-1	7	26.8			7	26.8
Total		**12**	**38.1**	**71**	**256.51**	**83**	**294.61**

Appendix A, Table 3 Local Lithic Formal Artifacts

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Catalog
7Q Hearth Area	7H	I		Sandstone	Pestle	1	90.33	3898
	7H	II		Sandstone	Saw	1	163.94	3570
	7I	I		Metavolcanic porphery	Drill/reamer	1	11.41	3716
	7I	II		Sandstone	Saw	1	10.32	4470
	7P	II		Metasedimentary	Unifacial tool	1	35.13	3870
	7Q	II		Metasedimentary	Chopper	1	150.72	3683
	7Q	II		Sandstone	Saw	1	8.49	4508
	7Q	II	7Q-1	Sandstone	Saw	1	10.9	3650
Hearth Feature 6 Area	8			Sandstone	Saw	1	123.58	51
	8	I		Sandstone	Saw	1	10.1	4480
	8	III		Sandstone	Saw	1	70.75	3583
	8	III		Sandstone	Saw	1	166.84	3599
	8	IV		Sandstone	Saw	1	104.33	3592
	8B	I		Sandstone	Abrader	1	9.48	456
	8B	I		Sandstone	Flake tool & abrader	1		381
	8B	II		Sandstone	Groundstone tool	1	127.3	217
	8B	I		Sandstone	Possible abrader	1	33.89	455
	8C	II		Quartz	Biface	1	2.06	461
	8C	II		Metavolcanic	Biface fragment	1	1.53	119
	8D	II		Sandstone	Fragment	1	59.72	3674
	8D	I		Porphyritic metavolcanic	Tool	1	106.31	3855
	8D2	II		Sandstone	Mortar fragment	1	73.48	3881
	8D2	II		Sandstone	Saw	1	35.7	4466

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Catalog
	8D2	II		Sandstone	Saw	1	12.35	4493
	8G	II		Sandstone	Groundstone	1	9.72	3914
	8G2	I		Sandstone	Pestle	1	38.57	3897
	8H	II		Sandstone	Pestle	1	264.41	3857
	8H	II		Sandstone	Saw	1	33.85	4474
Hearth Feature 9 Quadrant	7	I		Sandstone	Doughnut stone	1	40.96	3902
	7			Sandstone	Reamer	1	10.84	458
	7	II		Sandstone	Saw	1	34.21	3579
	7	II		Sandstone	Saw	1	36.46	4461
	7A	II		Sandstone	Saw	1	170.18	3603
	7A	II		Sandstone	Saw	1	196.99	3585
	7A	II		Sandstone	Utilized sandstone	1	26.55	451
	7B	I		Sandstone	Mortar fragment	1	110.43	3961
	7B	I		Sandstone	Mortar fragment	1	78.98	3960
	7B	I		Sandstone	Saw	1	46.07	4468
	7C	II		Sandstone	Saw	1	77.61	3594
Northeast Feature Area	8O	II		Sandstone	Pestle fragment	1	101.51	3672
	8A1		8A1-A	Quartz	Drill	1	0.23	3740
	8A1		8A1-A	Porphyritic metavolcanic	Flake tool	1	46.1	3984
	8A1	I		Sandstone	Saw	1	74.7	3582
	8A1	II		Sandstone	Saw	1	115.35	3584
	8A1		8A1-A	Sandstone	Utilized flake	1	45.35	3965
	8C107	I		Sandstone	Groundstone	1	84.36	3788
	8C107	II		Sandstone	Mortar fragment	1	512.45	3962
	8C107	I		Sandstone	Bowl fragment	1	94.75	3789

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Catalog
	8M	I		Quartz	Drill	1	1.89	3915
	8M	II		Quartz	Drill	1	0.75	3719
	8O	I		Sandstone	Saw	1	12.39	4463
	8O	II		Sandstone	Saw	1	75.16	3602
	8P	I		Porphyritic metavolcanic	Perforator	1	31.41	3854
	8P	II		Sandstone	Saw	1	6.78	4495
	8P	II		Sandstone	Saw	1	5.13	4491
	8Q	I		Sandstone	Abrader/hammerstone	1	169.34	4048
	8Q	I		Sandstone	Saw	1	42.2	4449
	8Q	I		Sandstone	Saw	1	16.38	4494
	8Q	II		Sandstone	Saw	1	76.66	4465
	8R	II		Calcite	Fragment	1	0.77	3683
	8R	I		Sandstone	Saw	1	46.93	3591
	8R	I		Sandstone	Saw	1	124.6	3601
Northeast Feature Quadrant	8T	I	8T-D	Metavolcanic porphery	Core/ tool	1	366.44	3894
	8T	I		Sandstone	Hammerstone fragment	1	302.16	3681
	8T	I		Sandstone	Mortar Fragment	1	201.46	3867
	8T	I	8T-D	Sandstone	Saw	1	230.46	3586
	8T	II		Quartz	Unifacial tool	1	6.6	3913
	8V	I		Sandstone	Bowl fragment	1	322.47	3677
	8V	II		Sandstone	Pestle	1	88.27	3886
	8W	I		Sandstone	Bowl fragment	1	140.43	3863
	8W	II		Sandstone	Groundstone/anvil	1	103.13	3885

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Catalog
	8W	I		Metavolcanic porphery	Hammer stone	1	248.05	3872
	8W	I		Sandstone	Pestle/abrader	1	205.6	3865
	8W	I		Sandstone	Saw	1	25.96	4455
	8W	II		Sandstone	Saw	1	33	3574
	8X	I		Metavolcanic porphery	Drill	1	5.85	3720
	8X		8X-E	Sandstone	Saw	1	86	4462
	8X	I		Sandstone	Saw	1	52.4	4452
Northwest Feature Area	7D	II		Sandstone	Saw	1	6.29	4477
	7D	II		Sandstone	Saw	1	34.6	4456
	7E	I		Sandstone	Possible abrader	1	6.06	204
	7E	I		Porphyritic metavolcanic	Drill	1	0.53	3735
	7E	II		Quartz	Projectile point	1	1.44	3695
	7E	I		Sandstone	Saw	1	37.63	3561
	7E	I		Sandstone	Saw	1	58.43	4450
	7E	II		Sandstone	Saw	1	111.02	3572
	7E	II		Sandstone	Saw	1	31.15	3604
	7F	I		Quartz	Core fragment	1	23.44	284
	7F	II		Sandstone	Drill	1	40.51	3715
	7F	II		Quartzite	Shatter with asphaltum	1	0.62	287
	7G	I		Metavolcanic porphery	Drill	1	4.8	452
	7G	I		Sandstone	Saw	1	28.51	4471

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Catalog
	7J	I		Porphyritic metavolcanic	Drill	1	4.8	3721
	7J	I		Sandstone	Pebble with asphaltum	1	13.38	3838
	7J	I		Sandstone	Sandstone with asphaltum	1	22.68	3834
	7K	I		Porphyritic metavolcanic	Drill	1	2.38	3738
	7K	I		Sandstone	Pestle	1	211.11	3682
	7M	II		Sandstone	Saw	1	54.78	3581
	7N		7N-1	Metasedimentary	Drill	1	21.05	3729
	7O	II		Sandstone	Groundstone	1	30.17	3900
Southeast Feature Area	8E2	II		Sandstone	Saw	1	89.55	3577
	8S	II		Porphyritic metavolcanic	Core	1	70.96	3981
	8S	II		Porphyritic metavolcanic	Flake tool	1	11.94	3724
	8S	II		Sandstone	Groundstone fragment	1	26.66	3890
	8S	II		Sandstone	Groundstone tool/ canoe effigy	1	2055.16	4014
	8S	II		Porphyritic metavolcanic	Hand axe	1	855.36	3979
	8S	II		Porphyritic metavolcanic	Hand axe	1	1096.52	3980
	8S	I		Sandstone	Maul	1	203	3922
	8S	I		Sandstone	Saw	1	22.31	4487
	8S	II		Sandstone	Saw	1	17.03	4490
	8U	I		Sandstone	Drill	1	10.75	3717

