ARCHAEOLOGICAL AND GEOSPATIAL INVESTIGATIONS OF
FIRE-ALTERED ROCK FEATURES AT TORREY PINES
STATE RESERVE, SAN DIEGO, CALIFORNIA

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by
Scott A. Mattingly
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by

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ABSTRACT OF THE THESIS

Archaeological and Geospatial Investigations of Fire-Altered Rock Features at Torrey Pines State Reserve, San Diego, California
by
Scott A. Mattingly
Master of Arts in Anthropology
San Diego State University, 2007

Hundreds of prehistoric fire-altered rock (FAR) features are located at Torrey Pines State Reserve, an area ethnographically occupied by the Kumeyaay Indians along the central coast of San Diego County, California. These features appear to be more densely concentrated at sites within the boundaries of Torrey Pines State Reserve than at other nearby sites, suggesting an association with a specific resource at the Reserve. Although FAR features are generally interpreted as Agave deserti or Yucca whipplei roasting pits, these species are rare and possibly modern introductions at the Reserve. This thesis presents the excavation results of two of these FAR features, as well as a regional spatial analysis of other FAR features near the Reserve. Human behavioral ecology (HBE) provides the theoretical framework for these analyses.

To supplement interpretations based on artifactual and macrofloral analyses from the excavations, geographic information systems (GIS) are utilized to examine spatial relationships between sites at the Reserve and nearby habitation sites. Patterns that demonstrate formal, spatial, and temporal relationships between features, sites, and environmental variables are revealed. These patterns indicate that sites at Torrey Pines State Reserve with heavy concentrations of FAR fit within central place foraging models. The sites appear to represent procurement areas where resources were gathered, processed to some degree, and taken to nearby habitation sites for consumption. The density of fire-affected rock features near the Torrey Pines, the relative paucity of associated artifacts, direct ethnographic evidence of the Torrey Pine as a Kumeyaay resource, and the proximity to large habitation sites support the interpretation of many sites at the Reserve as Torrey Pine nut processing areas.
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CHAPTER 1

INTRODUCTION

Dense concentrations of prehistoric fire-altered rock features are located at Torrey Pines State Reserve, an area ethnographically occupied by the Kumeyaay Indians on the central coast of San Diego County, California. Fire-altered rock features have been analyzed throughout Southern California (Gallegos et al. 1999; Gamble 2001, 2002; King 1993, Mealey 2006; Mealey and Jenkins 2003; True and True 1992, to name only a few). These features occur most often in inland settings, and are frequently interpreted as agave and/or yucca roasting pits (Dering 1999; Gamble 2001, 2002; King 1993; Phippen 1999; Texier and King 1991; True and True 1992).

What are the functions of the fire-altered rock features at Torrey Pines State Reserve? Although agave and yucca do grow naturally on the coast at Point Loma and Imperial Beach, the presence of these species at Torrey Pines State Reserve is minimal, and may be modern introductions (Darren Smith, California State Parks Environmental Scientist, personal communication, February 22, 2007). Furthermore, these features appear to be more densely concentrated at sites within the reserve (there are nearly fifty at the site that has been designated as CA-SDI-9595) than other nearby coastal sites. These unique characteristics of the features at Torrey Pines State Reserve offer an interesting research opportunity that may present insight into Kumeyaay coastal adaptation in San Diego County.

Ecofactual, artifactual, and spatial analyses of these features will provide valuable information regarding their functions. In particular, macrofloral analyses of materials burned within the features is key to understanding their functions. However, very little biological
material (other than fuel wood) has been recovered from previously excavated features (Gamble 2001, 2002; Mealey and Jenkins 2003). To supplement interpretations based on macrofloral analyses, analyzing the spatial relationships between sites where fire-altered rock features occur may offer insight into the uses of these features. Patterns demonstrating spatial and temporal relationships between features, sites, and the environment will provide a better understanding of the use and meaning of the environment and landscape in prehistoric San Diego County (Butzer 1980; True and True 1992).

A geographic information system (GIS) is a digital application that is used for the management, analysis, and display of geographic information (ESRI 2004a:8). In addition to excavation results, this thesis presents a regional spatial analysis of prehistoric archaeological sites with heavy concentrations of prehistoric burned features in central western San Diego County, California. Following basic principles of human behavioral ecology and central place foraging theory, spatial relationships between these sites are examined using a GIS.

I focus my research on the dense concentrations of burned features within the Torrey Pines State Reserve Extension, specifically at CA-SDI-9595. The status of Torrey Pines as a State Reserve has somewhat alleviated developmental impacts to cultural, geological, and biological resources within its boundaries. Therefore, the area serves as an excellent source of data to research several interrelated questions regarding prehistoric coastal adaptation.

**Organization**

This thesis is organized in the following manner. First, in this chapter, I provide the setting for the research by defining the study area, describing the non-cultural environment of the study area, and briefly reviewing the prehistory and history of the Kumeyaay. Also in the introduction, I review the research questions that this thesis will address. In Chapter 2, I
review the theoretical background and development of human behavioral ecology. I then
discuss previous archaeological research that addresses prehistoric site typologies and fire-
altered rock features in Southern California and San Diego County. Chapter 2 concludes
with a brief overview of GIS research in archaeology that has been performed in San Diego
County. Chapter 3 includes a detailed description of the methodologies applied in the
excavation and laboratory analysis of materials recorded at CA-SDI-9595 in the spring of
2006. GIS methods are also described in detail. In Chapter 4, I present the results of my
research, and offer interpretations of the data. Finally, in Chapter 5, I provide a summary of
my research, and conclude this thesis.

**STUDY AREA**

The region analyzed is within the central coastal ecological subregion of San Diego
County, and includes Del Mar Heights, the Scripps Plateau, Los Peñasquitos Lagoon and
Sorrento Valley (Figure 1, p. 4). Specifically, the study area is located in the Pueblo Lands
of San Diego on the Del Mar and La Jolla United States Geological Survey Quadrants
(Figure 2, p. 5). The area is between 117° 11' 37” west longitude and the Pacific Ocean,
and between 32° 50' 27” and 32° 58' 14” north latitude.

I defined the study area by selecting natural features in the terrain that surround
Torrey Pines State Reserve. Topographically, the study area is dominated by two adjacent
landmasses (Figure 3, p. 6): Del Mar Heights to the north and the Scripps Plateau in the
south. These landmasses are bound to the north by the San Dieguito Lagoon, to the
northeast by an unnamed stream, to the east by Carmel Mountain and Los Peñasquitos
Canyon, to the south by Rose Canyon and Soledad Mountain, and on the west by the
Pacific Ocean.