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Catalog
	8U	I		Sandstone	Fragment	1	75.25	3680
	8U	II		Quartzite	Handstone	1	536.96	3684
	8U	II		Sandstone	Saw	1	33.32	4451
	8U	II		Sandstone	Saw	1	35.79	4457
	8Y	II		Quartz	Drill	1	3.28	4367
	8Y	I		Sandstone	Scraper	1	34.99	3794
	8Y	I		Sandstone	Expedient tool	1	40.17	3795
	8Y	II		Sandstone	Expedient tool	1	323.36	3792
	8Y	II		Sandstone	Expedient tool	1	148.22	3793
	8Y	I		Sandstone	Saw	1	140.02	3593
	8Y	II		Sandstone	Saw	1	2.77	4496
	8Y	II		Porphyritic metavolcanic	Utilized flake	1	23.79	3791
	8Z	II		Quartz	Core/ tool	1	330.57	3951
	8Z	II		Sandstone	Groundstone	1	11.35	3952
	8Z	II		Metavolcanic	Polishing stone	1	30.88	3983
	8Z	II		Sandstone	Saw	1	140.94	4448
	8Z	II		Sandstone	Saw	1	22.66	4472
Southwest Feature Area	7A1			Sandstone	Abrader	1	4.61	3944
	7A1	II		Sandstone	Abrader	1	1.4	3943
	7A1	I		Sandstone	Saw	1	59.4	4453
	7A1	II		Sandstone	Saw	1	20.52	4464
	7A1		7A1-1	Quartzite	Utilized flake	1	85.72	3965
	7B1	II		Sandstone	Groundstone	1	207.85	3982
	7B1	II		Sandstone	Saw	1	57.96	3567
	7R	I		Sandstone	Abrader	1	71.17	3912

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Catalog
	7R	II		Sandstone	Abrader	1	359.59	3883
	7R	I		Silt stone	Charm Stone/ Pendant	1	7.41	3851
	7R	I		Sandstone	Groundstone fragment	1	92.9	3880
	7S	II		Porphyritic metavolcanic	Core/ chopper	1	213.25	3887
	7S	I		Sandstone	Saw	1	21.93	479
	7T	II		Sandstone	Drill/reamer	1	7.5	3711
	7T	II		Sandstone	Mortar fragment	1	474.39	3886
	7T	I		Sandstone	Pestle	1	78.8	3858
	7T	I		Sandstone	Saw	1	38.1	3590
	7T	II		Sandstone	Saw	1	41.36	3563
	7U	I		Sandstone	Saw	1	39.39	3575
	7V	I		Sandstone	Saw	1	61.29	3588
	7W	II		Metavolcanic porphery	Perforator	1	63.47	3949
	7W	II		Sandstone	Saw	1	23.24	3605
	7W	II		Breccia	Utilized flake	1	42.36	3948
	7X	II		Sandstone	Groundstone	1	31.31	3928
	7X	II	7X-A	Sandstone	Groundstone	1	672.07	3964
	7X	I		Porphyritic metavolcanic	Peforator	1	112.7	3924
	7X		7X-A	Sandstone	Saw	1	246.16	3652
	7X	II		Sandstone	Saw	1	88.04	3606
	7X	II		Sandstone	Saw	1	67.19	3596
	7X	II		Sandstone	Saw	1	207.38	3926

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Count (n)	Weight (g)	Catalog
	7X	II		Metasedimentary	Scraper	1	6.44	3925
	7Y	I		Sandstone	Mortar fragment	1	125.48	3938
	7Y	II		Sandstone	Reamer	1	7.53	3941
	7Y	II		Sandstone	Reamer	1	12	3931
	7Y	II		Sandstone	Saw	1	51.92	3576
	7Y	II		Sandstone	Saw	1	189.22	3571
	7Y	II		Sandstone	Saw	1	58.77	3564
	7Y	I		Sandstone	Saw/ scraper	1	23.7	3940
	7Y	I		Metasedimentary	Utilized flake	1	6.82	3939
	7Z	II		Sandstone	Mortor	1	592.28	3790
	7Z	II		Sandstone	Saw	1	10.79	4476
	7Z	II		Sandstone	Saw	1	20.7	4485
	7Z	II		Sandstone	Saw	1	21.52	3651
	7Z	II		Sandstone	Saw	1	88.93	3607
Triple Dog Burial Area	7D1			Metavolcanic	Drill tool	1	5.26	3811
	7E1			Sandstone	Pestle fragment	1	132.42	3803
	7E1	I		Sandstone	Pestle fragment	1	298.15	3802
	7E1	I		Sandstone	Saw	1	70.04	3689
	7E1	II		Sandstone	Saw	1	219.04	3688
	7J1	II		Sandstone	Saw	1	21.47	4460
	7L1	II		Sandstone	Saw	1	72.78	4486
	Grand Total					**179**	**19370.62**	

Appendix A, Table 4 Sandstone Saws.

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
7Q Hearth Quadrant	7H	II		Sandstone	Saw	1	163.94	3570
	7I	II		Sandstone	Saw	1	10.32	4470
	7Q	II		Sandstone	Saw	1	8.49	4508
	7Q	II	7Q-1	Sandstone	Saw	1	10.9	3650
Hearth Feature 6 Area	8	I		Sandstone	Saw	1	10.1	4480
	8	III		Sandstone	Saw	1	70.75	3583
	8	III		Sandstone	Saw	1	166.84	3599
	8	IV		Sandstone	Saw	1	104.33	3592
Hearth Feature 9 Quadrant	7	II		Sandstone	Saw	1	34.21	3579
	7	II		Sandstone	Saw	1	36.46	4461
	7A	II		Sandstone	Saw	1	196.99	3585
	7A	II		Sandstone	Saw	1	170.18	3603
	7B	I		Sandstone	Saw	1	46.07	4468
	7C	II		Sandstone	Saw	1	77.61	3594
Northeast Feature Area	8H	II		Sandstone	Saw	1	33.85	4474
	8O	I		Sandstone	Saw	1	12.39	4463
	8O	II		Sandstone	Saw	1	75.16	3602
	8P	II		Sandstone	Saw	1	5.13	4491
	8P	II		Sandstone	Saw	1	6.78	4495
	8Q	I		Sandstone	Saw	1	42.2	4449
	8Q	I		Sandstone	Saw	1	16.38	4494
	8Q	II		Sandstone	Saw	1	76.66	4465
	8R	I		Sandstone	Saw	1	46.93	3591
	8R	I		Sandstone	Saw	1	124.6	3601
Northeast Feature	8W	I		Sandstone	Saw	1	25.96	4455

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Quadrant	8W	II		Sandstone	Saw	1	33	3574
	8X	I		Sandstone	Saw	1	52.4	4452
	8T	II	8T-D	Sandstone	Saw	1	230.46	3586
Northwest Feature Area	7D	II		Sandstone	Saw	1	34.6	4456
	7D	II		Sandstone	Saw	1	6.29	4477
	7E	I		Sandstone	Saw	1	37.63	3561
	7E	I		Sandstone	Saw	1	58.43	4450
	7E	II		Sandstone	Saw	1	111.02	3572
	7E	II		Sandstone	Saw	1	31.15	3604
	7G	I		Sandstone	Saw	1	28.51	4471
	7M	II		Sandstone	Saw	1	54.78	3581
	8A1	I		Sandstone	Saw	1	74.7	3582
	8A1	II		Sandstone	Saw	1	115.35	3584
Southeast Feature Area	8D2	II		Sandstone	Saw	1	35.7	4466
	8D2	II		Sandstone	Saw	1	12.35	4493
	8E2	II		Sandstone	Saw	1	89.55	3577
	8S	I		Sandstone	Saw	1	22.31	4487
	8S	II		Sandstone	Saw	1	17.03	4490
	8U	II		Sandstone	Saw	1	33.32	4451
	8U	II		Sandstone	Saw	1	35.79	4457
	8Y	I		Sandstone	Saw	1	140.02	3593
	8Y	II		Sandstone	Saw	1	2.77	4496
	8Z	II		Sandstone	Saw	1	140.94	4448
	8Z	II		Sandstone	Saw	1	22.66	4472
Southwest	7A1	I		Sandstone	Saw	1	59.4	4453
	7A1	II		Sandstone	Saw	1	20.52	4464

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Southwest Feature Area	7B1	II		Sandstone	Saw	1	57.96	3567
	7S	I		Sandstone	Saw	1	21.93	479
	7T	I		Sandstone	Saw	1	38.1	3590
	7T	II		Sandstone	Saw	1	41.36	3563
	7U	I		Sandstone	Saw	1	39.39	3575
	7V	I		Sandstone	Saw	1	61.29	3588
	7W	II		Sandstone	Saw	1	23.24	3605
	7X	II		Sandstone	Saw	1	67.19	3596
	7X	II		Sandstone	Saw	1	88.04	3606
	7X	II		Sandstone	Saw	1	207.38	3926
	7Y	I		Sandstone	Saw	1	23.7	3940
	7Y	II		Sandstone	Saw	1	58.77	3564
	7Y	II		Sandstone	Saw	1	189.22	3571
	7Y	II		Sandstone	Saw	1	51.92	3576
	7Z	II		Sandstone	Saw	1	88.93	3607
	7Z	II		Sandstone	Saw	1	21.52	3651
	7Z	II		Sandstone	Saw	1	10.79	4476
	7Z	II		Sandstone	Saw	1	20.7	4485
	7X	II	7X-A	Sandstone	Saw	1	246.16	3652
Triple Dog Burial Area	7E1	I		Sandstone	Saw	1	70.04	3689
	7E1	II		Sandstone	Saw	1	219.04	3688
	7J1	II		Sandstone	Saw	1	21.47	4460
	7L1	II		Sandstone	Saw	1	72.78	4486
Triple Dog Burial Area	Grand Total					74	4814.83	

Appendix A, Table 5 Extra-local Lithic Debitage.

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Screen Size	Count (n)	Weight (g)
7Q Hearth Quadrant	7H	II		Monterey Chert	Flake	1/4 inch	3	2.42
	7H	II		Siliceous Shale	Flake	1/2 inch	1	2.09
	7H	II		Siliceous Shale	Flake	1/4 inch	1	1.32
	7H	II		Cico Chert	Flake	1/8 inch	1	0.08
	7H	II		Siliceous Shale	Flake	1/4 inch	1	0.94
	7I	I		Chalcedony	Flake	1/8 inch	1	0.10
	7I	I		Misc Chert	Flake	1/2 inch	2	5.52
	7I	II		Chalcedony	Flake	1/2 inch	1	5.06
	7I	II		Misc Chert	Shatter	1/4 inch	1	1.76
	7I	II		Monterey Chert	Flake	1/2 inch	1	7.02
	7I	II		Misc Chert	Flake	1/8 inch	1	0.05
	7I	II		Misc Chert	Flake	1/4 inch	1	1.66
	7P	I		Misc Chert	Flake	1/2 inch	1	4.60
	7P	I		Misc Chert	Flake	1/4 inch	1	0.50
	7P	I		Monterey Chert	Flake	1/2 inch	1	7.40
	7P	II		Monterey Chert	Flake	1/8 inch	1	0.20
	7Q	II		Monterey Chert	Flake	1/2 inch	1	1.45
	7Q	II		Monterey Chert	Shatter	1/4 inch	1	0.56
	7Q	II	7Q-1	Franciscan Chert	Flake	1/4 inch	1	0.22
	7Q	II	7Q-1	Monterey Chert	Flake	1/2 inch	1	2.99
	7Q	II	7Q-1	Monterey Chert	Flake	1/8 inch	1	0.19
	7Q	II	7Q-1	Monterey Chert	Shatter	1/4 inch	1	1.92
	7Q	II	7Q-1	Monterey Chert	Shatter	1/8 inch	2	0.37
	7Q	II	7Q-1	Monterey Chert	Flake	1/4 inch	3	1.91

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Screen Size	Count (n)	Weight (g)
	7Q	II	7Q-1	Franciscan Chert	Flake	1/4 inch	1	0.26
	7Q	II	7Q-1	Monterey Chert	Flake	1/4 inch	1	0.80
	7Q	II	7Q-1	Monterey Chert	Shatter	1/4 inch	1	0.52
	7Q	II	7Q-1	Monterey Chert	Flake	1/4 inch	1	0.38
	7Q	II	7Q-1	Steatite/Soapstone	Flake	1/8 inch	1	0.19
	7Q	II	7Q-1	Monterey Chert	Flake	1/2 inch	1	13.23
	7Q	II	7Q-1	Monterey Chert	Shatter	1/8 inch	2	0.10
	7Q	II	7Q-1	Monterey Chert	Flake	1/4 inch	1	0.40
	7Q	II	7Q-1	Monterey Chert	Shatter	1/4 inch	2	2.94
	7Q	II	7Q-1	Siliceous Shale	Flake	1/4 inch	1	1.43
	7Q	II	7Q-1	Siliceous Shale	Shatter	1/4 inch	1	0.43
	7Q	II	7Q-1	Chalcedny	Flake	1/4 inch	1	0.66
	7Q	II	7Q-1	Cico Chert	Flake	1/4 inch	2	0.55
	7Q	II	7Q-1	Monterey Chert	Flake	1/4 inch	5	1.63
	7Q	II	7Q-1	Monterey Chert	Shatter	1/4 inch	3	1.86
	7Q	II	7Q-1	Siliceous Shale	Shatter	1/8 inch	7	0.34
Hearth Feature 9 Quadrant	7	I		Monterey Chert	Flake	1/4 inch	1	0.90
	7	I		Monterey Chert	Flake	1/2 inch	1	1.80
	7	I		Monterey Chert	Flake	1/2 inch	1	7.20
	7	I		Monterey Chert	Shatter	1/2 inch	1	8.60
	7	I		Monterey Chert	Shatter	1/4 inch	1	1.50
	7	I		Siliceous Shale	Shatter	1/2 inch	1	6.10
	7	II		Misc Chert	Flake	1/2 inch	1	2.10
	7	III		Monterey Chert	Shatter	1/4 inch	1	1.30
	7B	II		Monterey Chert	Flake	1/4 inch	1	1.70
	7C	II		Monterey Chert	Flake	1/2 inch	1	3.10

Feature Area	Unit	Stratum	Feature Designation	Material	Item	Screen Size	Count (n)	Weight (g)
Northeast Feature Quadrant	8V	II		Obsidian	Flake	1/4 inch	2	0.60
	8V	II		Serpentine	Shatter	1/2 inch	1	7.70
	8W	II		Obsidian	Flake	1/2 inch	1	0.10
	8X	I	8X-E	Monterey Chert	Flake	1/2 inch	1	4.90
Northwest Feature Area	7D	I		Siliceous shale	Flake	1/2 inch	1	2.46
	7D	I		Siliceous shale	Shatter	1/4 inch	1	0.33
	7D	I		Misc Chert	Flake	1/2 inch	1	2.18
	7D	I		Monterey Chert	Flake	1/2 inch	1	2.14
	7D	I		Monterey Chert	Shatter	1/2 inch	1	1.83
	7D	I		Siliceous Shale	Shatter	1/2 inch	1	1.22
	7E	I		Monterey Chert	Flake	1/2 inch	1	4.70
	7E	II		Monterey Chert	Flake	1/4 inch	2	2.40
Triple Dog Burial Area	7D1	I		Misc Chert	Flake	1/4 inch	1	0.30
	7D1	I		Monterey Chert	Flake	1/2 inch	1	8.30
	7D1	I		Monterey Chert	Flake	1/2 inch	1	4.00
	7D1	II		Monterey Chert	Shatter	1/2 inch	1	4.50
	7E1	I		Misc Chert	Flake	1/4 inch	1	0.60
	7E1	I	7E-1	Monterey Chert	Shatter	1/4 inch	1	1.70
	7E1	I	7E-1	Siliceous Shale	Flake	1 inch	1	50.30
	7F1	II		Misc Chert	Flake	1 inch	2	2.00
	7F1	II		Siliceous Shale	Flake	1/4 inch	1	0.60
	7G1	II		Misc Chert	Flake	1/4 inch	2	5.20
	Grand Total						**97**	**218.41**

Appendix A, Table 6 Extra-local Lithic Formal Artifacts.