Over 200 prehistoric archaeological sites and hundreds of burned features are
located within the study area. Approximately 60 of these sites and over 200 burned features
are located within the Torrey Pines State Reserve (Mealey 2005). Over 20 habitation sites are within the study area. Two of these habitation sites have been identified as village sites (CA-SDI-16653 and the combined areas of CA-SDI-4513, CA-SDI-4609, and CA-SDI-5443), the latter of which are known as the Kumeyaay village, Ystagua and are located within three kilometers of Torrey Pines State Reserve (Carrico 1977; Carrico and Taylor 1983; Davis and Ezell 1968; Harris et al. 1999; Moriarty 1977).

Figure 1. Study area.
Figure 2. Detail of study area on Del Mar and La Jolla USGS 7.5 minute topographic quadrangles.
ENVIRONMENTAL SETTING

Del Mar Heights and the Scripps Plateau are two eroding sandstone terraces that are bisected by the Los Peñasquitos Creek as it flows northwest through the Soledad Valley into the Los Peñasquitos Lagoon, and eventually to the Pacific Ocean. Although Los Peñasquitos Creek is the only permanently flowing stream in the study area, there are over 100 seasonal drainages in the area that flow either into the creek, or directly into the Pacific Ocean. Elevations in the study area rise from sea level to approximately 400 feet above mean sea level along the top of the terraces. At its widest, the study area is approximately 5.4 km from east to west, and approximately 14.5 km from north to south.
The Torrey Pines State Reserve lies within the Pueblo Lands in Townships 14 and 15 south, Range 4 west, and occupies the central area of the study area. The total area of the reserve is 1,325.88 acres (Mealey 1997). The northern portion of the preserve (herein referred to as the extension) is located in Del Mar Heights while the main southern portion of the reserve is on the Scripps Plateau.

Eocene sandstones and siltstones are exposed in the steep cliffs along the continental shelf on the western edge of the study area. Reddish sediments of the Linda Vista Terrace, which is composed of basal sandstones and conglomerates of the Plio-Pleistocene sea floor, cap these cliffs. This terrace rises gently to the east forming a coastal plain, and rests above the uplifted granitic complex of the Peninsular Range. To the south, in the La Jolla area, the Rose Canyon fault zone folded, faulted, and uplifted the Linda Vista Terrace, resulting in the creation of Soledad Mountain (Inman 1983:27).

Vegetation in the study area is adapted to a Mediterranean climate. Plants become their greenest from November to April, during the rainy season. Growth slows during the winter months, and vegetation becomes dry and brown between May and October. In the few undeveloped locations, coastal sage scrub and chaparral are the dominant natural vegetation communities (Christenson 1991:30-31; Holland and Keil 1995; San Diego Association of Governments 2005). The main vegetation types within Torrey Pines State Reserve are pickleweed scrub, coastal sage scrub, and Torrey Pines woodland. Torrey pines (*Pinus torreyana*) only grow at this location and on the northeastern coast of Santa Rosa Island (Mealey 1997).

CA-SDI-9595 is located within the Torrey Pines State Reserve Extension, which is mapped on the Del Mar USGS 7.5 minute quadrangle. The site is on top of a ridge of eroding Lindavista and Torrey Sandstone formations (Kennedy 1975) sloping from
northeast to southwest, at 270-350 feet above mean sea level. Many ancient river cobbles of various sizes and materials are eroding out of the subsoil at several locations on the ridge. The site gradually slopes from level ground at the top of the ridge, to a 20 percent grade near the bank of an unnamed seasonal drainage to the west. Approximately eighty percent of the soil at the site is severely eroded, loamy alluvial land-Huerohuero complex. The remaining twenty percent, on the southwestern slope, is Corralitos loamy sand. Southern Maritime Chaparral and Torrey Pine Forest represent the majority of the vegetation at the site. Diegan Coastal Sage Scrub is present at the very southwestern edge of the site near the unnamed drainage (San Diego Association of Governments 2005; SanGIS 2006).

**Cultural Setting**

California’s southernmost hunter-gatherers have been labeled by Europeans as Diegueño; divided by linguists into Ipai and Tipai; and split into two cultures, the Kumeyaay and Kamia, by ethnographers (Hildebrand and Hagstrum 1995:87; Luomala 1978:592). For purposes of both uniformity and respect, they will herein be referred to as Kumeyaay, the name preferred by their contemporary descendants (Hildebrand and Hagstrum 1995:87).

**Prehistory**

Prior to European contact, the Kumeyaay inhabited present day San Diego County, Imperial County, and portions of northern Baja Mexico (Gamble and Zepeda 2002:72; Luomala 1978). Linguistically, Luomala (1978:592) describes the Kumeyaay as being divided into the Ipai and Tipai dialects (northern and southern, respectively) of the Yuma language family (Luomala 1978:592). They are bound to the west by the Pacific Ocean, and by the Luiseño (Takic) to the north, the Cahuilla to the northeast, the Quechan to the east, the Cocopa to the southeast, and the Paipai to the south (Luomala 1978:593).
Moratto (2004) synthesizes San Diego prehistory as being generally divided into three periods, based mainly on shifts in subsistence strategies. These periods are commonly referred to as the San Dieguito (or Paleo-Indian) tradition, the La Jolla complex (or Archaic horizon), and the Yuman (or Late-Prehistoric) phase. An abundance of artifacts associated with large mammal hunting characterizes the San Dieguito cultural tradition (∼8000 B.P. to 5500 B.P.). During the La Jolla phase (∼5500 B.P. to 2000 B.P.), subsistence strategies shifted from hunting to collecting. The presence of milling implements, shell middens, and a relative absence of hunting tools is indicative of this shift. Flexed and extended burials, as well as reburials of individuals, are associated with this period. The Yuman, or late prehistoric phase (∼2000 B.P. to contact), is characterized by wide range exploitation of various food sources. Mortars and pestles appear, projectile points become more refined, pottery appeared for the first time in the county, and cremation was practiced. The late prehistoric period is associated with a transition from the La Jolla complex to the Cuyamaca complex, represented by cultural traits associated with the Colorado River Valley Yuman (Moratto 2004; Wallace 1978). Wallace (1978) divides San Diego prehistory into three periods (Table 1) strictly based on shifts in subsistence strategies.