Feature Area	Unit	Stratum	Feature	Material	Item	Count (n)	Weight (g)	Catalog #
7Q Hearth Quadrant	7H	I		Monterey banded chert	Drill	1	0.73	3736
	7H	II		Chert	Drill	1	2.06	3727
	7H	II		Steatite (coarse-grained)	Disk bead	1	0.02	630
	7I	I		Monterey banded chert	Drill	1	5.98	3723
	7I	II		Monterey banded chert	Biface	1	3.23	3712
	7I	II		Steatite (coarse-grained)	Pendant fragment	1	1	2940
	7P	II		Shale	Projectile point	1	3.09	3633
	7Q	II		Monterey banded chert	Projectile point	1	0.75	3707
	7Q	II	7Q-1	Shale	Projectile point	1	0.5	3705
	7Q	II		Steatite	Bead	1	0.05	3460
Hearth Feature 6 Area	8A	II		Obsidian	Pressure flake	1	0.06	497
	8B	II		Steatite (fine-grained)	Ornament fragment	1	1.5	418
	8B			Monterey banded chert	Projectile point	1	2.98	3699
	8C	I		Monterey banded chert	Biface	1	1.96	464
	8C	I		Monterey banded chert	Projectile point	1	2.62	485
	8C	II		Monterey banded chert	Biface	1	1.38	477
	8C	II		Steatite (fine-grained)	Disk bead	1	0.09	25
	8D	I		Chert	Projectile point	1	1.13	3694
Hearth Feature 9 Quadrant	7C	I		Monterey banded chert	Projectile point	1	0.98	3697
	7C	II		Steatite (fine-grained)	Bowl fragment	1	36.34	2848
	7D	I		Chert	Pressure flake	1	0.12	246
	7D	I		Steatite (fine-grained)	Disk bead	1	0.11	1054
Northeast	8N	I		Chert	Projectile point	1	1.52	3702
	8P	II		Chert	Biface	1	3.13	3662

Feature Area	Unit	Stratum	Feature	Material	Item	Count (n)	Weight (g)	Catalog #
Northeast Feature Area	8P	II		Obsidian	Flake	1	0.05	3899
	8R	I		Chert	Projectile point	1	1.74	3693
	8R	II		Steatite (fine-grained)	Doughnut stone	1	51.17	2648
	8R	II		Steatite (fine-grained)	Pendant	1	8.41	2673
Northeast Feature Quadrant	8T	I		Steatite (fine-grained)	Groundstone	1	5.95	2607
	8T	wall fall		Calcedony	Projectile point	1	1.6	3700
	8T		8T-D	Monterey banded chert	Tool	1	3.93	3718
	8T		8T-1	Steatite	Pendant	1	3.5	3869
	8V	II		Steatite	Triangular bead	1	0.15	3953
	8W	II	8W-C	Monterey banded chert	Projectile point	1	1.07	3955
Northwest Feature Area	7E	I		Chert	Broken flake	1	4.75	202
	7E	I		Chert	Drill	1	0.71	3722
	7E	II		Serpentine	Disk bead	1	0.04	1065
	7F	I		Chert	Drill fragment	1	1.8	285
	7F	II		Chert	Shatter	1	2.53	289
	7J	I		Monterey banded chert	Drill	1	1.06	3363
	7K	I		Obsidian	Drill	1	2.91	3725
	8A1	V		Soapstone	Sucking tube	1	1.08	3741
Southeast Feature Area	8E	III		Serpentine	Disk bead	1	0.03	699
	8E2	II		Steatite (fine-grained)	Ornament	1	0.64	631
	8E2	II		Steatite (fine-grained)	Groundstone	1	1.7	759
	8J	II		Chert	Scraper	1	1.15	3713
	8J	II		Serpentine	Cylinder bead	1	0.02	2184
	8K	II		Steatite (coarse-grained)	Ornament	1	10.15	496
	8L	II		Soapstone	Fragment	1	0.14	760

Feature Area	Unit	Stratum	Feature	Material	Item	Count (n)	Weight (g)	Catalog #
	8S	II		Serpentine	Disk bead	1	0.03	2176
	8S	II		Steatite (fine-grained)	Disk bead	1	0.09	2633
	8U	I		Chert	blade	1	2	3739
	8U	II		Monterey banded chert	Projectile point	1	3.91	3696
	8Y	II		Chert	Projectile Point	1		4364
	8Y	II		Soapstone	Bead	1	0.024	4363
Southwest Feature Area	7R	I		Monterey banded chert	Projectile point	1	0.88	3701
	7R	II		Monterey banded chert	Drill	1	3.59	3361
	7T	II		Monterey banded chert	Biface	1	5.12	3714
	7V	I		Shale	Projectile point	1	1.68	3692
	7Y	II		Steatite	Stone tube	1	0.58	3932
	7Z	I		Monterey banded chert	Biface base	1	2.12	3966
Triple Dog Burial Area	7D1	I		Chert	Projectile point	1	3.54	3937
	Grand Total					**62**	**201.174**	

Appendix A, Table 7 Shell Fishhooks

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
7Q Hearth Quadrant	7H	II		*Haliotis cracherodii*	Circular fishhook	1	0.76	673
	7H	II		*Haliotis rufescens*	Circular fishhook	1	0.24	1069
	7H	II		*Haliotis cracherodii*	Circular fishhook	1	0.59	713
	7H	II		*Haliotis cracherodii*	Circular fishhook blank fragment	1	0.88	707
	7H	II		*Haliotis rufescens*	Circular fishhook fragment	1	0.4	711
	7H	II		*Haliotis rufescens*	Circular fishhook fragment	1	0.26	712
	7H	II		*Haliotis rufescens*	Fishhook blank	1	8.46	705
	7H	II		*Haliotis rufescens*	Fishhook blank fragment	1	1.9	704
	7H	II		*Haliotis rufescens*	Fishhook fragment	1	0.5	761
	7H	II		*Haliotis rufescens*	Fishhook fragment	1	0.3	672
	7H	II		*Haliotis rufescens*	Fishhook fragment	1	0.27	1018
	7H	II		*Haliotis* spp.	Fishhook fragment	1	0.19	745
	7H	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	5.12	132
	7H	II		*Haliotis rufescens*	Fishhook/ornament debris	1	4.88	749
	7H	II		*Haliotis rufescens*	Fishhook/ornament debris	1	1.22	1032

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
7Q Hearth Quadrant	7H	II		*Haliotis rufescens*	Fishhook/ornament debris	4	1.38	2350
	7H	II		*Haliotis rufescens*	Fishhook/ornament debris	2	0.9	1005
	7H	II		*Haliotis rufescens*	Fishhook/ornament debris	2	0.25	1007
	7I	II		*Haliotis rufescens*	Fishhook blank	1	2.03	2442
	7I	II		*Haliotis rufescens*	Fishhook blank fragment	1	2	858
	7I	II		*Haliotis rufescens*	Fishhook fragment	1	0.03	2441
	7I	II		*Haliotis rufescens*	Fishhook fragment	1	0.94	2445
	7I	I		*Norrisia norrisi*	Fishhook fragment	1	0.21	768
	7I	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	5.96	2443
	7I	II		*Haliotis rufescens*	Fishhook/ornament debris	1	15.64	2432
	7P	II		*Haliotis rufescens*	Circular fishhook fragment	1	0.57	2007
	7P	I		*Haliotis rufescens*	Fishhook blank	1	6.04	2018
	7P	II		*Haliotis rufescens*	Fishhook blank	1	2.77	1980
	7P	II		*Haliotis rufescens*	Fishhook blank	1	2.63	2709
	7P	II		*Haliotis rufescens*	Fishhook blank fragment	1	1.85	2012