**Table 1. Chronology of Subsistence Patterns in the San Diego Subregion (Adapted from Wallace, 1978, and Moratto, 2004)**

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<th>Subsistence Pattern</th>
<th>Interval</th>
<th>Culture</th>
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<tr>
<td>Period III: Diversified Subsistence</td>
<td>3000 B.C.-Contact</td>
<td>Transition in phase/Yuman</td>
</tr>
<tr>
<td>Period II: Collecting</td>
<td>6000-3001 B.C.</td>
<td>La Jolla</td>
</tr>
<tr>
<td>Period I: Hunting</td>
<td>9000-6001 B.C.</td>
<td>San Dieguito</td>
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Wallace (1978) states that “Period I: Hunting” is characterized by artifacts associated with large mammal hunting. During “Period II: Food Collecting” (Wallace 1978),
subsistence strategies shifted from hunting to collecting. “Period III: Diversified Subsistence” (Wallace 1978), is characterized by wide range exploitation of various food sources.

The presence of both milling implements and coastal shell middens during Period II (Wallace 1978) indicates that the people associated with the La Jolla complex exploited both terrestrial and marine food resources (Heflin 2000; Masters and Gallegos 1997; Moratto 2004; Wallace 1978). Masters and Gallegos (1997) suggest that between 7500 RYBP and 3500 RYBP, dependence upon maritime resources intensified in coastal San Diego County. The authors base their argument on recovery of small cobble mortars from submerged archaeological sites off the San Diego coast near La Jolla (Masters and Gallegos 1997).

The appearance of the mortar and pestle, as well as a general, gradual shift from coastal to inland locales, reflect a transition (ca. 3000-1500 B.P.) toward increased dietary dependence on terrestrial food sources, particularly acorns (Moratto 2004). The Kumeyaay annual cycle of gathering coastal and inland resources followed a vertical path. As vegetation ripened at low altitudes, the Kumeyaay would travel down from the peninsular ranges to those areas. Small groups of just a few families would arrive at seasonal campsites to gather and process nearby resources. Among the resources gathered and pounded into flour were at least six species of acorns, agave, wild plums, mesquite pods, piñon nuts, sages, grasses, cacti and a variety of wild fruit. Watercress, wild lettuce, roses, manzanita, elderberry, clover, yucca stalks and roots, and agave were also used as fresh foods and seasonings (Luomala 1978:599-600).

Consideration of the Kumeyaay as a relatively simple, hunter-gatherer society began to be reconsidered in the latter part of the twentieth century (Bean and Blackburn 1976). Researchers redefined the social structure of the Kumeyaay as a highly developed hunter-gatherer society, transitioning into a “semi-agricultural” subsistence (Bean and Lawton 1973:xxxvi). This subsistence pattern was supported by fire ecology, complex systems of
land tenure and management, and supplemented through trade (Blackburn and Anderson 1993; Lewis 1973; Gamble and Zepeda 2002; Shipek 1987).

Shipek (1987) describes the history of land tenure among Native Californians. She argues that complex systems of land tenure, environmental management, fire ecology, and prototypic forms of agriculture developed as a response to high population densities (Shipek 1987:12). Shipek (1987:13-16) describes Kumeyaay concepts of land tenure as being hierarchically divided:

1. nation (Luiseño or Kumeyaay)
2. band territory
3. sacred land
4. band gathering areas
5. family owned areas
6. resources reserved for “individuals engaged in shamanism” (Shipek 1987:16)
7. individually owned mobile property

A perspective that recognizes several aspects of traditional Kumeyaay sociopolitical and economic structures suggests a more complex organization than that of small family groups struggling for survival, depending solely on hunting and gathering, and passive in the management of their environment (Blackburn and Anderson 1993). In the late 1970s and 1980s, anthropologists began a theoretical reconsideration of the Kumeyaay, making structural and cultural ecological arguments for greater social complexity (Bean and Blackburn 1976).

**History**

With the arrival of Europeans in San Diego County came new plants, animals, technology, and political and religious organizations. Overgrazing by livestock and the introduction of foreign weeds and plants resulted in the acceleration of erosion, diminished water supplies, and the replacement of native grasses that produced seed-foods. Bear and antelope populations dwindled as these grasses disappeared. The relative presence of sheep and mountain lions decreased as well (Shipek 1978).
European officials were soon appointed to the tribes of Southern California to act as intermediaries and relegate Mexican order. These officials became entrepreneurs of Indian labor forces on Mexican ranchos even after the arrival of Americans in 1846. Native Californians lost social, political, and economic administrative responsibilities, leaving ritual matters and activities as their only truly independent functions. The Kumeyaay were forced to enter the new European economic niches in order to survive (Shipek 1978).

In 1875, by executive order, Ulysses Grant granted reservations of land to California Indians. Between 1891 and 1913, the "Act for the Relief of Mission Indians" gave these grants legal status as patent trusts. The relatively small reservations (the Cahuilla recognized Morongo as being approximately 30,000 acres, but were granted only 1,300) have differential access to resources such as water and farmable land. Under the direction of the Bureau of Land Management, European conceptualizations of land tenure were implemented on the reservations (Shipek 1978). In the late 1800s, the Dawes Act was passed in order to define who was (or was not) Indian so that reservation land could be divided up "appropriately." The Dawes Act forced Native Americans to be identified by their bloodline; one-quarter "pure blood" was, and is, the standard for the definition (Castile 1996). While California Indians did have private and family lands, certain areas were shared within the tribe, and others were considered to be strictly for ceremonial usage. By dividing the land to individuals, the Bureau of Land Management took previously developed property from some Indian families and gave it to others (Shipek 1978).

Meanwhile, water tables continued to lower due to the increase of deeper wells. European farmers diverted riparian waters from the reservations. The resulting agricultural failure on the reservations forced many Native Californians to seek off-reservation work. However, developing technologies made the need for unskilled farm labor minimal, and those individuals without training in various trades and professions took refuge on reservations. As described by Shipek, "Indians came to be stereotyped as lazy by the public
due to what was easily visible on the scattered reservations—unused (that is, unusable) farmlands and the unemployed (that is, unemployable) fraction of the Indian population” (1978:611).