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
7Q Hearth Quadrant	7P	II		*Haliotis rufescens*	Fishhook fragment	1	0.27	1981
	7P	II		*Haliotis rufescens*	Fishhook fragment	1	0.39	2009
	7P	II		*Haliotis rufescens*	Fishhook fragment	1	0.53	2008
	7P	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	1.23	2013
	7P	II		*Mytilus californianus*	Fishhook/ ornament blank	1	7.25	3146
	7P	II		*Haliotis rufescens*	Fishhook/ornament debris	1	1.65	2002
	7P	II		*Haliotis rufescens*	Fishhook/ornament debris	1	0.95	2003
	7Q	II		*Haliotis cracherodii*	Circular fishhook	1	0.53	2941
	7Q	II		*Haliotis rufescens*	Circular fishhook fragment	1	0.75	2338
	7Q	II		*Haliotis rufescens*	Fishhook blank	1	6.63	2337
	7Q	II	7Q-1	*Haliotis rufescens*	Circular fishhook fragment	1	0.98	2399
	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook	1	0.12	3704
	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook blank	1	2.91	2397
	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook blank	1	7.96	3818

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
7Q Hearth Quadrant	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook blank fragment	1	0.53	2398
	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook blank fragment	1	0.81	2410
	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook blank fragment	1	2.05	2411
	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook fragment	1	0.35	2400
	7Q	II	7Q-1	*Haliotis* spp.	Fishhook fragment	1	0.46	3827
	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook/ ornament blank	1	0.86	3172
	7Q	II	7Q-1	*Haliotis rufescens*	Fishhook/ ornament blank	1	0.87	2388
Hearth Feature 6 Area	8	III		*Haliotis rufescens*	Fishhook/ornament debris	1	3.39	2933
	8A	II		*Haliotis rufescens*	Fishhook blank	1	10.63	828
	8A	II		*Haliotis rufescens*	Fishhook blank	1	1.82	829
	8A	II		*Haliotis rufescens*	Fishhook blank fragment	1	5.96	145
	8A	II		*Haliotis rufescens*	Fishhook blank fragment	1	2.06	188
	8A	II		*Haliotis rufescens*	Fishhook blank fragment	1	0.81	830
	8A	II		*Haliotis rufescens*	Fishhook blank fragment with asphaltum	1	30.08	147
	8A	II		*Haliotis rufescens*	Fishhook fragment	1	0.86	185

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Hearth Feature 6 Area	8A	II		*Haliotis rufescens*	Fishhook fragment	1	0.57	186
	8A	II		*Haliotis rufescens*	Fishhook fragment	1	0.74	187
	8A	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	5.71	2755
	8B	II		*Haliotis rufescens*	Fishhook blank fragment	1	1.4	415
	8B1	II		*Haliotis* spp.	Fishhook fragment	1	0.16	3989
	8B107	I		*Haliotis rufescens*	Fishhook blank	1	3.36	4017
	8C	I		*Haliotis rufescens*	Circular fishhook	1	1.04	251
	8C	II		*Haliotis cracherodii*	Fishhook blank	1	2.6	170
	8C	II		*Haliotis rufescens*	Fishhook fragment	1	0.45	120
	8C	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	2.21	459
	8C	II		*Haliotis rufescens*	Fishhook/ornament debris	1	2.37	2862
	8C	II		*Haliotis rufescens*	Fishhook/ornament debris	1	3.39	2863
Hearth Feature 9 Quadrant	7	I		*Haliotis rufescens*	Fishhook blank fragment	1	4.67	2771
	7A	II		*Haliotis rufescens*	Fishhook blank	1	6.6	826
	7A	II		*Haliotis rufescens*	Fishhook blank fragment	1	2.04	2762

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Hearth Feature 9 Quadrant	7A	II		*Haliotis rufescens*	Fishhook blank fragment	1	4.26	2763
	7A	II		*Haliotis rufescens*	Fishhook fragment	1	0.28	1259
	7A	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	5.77	825
	7A	II		*Haliotis cracherodii*	Fishhook/ornament debris	1	0.61	820
	7B	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	5.27	2834
	7B	II		*Haliotis rufescens*	Fishhook/ornament debris	1	2.43	2832
	7B	II		*Haliotis rufescens*	Fishhook/ornament debris	1	0.13	2833
	7C	I		*Haliotis rufescens*	Fishhook fragment	1	1.23	955
	7C	II		*Haliotis rufescens*	Fishhook/ornament debris	1	0.65	2852
	7C	II		*Haliotis rufescens*	Fishhook/ornament debris	1	1.49	2854
	7C	II		*Haliotis rufescens*	Fishhook/ornament debris	1	2.04	2855
Northeast Feature Area	8A1	II		*Haliotis rufescens*	Fishhook blank	1	10.67	4033
	8A1	II		*Haliotis rufescens*	Fishhook blank	1	2.18	4043
	8A1	II		*Haliotis rufescens*	Fishhook blank fragment	1	3.3	4031
	8A1		8A1-A	*Haliotis nacre*	Circular fishhook	1	0.42	3322

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Northeast Feature Area	8C107	II		*Haliotis rufescens*	Fishhook fragment	1	0.49	3999
	8C107	II		*Haliotis* spp.	Fishhook fragment	1	1.27	4001
	8G2	I		*Haliotis* spp.	Circular fishhook blank	1	0.81	1192
	8H	II		*Haliotis rufescens*	Fishhook blank fragment	1	2.06	947
	8H	II		*Haliotis rufescens*	Fishhook fragment	1	0.25	948
	8H	II		*Haliotis rufescens*	Fishhook fragment	1	0.69	949
	8H	II		*Haliotis rufescens*	Fishhook/ornament debris	1	4.76	2787
	8H2	I		*Haliotis rufescens*	Circular fishhook fragment	1	0.1	807
	8H2	II		*Haliotis rufescens*	Circular fishhook fragment	1	0.21	810
	8M	I		*Haliotis rufescens*	Fishhook blank fragment	1	1.75	3219
	8M	I		*Haliotis rufescens*	Fishhook fragment	1	1.18	2250
	8M	I		*Haliotis rufescens*	Fishhook/ornament debris	1	0.96	2915
	8N	I		*Haliotis cracherodii*	Fishhook blank	1	7.71	2253
	8N	I		*Haliotis rufescens*	Fishhook blank fragment	1	1.84	2491
	8N	II		*Haliotis rufescens*	Fishhook blank fragment	1	3.32	3216

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Northeast Feature Area	8N	I		*Haliotis rufescens*	Fishhook/ornament debris	1	1.11	2492
	8O	II		*Haliotis rufescens*	Fishhook blank fragment	1	0.41	2682
	8O	II		*Haliotis rufescens*	Fishhook fragment	1	0.49	2683
	8O	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	3.22	2744
	8O	II		*Haliotis rufescens*	Fishhook/ornament debris	1	3.01	2678
	8P	II		*Haliotis rufescens*	Fishhook blank	1	3.55	3228
	8P	II		*Haliotis cracherodii*	Fishhook blank fragment	1	4.06	3222
	8P	I		*Haliotis rufescens*	Fishhook blank fragment	1	3.19	2651
	8P	II		*Haliotis rufescens*	Fishhook fragment	1	0.92	3227
	8P	II		*Haliotis* spp.	Fishhook fragment	1	0.09	3196
	8P	II		*Mytilus californianus*	Fishhook fragment	1	0.51	3221
	8Q	I		*Haliotis rufescens*	Fishhook blank	1	1.86	4029
	8Q	I		*Haliotis rufescens*	Fishhook fragment	1	1.67	4002
	8Q	I		*Haliotis* spp.	Fishhook fragment	1		4166
	8R	I		*Haliotis rufescens*	Fishhook blank	1	2.9	2912