Furthermore, Indians were becoming aware that their own elected officials frequently did not meet the approval of federal government officials. Native Americans began trusting “advocates” (Shipek 1978) to represent them. Here, the term “advocates” refers to those individuals and groups that claim to have interest in upholding Indian rights. While being of service in some situations, these advocates have often not fully understood the Indians’ problems. Likewise, they often have only conceptualized Indians in their own terms, and have had ulterior motives behind their advocacy (Shipek 1978).

Native American groups in Southern California have begun to represent themselves through tribal governments and intertribal affiliations (Shipek 1978). In California v. Cabazon Band of Mission Indians, the United States Supreme Court upheld the legal right for gaming on reservations. Since this precedence was set in 1987, the Indian gaming industry has spread throughout reservations across the United States generating multibillion-dollar revenues (Gonzales 2003).

The Native American Graves Protection and Repatriation Act (NAGPRA) was passed in 1990. NAGPRA is a federal regulation that outlines procedures for federal agencies and museums to return Native American skeletal remains and associated funerary items to contemporary American Indian communities (National Park Service 2004). The situation regarding Native American remains and archaeological research has become very sensitive, and has recently attracted a great deal of public attention (Owsley and Jantz 2001; Swedlund and Anderson 1999, 2003).

**RESEARCH QUESTIONS**

The following research questions addressed will be addressed in this thesis.
What are the function(s) of burned features?

Considering their frequent excavation, relatively little has been published regarding the actual functions of burned features on the coast of San Diego County. Gaining a better understanding of the various purposes of burned features will lead to new insights regarding prehistoric settlement and subsistence patterns.

The burned features within the Torrey Pines State Reserve appear to be associated with specific use sites where resources were processed by inhabitants of nearby habitation sites. The main goal of this thesis is to reveal what those specific resources were.

How are the features and sites in the study area related temporally and spatially?

Differentiating burned feature types and considering typological frequencies through time may lead to implications regarding subsistence change or stability in the past. However, few of previously recorded sites within the study area have been carbon dated. A major task involved with this research was to identify which sites have been dated. Furthermore, in the past, many archaeologists working in the area recorded very little information regarding burned features. Many site record forms from the 1960s and earlier simply note the presence of these features, offering no quantification, no description of their form, nor any interpretation of their use. Wherever possible, I have gleaned this information from site records and reports on file at the South Coastal Information Center.

Spatial relationships between and among burned features and sites can offer valuable insight into the meaning of landscape in prehistory. If it can be demonstrated that there are spatial patterns between special use sites with burned features in relation to habitation sites, a greater understanding of the prehistoric cultural landscape can be reached. Revealing interrelationships between different areas within the landscape and various types of burned features may provide researchers with stronger data regarding subsistence and settlement patterns.
CHAPTER 2

LITERATURE REVIEW

During the 1960s and 1970s, the archaeological debate concerning the prioritization of theoretical interpretation over empirical data gathering produced a generation of archaeologists in pursuit of pluralistic and productive avenues of research (Butzer 1980:417). Archaeologists following the processual approach were committed to statistics, ecology, and a multitude of perspectives on the philosophy of science. Many processual archaeologists advocated systems theory for its effectiveness in theoretical development, modeling, and interpretation (Plog 1975:207-208).

THEORETICAL BACKGROUND

As described by Plog, systems theory in archaeology emphasizes the relationship between artifacts and patterns in artifact distributions on the one hand and the behavioral context in which these artifacts were made and used on the other, rather than the relationship between artifacts and norms or templates. Culture, from a systemic perspective, is defined not as aggregates of shared norms, but as interacting behavioral systems. [Plog 1975:208]

By 1980, systems theory had become one of the dominant theoretical frameworks in American archaeology. The application and relevance of systems theory to archaeology, however, was considered by many to be questionable (Butzer 1980; Salmon 1978). Based on mathematical and biological systems, applications of systems theory in archaeology frequently resulted in complicated jargon that did not necessarily explain past human behavior (Butzer 1980; Salmon 1978). However, the basic principles of systems theory that facilitate modeling of complex interrelationships are essential to understanding the role of
environment in the theoretical approach Butzer defined as “contextual archaeology” (1980:419).

As described by Butzer, context is the spatial and temporal matrix encompassing both cultural and non-cultural environments. Context, in this definition, can be applied to interpretation of a single artifact, or to a range of sites. Spatial archaeology, for example, considers patterns of artifacts within sites, and the relationships between and among sites in a region. A range of conceptual frameworks in archaeology has been developed based upon context: archaeometry, spatial archaeology, geoarchaeology, zooarchaeology, and archaeobotany to name only a few (Butzer 1980:418).

From a contextual perspective, the role of environment is that of an essential component of an ecosystem. An ecosystem is a phenomenon in which a community of organisms interacts with the environment. Energy flows through a well-defined food chain and through exchanges between the living and non-living environment (Butzer 1980:418). Butzer applies this perspective to human communities by stating that “the essential components of the non-cultural environment become distance or space, topography or landforms, and resources, biotic, mineral and atmospheric” (1980:418).

By approaching the cultural landscape with two methodological objectives in mind, archaeologists can effectively describe such complex systems. The first objective is to accomplish the immediate goals of the subdisciplines involved, such as spatial archaeology, and archaeobotany. The second objective is to synthesize the results of these various subdisciplines to gain an understanding of past human ecosystems. As demonstrated by Butzer, “It is within this human ecosystem that communities once interacted spatially, economically, and socially, with the environmental matrix into which they were adaptively networked” (Butzer 1980:419).

According to Butzer (1980), there are five central themes in contextual archaeology:
1. Space. Objects and actions in space are rarely homogeneous. Spatial patterning of human groups, topography, climates, and resources are therefore readily available for analysis.

2. Scale. Scale must be clearly defined in spatial analysis. In addition, considering temporal scale in spatial analysis may reveal episodic patterns or processes.

3. Complexity. The human ecosystem is not homogeneous. Flexible, multi-faceted approaches must be employed to characterize and understand this complex system.

4. Interaction. Interaction between humans and the environment occurs at multiple spatial and temporal scales, and at varying levels of complexity.


Butzer notes that by attempting to explain multidimensional human decision-making within the environment, the contextual approach focuses on sites more than artifacts (1980:419). However, Dunnell and Dancey (1983) critique the concept of site altogether. The authors argue that the use of “site” forces researchers to focus mainly on artifact densities believed to represent domestic areas, and therefore limits data collection and interpretation. A dense cluster of artifacts did not necessarily have meaning in the past. Dunnell and Dancey argue that “the archaeological record is most usefully conceived as a more or less continuous distribution of artifacts over the land surface with highly variable density characteristics” (Dunnell and Dancey 1983:272).