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Northeast Feature Area	8R	II		*Haliotis rufescens*	Fishhook blank	1	3.22	2638
	8R	I		*Haliotis rufescens*	Fishhook/ ornament blank	1	2.98	2911
	8T	I		*Haliotis cracherodii*	Fishhook blank	1	1.54	3211
	8T	II		*Haliotis cracherodii*	Fishhook blank	1	20.27	2614
	8T	II		*Haliotis rufescens*	Fishhook blank	1	11.12	3217
	8T		8T-D	*Haliotis cracherodii*	Fishhook blank	1	3.86	3259
	8T		8T-D	*Haliotis rufescens*	Fishhook blank	1	6.7	3226
	8T		8T-D	*Haliotis rufescens*	Fishhook fragment	1	2.3	3225
	8V	II		*Haliotis cracherodii*	Fishhook blank	1	1.87	3207
	8V	II		*Haliotis rufescens*	Fishhook blank	1	1.08	3204
	8V	II		*Haliotis rufescens*	Fishhook blank	1	3.73	3205
	8V	II		*Haliotis rufescens*	Fishhook blank	1	3.04	3206
	8V	II		*Haliotis rufescens*	Fishhook fragment	1	2.08	3197
	8V	II		*Haliotis rufescens*	Fishhook fragment	1	0.59	3208
	8V	II		*Haliotis cracherodii*	Fishhook/ ornament blank	1	3.93	3975

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Northeast Feature Area	8V	II		*Haliotis cracherodii*	Fishhook/ ornament blank	1	2.72	3976
	8W	II		*Haliotis* spp.	Circular fishhook fragment	1	0.1	3200
	8W	II		*Haliotis cracherodii*	Fishhook blank	1	8.1	3215
	8W	II		*Haliotis rufescens*	Fishhook blank	1	5.3	3199
	8W	II		*Haliotis rufescens*	Fishhook blank	1	10.28	3212
	8W	II		*Haliotis rufescens*	Fishhook blank	1	2.08	4018
	8W	II		*Haliotis cracherodii*	Fishhook fragment	1	0.52	3201
	8W	II		nacre	Fishhook/ ornament blank	1	0.55	3202
	8W		8W-C	*Haliotis* spp.	Fishhook blank	1	2.79	4039
	8W		8W-C	*Haliotis* spp.	Fishhook fragment	1	0.21	4000
	8X	II		*Haliotis rufescens*	Fishhook blank	1	2.81	3209
	8X	II		*Haliotis rufescens*	Fishhook blank fragment	1	6.73	3203
	8X	II		*Haliotis rufescens*	Fishhook fragment/ ornament	1	0.81	3198
	8X		8X-E	*Haliotis rufescens*	Fishhook blank fragment	1	4.45	4024
Northwest	7E	I		*Haliotis rufescens*	Circular fishhook fragment	1	0.1	200
	7E	II		*Haliotis rufescens*	Circular fishhook fragment	1	0.08	1033

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Northwest Feature Area	7E	I		*Haliotis rufescens*	Fishhook fragment	1	0.17	766
	7E	I		*Haliotis cracherodii*	Fishhook/ ornament blank	1	2	567
	7E	I		*Haliotis rufescens*	Fishhook/ ornament blank	1	0.17	492
	7E	I		*Haliotis rufescens*	Fishhook/ ornament blank	1	0.59	1017
	7E	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	1.61	446
	7E	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	0.97	1169
	7F	I		*Haliotis rufescens*	Fishhook blank	1	4.05	1057
	7F	I		*Haliotis rufescens*	Fishhook fragment	1	1.61	999
	7F	I		*Norrisia norrisi*	Fishhook fragment	1	0.12	767
	7F	I		*Haliotis* spp.	Fishhook/ ornament blank	1	1.76	288
	7G	II		*Haliotis rufescens*	Circular fishhook fragment	1	0.14	1010
	7G	I		*Haliotis rufescens*	Fishhook fragment	1	1	1022
	7G	I		*Haliotis rufescens*	Fishhook/ ornament blank	1	5.45	329
	7J	II		*Haliotis cracherodii*	Fishhook blank	1	5.65	3175
	7K	I		*Haliotis rufescens*	Fishhook blank fragment	1	1.33	502

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Northwest Feature Area	7K	I		*Haliotis rufescens*	Fishhook blank fragment	1	1.8	3188
	7K	II		*Haliotis* spp.	Fishhook fragment	1	0.37	3169
	7K	II		*Haliotis* spp.	Fishhook fragment	1	1.7	3170
	7K	II	7K7J-A	*Haliotis* spp.	Fishhook	1	2.16	3186
	7K		7K7J-A	*Haliotis* spp.	Fishhook blank	1	2.68	3185
	7K	II	7K7J-A	*Haliotis rufescens*	Fishhook fragment	1	0.27	3187
	7M	I		*Haliotis rufescens*	Fishhook/ ornament blank	1	2.23	2048
	7N	II		*Haliotis rufescens*	Fishhook blank fragment	1	1.66	2040
	7N	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	2.02	2238
Southeast Feature Area	8D2	II		*Haliotis rufescens*	Fishhook blank	1	5.82	659
	8D2	II		*Haliotis rufescens*	Fishhook blank	1	4.75	1163
	8D2	II		*Haliotis rufescens*	Fishhook blank	1	26.42	1158
	8D2	II		*Haliotis cracherodii*	Fishhook blank fragment	1	2.38	533
	8D2	II		*Haliotis cracherodii*	Fishhook blank fragment	1	2.64	534

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Southeast Feature Area	8E	I		*Haliotis rufescens*	Fishhook blank fragment	1	1.63	690
	8E	I		*Haliotis* spp.	Fishhook fragment	1	0.11	691
	8E2	II		*Norrisia norrisi*	Fishhook fragment	1	0.6	596
	8F	II		*Haliotis rufescens*	Fishhook fragment	1	0.38	2873
	8J	II		*Haliotis rufescens*	Fishhook blank	1	3.88	2178
	8J	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	6.4	2179
	8J	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	2.86	2180
	8J	II		*Mytilus californianus*	Fishhook/ ornament blank	1	1.13	1127
	8J	II		*Haliotis cracherodii*	Fishhook/ ornament blank	1	1.01	2374
	8J	II		*Haliotis rufescens*	Fishhook/ornament debris	1	2.96	2363
	8K	II		*Haliotis rufescens*	Circular fishhook	1	0.24	2298
	8K	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	6.41	2318
	8L	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	11.09	2476
	8S	II		*Haliotis rufescens*	Fishhook blank	1	2.05	2625
	8S	II		*Haliotis rufescens*	Fishhook blank	1	2.53	2623

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Southeast Feature Area	8S	II		*Haliotis rufescens*	Fishhook fragment	1	1.68	2173
	8S	II		*Haliotis rufescens*	Fishhook fragment	1	0.58	2626
	8S	II		*Haliotis* spp.	Fishhook fragment	1	1.26	2085
	8S	II		*Haliotis rufescens*	Fishhook/ ornament blank	1	5.95	2172
	8S	II		*Haliotis rufescens*	Fishhook/ornament debris	1	0.31	2621
	8S	II		*Haliotis rufescens*	Fishhook/ornament debris	1	2.06	2622
	8U	II		*Haliotis rufescens*	Circular fishhook	1	0.53	2152
	8U	I		*Haliotis rufescens*	Circular fishhook fragment	1	0.43	2105
	8U	II		*Haliotis rufescens*	Fishhook blank fragment	1	1.79	2118
	8U	II		*Haliotis rufescens*	Fishhook blank fragment	1	1.96	2153
	8U	II		*Haliotis rufescens*	Fishhook blank fragment	1	2.89	2154
	8U	II		*Haliotis rufescens*	Fishhook fragment	1	0.65	2135
	8U	II		*Haliotis rufescens*	Fishhook fragment	1	0.47	2136
	8U	II		*Haliotis rufescens*	Fishhook fragment	1	1.6	2137
	8U	II		*Haliotis cracherodii*	Fishhook/ornament debris	1	2.25	2125