While Butzer (1980) and Dunnell and Dancey (1983) were arguing for a more contextual approach, Binford (1980:4) defined the archaeological record as comprised of static elements whose spatial distribution is the result of dynamic cultural adaptations. Similar to Butzer’s (1980) argument, Binford (1980) demonstrated that one of the key variables to variation in settlement patterns is the environments within which hunter-gatherers live. He applied ethnographic research to develop a framework for understanding prehistoric hunter-gatherers settlement patterns. As described by Binford, these dynamic patterns produced the artifacts that archaeologists analyze. He argues that hunter-gatherer
settlement patterns can be understood by differentiating forager strategies and collector strategies (Binford 1980).

Foragers, according to Binford (1980), move residential bases seasonally based upon the locations of various resource patches. Resources are gathered during daily trips from a “residential base” (Binford 1980:9) out to “locations” (Binford 1980:9) where resources are extracted. Foragers generally do not store surplus, so these locations are only occupied for a very short period, leaving a very faint artifactual record (Binford 1980).

Collectors, as described by Binford (1980), organize special task groups to exploit specific resources. Unlike foragers, collectors do store food. Special task groups intending to store surpluses may leave a residential base and establish a field camp near the best location for exploiting specific resources. Therefore, the types of sites associated with collectors differ from those associated with foragers. Foragers will produce sites that can be grouped mainly into either residential bases, or locations where extractive activities occurred. Collectors, on the other hand, will produce a number of different of site types, from residential bases, task group “field camps” (Binford 1980:10), information gathering “stations” (Binford 1980:10), and field storage “caches” (Binford 1980:10).

The fundamental difference between the two types of procurement systems that Binford (1980) describes is that groups either relocate to the locations of resources, or logistically bring the resources to the consumers. Binford (1980) considers environmental variables key in understanding the conditions that result in the selection of one strategy over the other.

Somewhat contemporaneously with these theoretical developments, human behavioral ecology (HBE) was introduced in archaeology as a framework for understanding hunter-gatherer decision-making processes. One initial goal of HBE was to provide a solid theoretical background for cultural ecology by associating it with neo-Darwinism. Human behavioral ecologists develop testable hypotheses by creating models that are based upon
principles of evolution. By seeking simple, generalist solutions to research topics concerned with specific categories of behavior, HBE does not attempt to be a holistic discipline. It is reductionist at its core. This should not lessen the usefulness of HBE in archaeology, however. Archaeologists must understand that HBE is most applicable to research in specific behavioral categories such as sexual division of labor or resource intensification (Winterhalder and Smith 2000:51-54). Results of studies within a behavioral category must be compared with research in other behavioral categories for a holistic perspective to be achieved.

Optimal foraging theory (OFT) was the focus of much HBE research during the 1980s. OFT is comprised of a series of models that are concerned mainly with resource selection and habitat movement in relation to resource patches. However, OFT is most applicable to ethnographic research due to its dependence upon choices made by individuals; which is, of course, highly problematic when dealing with the prehistoric archaeological record (Winterhalder and Smith 2000:54-57).

However, valuable archaeological applications of OFT have recently been developed in the form of central place foraging (CPF) models that address residential movement and field processing (Winterhalder and Smith 2000:57). Kennett (2005) considers several HBE models for the Santa Barbara Channel Island Chumash of Southern California and demonstrates the particular effectiveness of CPF theory for the Santa Barbara Channel Islands.

Kennett states that a basic economic principle underlying CPF theory is that foragers will exploit resources that require the least energy expenditure while maximizing energy intake. Since resources are rarely distributed evenly in space, CPF theory predicts that primary habitation sites (central places) will be located in areas that “maximize the net central place foraging returns given the pursuit, handling, and transport costs of resources from different patches” (Kennett 2005:225).
Kennett skillfully demonstrates that the Holocene archaeological record for the Channel Islands is consistent with CPF theory. Primary villages were located in areas where foragers had access to several littoral and terrestrial resource patches. Of particular relevance to this thesis is the statement:

With a settlement base on the northeast coast of Santa Rosa people had access to a variety of productive intertidal and nearshore habitats locally, but they could also travel to more distant locations on San Miguel to hunt sea mammals or collect shellfish from intertidal habitats that were not suffering the same impact as those in the immediate vicinity of primary villages. Oak and Torrey Pine groves in the island interiors could also be targeted from the northeast coast of Santa Rosa, along with mollusks from the estuary at the mouth of Old Ranch Canyon. [Kennett 2005:225-226]

The decisions made by the Island Chumash to locate their primary habitations in areas with relatively easy access to a wide range of resources did not, however, eliminate the logistic exploitation of resources from more distant patches. Kennett describes the evidence for logistical foraging as being evident in sites located in areas that were not permanently occupied. Specifically, Kennett interprets sites that have thin lenses of red abalone shell and relatively few artifacts as processing camps. As described by Kennett:

Limited tool and faunal diversity at these sites is indicative of highly specialized subsistence activities, and seasonality data suggest periodic rather than perpetual harvesting of shellfish. The removal of heavy red abalone shells where they were harvested suggests that foragers were trying to maximize net delivery rate of this resource to primary villages located elsewhere on the islands. [Kennett 2005:226]

Considering this type of settlement pattern in a CPF context, sites with relatively little material data can be understood as logistical resource processing sites that were repeatedly exploited, perhaps seasonally (Kennett 2005:226). Many sites within the Torrey Pines State Reserve, including CA-SDI-9595, fit this description very well. The sites are dominated by dense concentrations of fire-affected rock with relatively few other associated artifacts. Furthermore, the sites are easily accessed from several known village sites. The relationship between resource processing sites at Torrey Pines State Reserve and nearby village sites will be discussed in detail in Chapter 4.
Another effective archaeological application of OFT is a set of models within CPF theory that address field processing of resources (Bettinger et al. 1997; Kennett 2005; Winterhalder and Smith 2000). Bettinger and colleagues (1997) use a CPF model of field processing to consider the archaeological implications of the exploitation of black oak (Quercus kelloggii) and big mussel (Mytilus californianus). The authors describe the utility of field processing models for determining whether “one or more stages of field processing would increase the overall efficiency with which resources are delivered from foraging locations to a central place, the goal being to deliver as much useful material (i.e. utility) as quickly as possible to that central place” (Bettinger et al. 1997:888). Resource processing involves the elimination of excess material that is of low or no utility, i.e., seed and nutshells, mollusk shells, and lithic cortices. At the core of CPF modeling is the determination of the difference between the amount of time involved in field processing time, and travel time. Field processing may increase the amount of useful material that is returned to the central place in a single trip, therefore decreasing the travel time required to obtain the resource. However, the amount of time involved in the field processing may be greater than the amount of time required to make more than one trip. For example, it will take more time to collect and decorticate two kg of raw lithic material into one kg of useful tools than it would to transport two kg of the raw material to the central place (Bettinger et al. 1997:888).

According to Bettinger et al. (1997), the decision to field process is dependent upon:

1. the amount of time processing takes; 2. the amount by which processing increases the utility of material being transported; and 3. the distance to the central place. If processing time is low enough, and the resulting increase in resource utility is high enough, field processing will increase the rate at which useful material reaches the central place. Even if processing is time costly, it may still increase efficiency if the distance is between the central place is large, because fewer trips will have to be made. [Bettinger et al. 1997:888]

Applying HBE and CPF modeling to the current study area is a productive avenue of research in that it will provide a conceptual framework in which to understand the context of prehistoric sites in the area. The previous research discussed in the following pages
strongly suggests that the relationship between sites near Torrey Pines with heavy concentrations of fire-affected rock and nearby habitation sites fits predictions of CPF modeling.

**PREVIOUS RESEARCH**

What is an archaeological site? To facilitate the protection of antiquities, the California Office of Historic Preservation (OHP) defines a site as:

> the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archaeological value regardless of the value of any existing building, structure, or object. A site need not be marked by physical remains if it is the location of a prehistoric or historic event, and if no buildings, structures or objects marked it at that time. Examples of such sites are trails, designed landscapes, battlefields, habitation sites, Native American ceremonial areas, petroglyphs and pictographs. [California Office of Historic Preservation 1997:2]

This definition, however, does little to clarify variations within prehistoric archaeological site types.

**Prehistoric Archaeological Site Types**

Gallegos and colleagues (1999) note that site nomenclature is frequently abused in the archaeological literature. In an attempt to clarify site types in San Diego County, they (Gallegos et al.1999:2-2–2-4) offer the following typology.

- Artifact scatter—a scatter of artifacts that may represent a resting place along a journey, or an area where a specific task was accomplished.
- Habitation—short or long term occupation areas that contain a range of artifacts and features within a significant subsurface deposit.
- Historic—in accordance with OHP, any remains of activities greater than 45 years old.
- Isolate—three or less artifacts within 50 feet of each other.
- Flaked stone scatter—representative of areas where lithic reduction was the main (if not only) activity.
Quarry—areas where raw lithic materials were collected, tested, and minimally processed.

Rock Art—sites containing either petroglyphs (pecked rock) or pictographs (painted rock).

Rock Shelter—overhangs and small caves used for protection from the elements.

Shell Midden—shellfish processing areas.

Of particular interest to the current project is the relationship between what Gallegos and his associates (1999:2-3) classify as “artifact scatters” and “habitation” sites. Sites with burned features at Torrey Pines State Reserve are most similar to those described by Gallegos et al. (1999:2-3) as “artifact scatters” in that they are areas in which specific tasks were accomplished. The relatively limited presence of artifacts other than fire-altered rock, and a lack of faunal material, suggest that these locations were used specifically for processing vegetal resources, such as agave, yucca, or Torrey Pine nuts (Gamble 2001, 2002; Mealey and Jenkins 2003; Moriarty 1977).

Twenty-four habitation sites, as defined by Gallegos and colleagues (1999:2-3), have been identified within the study area. Many of these habitation sites have received a great deal of attention by archaeologists, including, the Spindrift Site (CA-SDI-17372) in La Jolla Shores (Gross 1999), and several sites near the University of California, San Diego, most notably CA-SDI-525 and CA-SDI-4670 (Hanna 1980).

However, two habitation sites in the study area are of particular interest here, based upon their proximity to Torrey Pines State Reserve. Ystagua (CA-SDI-4513, CA-SDI-4609, and CA-SDI-5443), in Sorrento Valley, was a Kumeyaay village site first documented by members of the 1769 Portolá expedition traveling from Baja California, through San Diego to Monterey. Spanish missionaries maintained contact over the next 26 years with the Kumeyaay at Ystagua and areas associated with it (Carrico 1977:34). The second nearby habitation site is CA-SDI-16653, previously referred to as W-20 (Williams 1999). This site
was once located on the north side of the Los Peñasquitos lagoon, at the southeastern edge of Del Mar Heights. Although completely destroyed now, initial excavations at the site revealed a series of occupations with artifacts temporally diagnostic of each phase of San Diego County prehistory. Cutting 18-foot deep trenches, Davis and Ezell (1968) recorded a clay lined surface resembling that of a house floor, fire-altered rock features, a human burial, and several shell middens. Were the special use sites with burned features at Torrey Pines State Reserve used by peoples from these habitation sites to process resources?

**Fire-Altered Rock Features**

Burned features are concentrations of fire-altered rock, used for heat, light, resource treatment, cooking, roasting, or ceremonial purposes. These burned features contain a wealth of information regarding subsistence patterns and resource use in prehistory. Archaeologists frequently collect carbon samples for dating resources from within these features. However, relatively little has been written regarding the range of forms and functions of burned features (Gallegos et al. 1999:3-92).

The main constituents of burned features are, of course, fire-altered rocks. The various functions of the features alter the constituent rocks in various ways. Gallegos and colleagues (1999) describe several physical characteristics of fire-altered rock. Color is the primary indicator. While natural weathering may discolor the exterior surface of the rock, exposure to intense heat results in interior discoloration. At very high temperatures, the exterior of the rock is bleached. “Spalling” occurs when exterior fragments of the rock break away under heat stress. Gallegos et al. (1999:3-89) refer to this as a “potlid” effect. The authors (Gallegos et al. 1999:3-89) describe rocks that have an exterior covered in small, narrow fractures as “crazed.” Using a heated rock to boil water can result in a crazed exterior. A “heat rind” (Gallegos et al. 1999:3-89) is descriptive of the discoloration of the outer several centimeters of a fire-affected rock. “Pocked” rocks are those that have
exfoliated portions of the matrix leaving a pocked effect on surface of the rock. Finally, some rocks will completely decompose and disintegrate when exposed to fire (Gallegos et al. 1999:3-89).