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Southeast Feature Area	8U	II		*Haliotis cracherodii*	Fishhook/ornament debris	1	1.61	2588
	8U	II		*Haliotis rufescens*	Fishhook/ornament debris	1	0.99	2149
	8U	II		*Haliotis rufescens*	Fishhook/ornament debris	1	3.75	2910
	8Y	II		*Haliotis* spp.	Fishhook fragment	1	0.6	3958
	8Z	II		*Haliotis rufescens*	Fishhook fragment	1	2.29	3995
Southwest Feature Area	7A1	I		*Haliotis rufescens*	Fishhook blank	1	7.43	3956
	7A1	II		*Haliotis rufescens*	Fishhook fragment	1	0.72	3996
	7A1		7A1-1	*Haliotis rufescens*	Fishhook blank fragment	1	0.98	4030
	7B1	I		*haliotis rufescens*	Fishhook blank	1	1.73	3967
	7B1	I		*Haliotis rufescens*	Fishhook blank	1	6.11	3968
	7B1	II		*Haliotis rufescens*	Fishhook blank	1	5.37	3974
	7B1	I		*Haliotis* spp.	Fishhook blank fragment	1	0.06	3970
	7R	II		*Haliotis* spp.	Fishhook blank fragment	1	0.88	3178
	7R	II		*Haliotis* spp.	Fishhook fragment	1	0.29	3177
	7R	II		*Haliotis* spp.	Fishhook fragment	1	0.24	3179
	7S	II		*Haliotis rufescens*	Fishhook	1	0.08	4016

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Southwest Feature Area	7S	II		*Norrisia norrisi*	Fishhook	1	0.57	4026
	7S	I		*Haliotis rufescens*	Fishhook blank	1	9.08	4015
	7S	I		*Haliotis rufescens*	Fishhook blank	1	9.25	4021
	7S	II		*Haliotis* spp.	Fishhook fragment	1	0.09	3174
	7T	II		*Haliotis rufescens*	Fishhook blank	1	7.67	3194
	7T	II		*Haliotis* spp.	Fishhook blank fragment	1	0.23	3193
	7T	II		*Haliotis rufescens*	Fishhook fragment	1	1.31	3189
	7T	II		*Haliotis rufescens*	Fishhook fragment	1	2.29	3190
	7T	II		*Haliotis* spp.	Fishhook fragment	1	0.09	3191
	7T	II		*Haliotis* spp.	Fishhook/ ornament blank	1	0.41	3171
	7U	II		*Haliotis cracherodii*	Fishhook blank fragment	1	0.54	3163
	7U	II		*Haliotis* spp.	Fishhook blank fragment	1	0.87	3160
	7U	II		*Haliotis* spp.	Fishhook blank fragment	1	0.44	3162
	7U	I		*Haliotis* spp.	Fishhook fragment	1	0.39	3183
	7U	II		*Haliotis* spp.	Fishhook fragment	1	0.16	3161
	7U	II		*Haliotis* spp.	Fishhook fragment	1	0.66	3164
	7U	II		*Haliotis* spp.	Fishhook fragment	1	0.21	3165
	7U	II		*Haliotis* spp.	Fishhook fragment	1	0.17	3166

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Southwest Feature Area	7U	Wallfall		*Mytilus californianus*	Fishhook fragment	1	0.23	3796
	7U	II		*Haliotis* spp.	Fishhook/ ornament blank	1	1.23	3167
	7U	I		*Haliotis* spp.	Fishhook/ ornament blank	1	1.05	3184
	7U	II		*Haliotis* spp.	Fishhook/ ornament blank	1	0.39	3168
	7V	I		*Haliotis cracherodii*	Fishhook/ ornament blank	1	0.94	3182
	7W	II		*Haliotis* spp.	Fishhook blank	1	1.38	3972
	7W	II		*Norrisia norrisi*	Fishhook blank	1	1.75	3977
	7W	II		*Haliotis* spp.	Fishhook/ ornament blank	1	1.16	3180
	7W		7W-1	*Haliotis rufescens*	Fishhook fragment	1	0.84	3991
	7X	II		*Haliotis cracherodii*	Fishhook fragment	1	0.22	3993
	7X	I		*Mytilus californianus*	Fishhook/ ornament blank	1	1.07	4036
	7X	II	7X-A	*Haliotis rufescens*	Fishhook fragment	1	0.54	3992
	7Y	II		*Haliotis rufescens*	Circular fishhook	1	0.81	3321
	7Y	II		*Haliotis rufescens*	Fishhook	1	0.73	4040

Feature Area	Unit	Stratum	Feature Designation	Material Type	Item	Count (n)	Weight (g)	Catalog #
Southwest Feature Area	7Y	II		*Haliotis rufescens*	Fishhook fragment	1	0.76	3998
	7Y	II		*Haliotis* spp.	Fishhook fragment	1	0.69	3935
	7Y	II		*Haliotis rufescens*	Fishhook/pendant	1	0.25	3367
	7Z	II		*Haliotis rufescens*	Fishhook blank fragment	1	1.57	3957
	7Z	II		*Haliotis rufescens*	Fishhook blank fragment	1	2.34	3973
	7Z	II		*Haliotis cracherodii*	Fishhook fragment	1	0.64	3997
Triple Dog Burial Area	7D1	II		*Haliotis nacre*	Fishhook	1	0.14	3323
	7D1	II		*Haliotis rufescens*	Fishhook fragment	1	0.53	4042
	7E1	I		*Haliotis rufescens*	Fishhook blank	1	7.97	3797
	7E1	I		*Haliotis rufescens*	Fishhook blank	1	3.17	3798
	7E1	II		*Haliotis rufescens*	Fishhook blank	1	5.45	3804
	7E107	II		*Haliotis rufescens*	Fishhook	1	0.79	4038
	7E1	I		*Haliotis rufescens*	Fishhook	1	3.76	3799
	Grand Total					**275**	**670.4**	

Appendix A, Table 8a Red Ochre within Units.

		Stratum I		Stratum II			
Feature Area	Unit	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count	Total Weight
7Q Hearth Quadrant	7H			4	16.41	4	16.41
	7I			3	1.06	3	1.06
	7P	1	0.03	2	0.55	3	0.58
	7Q	4	2.96	4	3.08	8	6.04
Hearth Feature 6 Area	8			4	21.35	4	21.35
	8G			2	10.29	2	10.29
	8H			6	0.39	6	0.39
	8H2	3	7.92	4	0.66	7	8.58
	8I12			3	4.67	3	4.67
Hearth Feature 9 Quadrant	7A	1	0.08	3	2.93	4	3.01
	7B	5	23.26			5	23.26
	7C	3	0.55	3	4.63	6	5.18
Northeast Feature Quadrant	8T	2	14.62	7	13.65	9	28.27
	8T	1	0.34			1	0.34
	8U	5	5.55	31	8.72	36	14.27
	8V	2	2.76	29	29.37	31	32.13
	8W			34	25.96	34	25.96
	8X	56	31.4	78	10.14	134	41.54
Northwest Feature Area	7D			10	24.11	10	24.11
	7E			10	8.79	10	8.79
	7F			8	12.74	8	12.74
	7G			8	4.24	8	4.24
	7J	1	1.79	4	7.14	5	8.93
	7K	30	9.28	45	21.98	75	31.26

		Stratum I		Stratum II			
Feature Area	Unit	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count	Total Weight
Northwest Feature Area	7L			12	4.18	12	4.18
	7M	1	25.85	6	0.9	7	26.75
	7N	4	2	5	2.31	9	4.31
	8A1	2	0.38	14	2.14	16	2.52
	8B107	3	0.88	27	17.97	30	18.85
	8C107			40	10.54	40	10.54
	8M	9	3.94	37	14.43	46	18.37
	8N			37	19.36	37	19.36
	8O			17	9.41	17	9.41
	8P	5	1.58	26	11.51	31	13.09
	8Q			7	9.17	7	9.17
	8R	3	0.48	7	2.19	10	2.67
Southeast Feature Area	8D2			40	20.55	40	20.55
	8E			14	4.84	14	4.84
	8E2			5	188.26	5	188.26
	8F			12	6.5	12	6.5
	8J			7	7.56	7	7.56
	8K	3	4.47	8	8.19	11	12.66
	8L			17	9.18	17	9.18
	8S			9	20.23	9	20.23
	8Y	2	2.32	6	3.65	8	5.97
	8Z			5	97.62	5	97.62
	7A1			9	1.17	9	1.17
	7B1	3	1.47	7	3.85	10	5.32
	7C1			3	0.27	3	0.27

		Stratum I		Stratum II			
Feature Area	Unit	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count	Total Weight
Southeast Feature Area	7R			6	2.69	6	2.69
	7S	4	4.84	1	0.25	5	5.09
	7T	1	32.28	5	3.24	6	35.52
	7U			15	1.92	15	1.92
	7V	1	0.02	6	6.61	7	6.63
	7W	1	0.01			1	0.01
	7X			6	6.04	6	6.04
	7Y	2	0.16	29	33.16	31	33.32
	7Z	2	9.88	1	0.02	3	9.9
Triple Dog Burial Area	7D1	8	3.3	13	21.08	21	24.38
	7F1			7	0.95	7	0.95
	7G1			3	1.06	3	1.06
	Grand Total	**168**	**194.46**	**771**	**785.86**	**939**	**980.26**

Appendix A, Table 8b Red Ochre within Features.