In Carlsbad, California, Gallegos and colleagues (1999) excavated several burned features at CA-SDI-12814. This site is approximately 25 kilometers north of the current study area. The excavation resulted in the creation of a burned feature typology for San Diego County. The authors defined the four types described below.

- Type 1 represents a single burn within a small pit. This type may have been used for light, heat, or to cook small game (Gallegos et al. 1999:3-92).

- Type 2 features are multiple event burns within a circular pit. The pit generally measures approximately 30 cm deep by 100 cm in diameter. The presence of fire-altered rock throughout the pit, in no discernable order, suggests frequent reuse. This type of feature may have been used for heating rocks for use in boiling, steaming, roasting, or processing (Gallegos et al. 1999:3-92).

- Type 3 represents a circular pit, 40 cm in depth, and up to two meters in diameter. This type of burned feature is lined with large stones so that heat within the fire is reflected back onto the item being roasted or cooked. Type 3 burned features may be representative of agave, yucca, or large game roasting pits (Gallegos et al. 1999:3-94).

- Type 4 is an oblong platform of stones that are stacked at least three high and measuring up to two meters long. Gallegos and colleagues consider this form to be representative either of a roasting platform, a sweathouse, or of other ceremonial use (Gallegos et al. 1999:3-94).

King (1993) describes a range of prehistoric burned features found in Southern California. These include slab-lined cooking ovens, yucca ovens, rock piles for boiling, lined and unlined hearths, and roasting areas. King pays particular attention to the differentiation of slab-lined cooking ovens and yucca ovens at sites in Ventura County, California (King 1993; Texier and King 1991).

Slab lined ovens are described as a parabolic pit between approximately one and two meters in diameter. Stone slabs or large flat cobbles typically line these pits. A fire is built on the surface nearby where rocks were heated and placed into the oven in order to
bake various types of food (King 1993). This description is similar to Gallegos and colleagues (1999) Type 2 and 3 features, respectively.

Yucca ovens, as described by King (1993), are much more elaborate. At CA-VEN-1020, King excavated a large concave pit that dated to approximately 1090 B.P. The feature was about 50 cm deep and nearly two meters wide. An 80 cm wide by 40 cm deep vertical shaft was exposed at the bottom of this pit, making the maximum depth of the feature 90 cm below the surface. At least three fires had been built within this shaft, each with a course of very large stones above it. Yucca carbon was concentrated in the area just above the third fire, which was covered by a final course of stones. Carbonized soap plant bulbs and pollen from greens were also located in the upper layers of this feature. (King 1993).

**Functions of Fire-Altered Rock Features**

True and True (1992) synthesize ethnographic uses of burned features (particularly roasting pits) throughout the greater southwest. The authors describe agave processing as the most widespread function of these burned features. Heads of agave were roasted directly in a fire for several hours, and then buried in a rock-lined pit of approximately the same dimensions described by Gallegos et al. (1999) and King (1993). After roasting over night, the overburden of rocks and dirt was removed, and the agaves were prepared for use (True and True 1992:6). Do the burned features near Torrey Pines State Reserve represent agave roasting pits, or were they used to process other resources?

Pine nut exploitation has been well documented as a food resource throughout California (G. J. Farris 1982), and specifically described by Delfina Cuero as occurring in an area just north of La Jolla (Shipek 1991:27-28). Torrey pinecones were collected by the Kumeyaay in the fall, and often roasted in order to extract the nut (Shipek 1991:94). Cuero, however, does not describe the actual roasting process. Shipek (1991) consulted with
Cuero, a Kumeyaay elder, to document indigenous ethnobotany in southern San Diego County. As described by Cuero to Shipek (1991:27):

We used to gather pine nuts right near the ocean near San Diego beyond mat kula-xu-y (La Jolla or “land of holes”). If there weren’t so many houses maybe I could find my way to all the places again. It wasn’t far from Mission Valley to the place for pine nuts [probably Torrey Pines, now a State Park]. The men got fish and other things from the ocean when we got pine nuts. There were a lot of semay a-saw [vegetables or eating greens] all over near the ocean. [Shipek 1991:27-28]

While summarizing ethnographic accounts of pine nut exploitation in central and northern California, Farris (1982) describes the process of extraction. The cones were taken to a clearing, placed in piles, covered with pine needles, and ignited. He argues that the firing process did not actually open the cones, but simultaneously removed the pitch, slightly roasted the nuts, and rendered the cone easier to split. At this point, the pine nuts could be removed by simply pressing down on the scales of the cone. In some instances however, the cone may have been split lengthwise using a stone tool (G. J. Farris 1982:20-21).

Farris describes the process of extracting the pine nuts from dense shells as follows:

The prime means of breaking the pine nut shells used by humans was the nutting stone with the nut placed on some form of anvil. The nutting stone is generally a small, hard, oval rock held between the thumb and forefinger. The anvil is usually a stone block, often with pits in it to keep the nut from sliding around when being struck. [G. J. Farris 1982:124]

Farris adds that in areas where cobbles are prevalent, distinguishing those that were used for pine nut processing could prove to be quite difficult, considering that the process leaves little wear on the tools (G. J. Farris 1982:137).

**Previous Archaeological Fieldwork**

Malcolm J. Rogers first surveyed the study area in the 1920s as part of an archaeological investigation of the Southern California coast (Hanna 1980). Since that time, over 300 archaeological projects of various scales have been conducted in the area. These projects have revealed 204 archaeological sites of all phases of prehistory, protohistory, and
history. Most prominent are early and middle archaic sites that are rich with human osteological remains and indicative of the cultural pattern that Rogers labelled the “La Jolla material pattern” (Hanna 1980:84). According to site record forms on file at the SCIC, fire-affected rock has been recorded at almost all of these sites. However, only 57 of the sites contained well-defined, intact fire-affected rock features (Hanna 1980; Mealey 1997, 2005).

Mealey (1997, 2005) recorded 223 prehistoric burned features at 40 prehistoric archaeological sites within Torrey Pines State Reserve. The California Department of Parks and Recreation has promoted archaeological survey and excavation (Gamble 2001, 2002; Mealey 1997, 2005; Mealey and Jenkins 2003) at Torrey Pines State Reserve as part of the continuing effort to record archaeological resources before they are irreparably damaged by pedestrian traffic, or totally lost to erosion.