Feature Area	Feature Designation	Stratum I Sum of Count (n)	Stratum I Sum of Weight (g)	Stratum II Sum of Count (n)	Stratum II Sum of Weight (g)	Total Count	Total Weight
7Q Hearth Quadrant	7I-1			5	0.47	5	0.47
Hearth Feature 6 Area	F-6	9	4.63	53	22.35	62	26.98
Northeast Feature Area	8N-1			21	17.81	21	17.81
Northeast Feature Quadrant	8T-BS			1	8.81	1	8.81
	8T-D	7	3.69	21	5.37	28	9.06
	8V-A			4	1.59	4	1.59
	DDB			21	10.75	21	10.75
Northwest Feature Area	7K7J-A			1	0.31	1	0.31
	7N-1			7	10.13	7	10.13
Southeast Feature Area	8L8K-1			4	0.27	4	0.27
	8U-1			17	17.17	17	17.17
	7B1-B			2	0.52	2	0.52
	7C1-2			1	1	1	1
	Grand Total	**16**	**8.32**	**158**	**96.55**	**174**	**104.87**

Appendix A, Table 9a. Quartz Crystals within Units.

		Stratum I		Stratum II			
Feature Area	Unit	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count	Total Weight
7Q Hearth Quadrant	7H			4	1.67	4	1.67
	7I	15	39.13	4	4.71	19	43.84
	7P	7	5.06			7	5.06
	7Q	1	0.78			1	0.78
Hearth Feature 6 Area	8			2	2.9	2	2.9
	8A	4	0.76	20	22.73	24	23.49
	8B	1	3.05	3	3.02	4	6.07
	8B1	3	1.81	3	3.11	6	4.92
	8C			2	2.29	2	2.29
	8C1			5	6.69	5	6.69
	8D	1	6.9	1	7.09	2	13.99
	8G	3	8.1			3	8.1
	8G2	1	0.91			1	0.91
Hearth Feature 9 Quadrant	7	5	10.69	5	3.98	10	14.67
	7A			1	1.65	1	1.65
	7B	1	3.49	11	4.68	12	8.17
	7C	4	4.64	1	1.2	5	5.84
Northeast Feature Area	8A1	2	3.49	10	39.11	12	42.6
	8B107			6	11.37	6	11.37
	8C107			9	2.97	9	2.97
	8H2	2	1.87			2	1.87
	8M	17	11.37	9	11.7	26	23.07
	8N	2	2.64	5	19.01	7	21.65
	8O			3	11.19	3	11.19

		Stratum I		Stratum II			
Feature Area	Unit	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count	Total Weight
Northeast Feature Area	8P	8	13.39	7	7.13	15	20.52
	8Q	2	7.43			2	7.43
	8R	1	10.14	3	4.12	4	14.26
	8T	9	13.56	14	21.02	23	34.58
	8V	1	0.85	11	15.31	12	16.16
	8W	2	5.65	9	15.14	11	20.79
	8X	9	19.36	12	7.71	21	27.07
Northwest Feature Area	7D	13	11.19			13	11.19
	7E	10	12.52			10	12.52
	7F	9	15.69			9	15.69
	7G	6	8.24	10	13.31	16	21.55
	7J	6	17.21	8	15.08	14	32.29
	7K	3	13.04	2	1.05	5	14.09
	7L			5	8.81	5	8.81
	7M	2	1.26			2	1.26
	7N	2	3.26	2	0.2	4	3.46
	7O	3	1.65	1	0.59	4	2.24
Southeast Feature Area	8D2			8	11.97	8	11.97
	8E2			5	8.07	5	8.07
	8J			10	8.07	10	8.07
	8K			5	3.75	5	3.75
	8L			1	0.21	1	0.21
	8S	2	1.7	9	30.79	11	32.49
	8U	1	1.23	9	33.34	10	34.57
	8Y	2	4.07	8	8.16	10	12.23

		Stratum I		Stratum II			
Feature Area	Unit	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count	Total Weight
Southeast	8Z	2	3.43	11	31.91	13	35.34
Southwest Feature Area	7A1	6	9.74	10	19.64	16	29.38
	7B1			1	0.76	1	0.76
	7C1	3	8.4	4	8.3	7	16.7
	7R	3	3.32	1	0.25	4	3.57
	7S	1	1.39	3	3.8	4	5.19
	7T			4	8.85	4	8.85
	7U			4	15.8	4	15.8
	7V	1	3.29	2	2.72	3	6.01
	7W	2	3.33	5	8.12	7	11.45
	7X			5	5.33	5	5.33
	7Y	9	8.18	33	15.07	42	23.25
	7Z	5	9.42	9	31.41	14	40.83
Triple Dog Burial Area	7D1	1	0.82	2	3.02	3	3.84
	7F1	3	2.09	6	14.49	9	16.58
	7G1			5	40.76	5	40.76
	7J1			4	7.98	4	7.98
	7K1			2	4.64	2	4.64
	7L1	2	1.02			2	1.02
	Grand Total	**198**	**320.56**	**354**	**597.75**	**552**	**918.31**

Appendix A, Table 9b. Quartz Crystals within Features.

		Stratum I		Stratum II			
Feature Area	Feature Designation	Sum of Count (n)	Sum of Weight (g)	Sum of Count (n)	Sum of Weight (g)	Total Count	Total Weight
Northeast Feature Area	8A1-A			4	3.48	4	3.48
	8N-1			1	0.99	1	0.99
	8T-D			9	9.26	9	9.26
Northeast Feature Quadrant	8V-A			4	3.25	4	3.25
	8V-B			1	0.35	1	0.35
	8W-C			4	2.22	4	2.22
	8X-E			9	8.39	9	8.39
	DDB			1	0.7	1	0.7
Northwest Feature Area	7K7J-A			6	12.34	6	12.34
Southwest Feature Area	7B1-B			1	2.25	1	2.25
	7C-1			1	0.98	1	0.98
	7T-C			1	0.19	1	0.19
	7V-1			1	0.32	1	0.32
	7W-1			1	0.14	1	0.14
	7X-A			1	6.18	1	6.18
Triple Dog Burial Area	TDB	4	7.99	2	1.02	6	9.01
	Grand Total	**4**	**7.99**	**47**	**52.06**	**51**	**60.05**

Appendix A, Table 10 Calcite Crystals

Feature Area	Unit	Feature Designation	Stratum	Count (n)	Weight (g)
Hearth Feature 6 Area	8		III	1	1.87
	8D2		II	1	6.67
	8H		II	1	2.5
Northeast Feature Area	7K	Pit 7K-A	II	1	0.38
	7D		I	1	0.2
	8C107		II	1	2.56
	8R		II	1	0.77
	8Z		II	1	1.36
	8Z		II	1	1.82
Northeast Feature Quadrant	8W	Pit 8W-C		1	0.46
	8X		II	1	0.44
	8X		II	1	2.66
	8X		II	1	1
	8X		IIB	1	0.23
Northwest Feature Area	7J		II	1	5.48
	7K		I	1	0.15
Southeast Feature Area	8U	Feature 8U-1		1	0.38
Southeast Feature Area	8S		II	1	1.01
	8S		IIB	1	11.82
	8U		II	1	2.25
	8U		II	1	1.95
Southwest Feature Area	7A1		I	1	1.01
	7Y		I	1	0.37
	7Y		II	1	0.16
	Grand Total			**24**	**47.5**