As part of this effort to protect archaeological resources from erosion, Gamble (2001, 2002) excavated a large burned feature at CA-SDI-15557 within the Torrey Pines State Reserve Extension. CA-SDI-15557 is a quarry site where cobbles of various materials were used to create chipped stone tools and bi-products, such as debitage. Five FAR features are located at the site as well, but do not appear to have been used for heat treating the lithic materials that were quarried at the site. Feature A was buried under approximately 65 cm of colluvium. The feature measured approximately 160 cm in diameter, and 40 cm in depth. It consisted of a stone lined, concave pit filled with fire-altered rocks, charcoal and blackened soil. Two charcoal samples from the feature were radiocarbon dated to approximately 1600 B.P. Gamble (2001, 2002) supervised the flotation of the feature matrix, and the Cotsen Institute of Archaeology at the University of California, Los Angeles, performed ethnobotanical analyses of 70.3 liters of the floated material. Ceanothus sp. and Rosaceae charcoal were the only materials recovered. Ceanothus grows in abundance at Torrey Pines State Reserve, and was most likely used as fuel. No other plant remains were identified. However, based on the physical form of the feature, and
its structural similarity to those described by King (1993) and Gallegos et al. (1999), Gamble (2001, 2002) concludes that the feature was used as an oven. Although the absence of plant remains makes the specific functions of this oven difficult to determine, she did suggest that inhabitants of nearby habitation sites may have traveled to this location to roast bulbs, Torrey Pine nuts, and other plant foods (Gamble 2001, 2002:9).

Subsequent excavations at the Torrey Pines State Reserve Extension have exposed at least four other prehistoric burned features (Mealey and Jenkins 2003). Mealey and Jenkins (2003) excavated and analyzed features at CA-SDI-14451 and CA-SDI-14452. They described each feature as relatively small (less than a meter in diameter) clusters of fire-altered rock surrounded by a ring of larger stones. Each feature was immediately below the surface, and had a total vertical depth of less than 30 cm. One feature at CA-SDI-14451 was dated to between CAL B.P. 760-660 by Beta Analytic. In contrast, CA-SDI-14452 was dated to between CAL B.P. 8170-7680 B.P. Beta Analytic confirmed that this was a sound date, as the sample analyzed was not contaminated. Mealey and Jenkins (2003:36) submitted seven soil samples to Paleo Research Institute in Golden, Colorado, for floral analyses. The only macrofloral materials identified were *Adenostoma* and *Rhamnus*, which suggest the use of buckthorn and chamise as fuel (Mealey and Jenkins 2003). The description of these burned features suggests similarity to Type 2 features as described by Gallegos and colleagues (1999).

The fourth burned feature excavated at the Torrey Pines State Reserve Extension was located at CA-SDI-9595 (Mealey and Jenkins 2003). The portion of the burned feature exposed by the excavation was greater than two meters in length (from north to south) and measured to a maximum depth of approximately 30 cm below the surface at the bottom of the feature. It had a well-defined concave shape outlined by a circular ring of larger stones. Carbon dated charcoal samples place the use of this feature at between 970 and 750 B.P. Although macrofloral analysis revealed no data regarding the use of the feature, soil molds
similar to the size and shape of Torrey Pine nutshells were noted (Mealey and Jenkins 2003). The form of this feature is similar to Gallegos and colleagues' definition (1999:3-94) of a Type 3 roasting pit.

Continued research at Torrey Pines and throughout the study area may reveal previously unrecognized spatial patterns of prehistoric burned features. The relative lack of artifacts and ecofacts associated with these burned features (Gamble 2001, 2002; Mealey and Jenkins 2003) will be discussed later in this thesis. This lack of associated artifacts suggests that the features and sites are limited, specific use areas. Perhaps these areas were used for resource procurement and processing by gatherers residing at nearby village sites (Gamble 2001, 2002).

From an HBE perspective, sites at Torrey Pines with heavy concentrations of fire-affected rock fit central place foraging models in that they represent procurement areas where resources were gathered, processed to some degree, and taken back to a central place (Bettinger et al. 1997; Kennett 2005; Winterhalder and Smith 2000). Considering archaeological sites in this context will lead to a better understanding of settlement and subsistence patterns and resource exploitation, manipulation, and management in prehistoric San Diego County.

**GIS Research**

Church et al. (2000) argue that archaeologists have generally confined the application of GIS to visualization, data management, or predictive modeling. The authors state: “We would argue that except for management applications, the vast majority of GIS studies have confused either ‘pretty pictures’ with innovation, as in the case of visualization, or the statement of simple correlations with theory, as in the case of predictive models” (Church et al. 2000:135). The authors continue by stating that predictive modeling and other archaeological applications of GIS are indeed useful. However, they will only become most
effective when archaeologists shift applications of GIS from methodological tools to more theoretical orientations (Church et al. 2000:136). The authors conclude that the most effective theoretical framework for archaeological applications of GIS is one that combines ecology and archaeology (Church et al. 2000:150).

Currently, few archaeologists working within the traditional territory of the Kumeyaay have attempted to apply GIS for anything more than visualization. One exception is Tsunoda’s recent masters thesis at San Diego State University (2006). Tsunoda employs GIS to identify relationships between Kumeyaay settlement patterns and environmental variables at Cuyamaca Rancho State Park in San Diego County. Utilizing the spatial analyst function of ArcView 9.1 and 3.3, he compares site locations in relation to slope, elevation, aspect, vegetation, and the nearest sources of fresh water. By performing these analyses, Tsunoda (2006) concludes that the Kumeyaay preferred locations in level areas or gentle slopes facing south, near oak communities and fresh water. Furthermore, many of the sites were located in ecotones near several types of habitats (Tsunoda 2006).

Approximately 30 kilometers to the north of the current study area, within the traditional territory of the Luiseño, Byrd and colleagues apply a “GIS landscape approach” to archaeological research at Camp Pendleton, California (2004:26). The authors consider Late Prehistoric Luiseño sites and their interrelationship with the physical landscape. They argue that demonstrating relationships between cultural and physical landscapes permits the integration of various site types into a model of hunter-gatherer settlement patterns along the northern San Diego coast (2004:26). Byrd and his associates (2004) consider drainage size, distances to the shore, and distances to streams as environmental variables. The cultural attributes the authors examine are site size, site type, and foraging range. The focus of the analysis is to consider how these physical and cultural variables relate (Byrd et al. 2004).
By measuring distances from residential bases, short-term campsites, and limited activity sites to sources of fresh water and the coast, Byrd and colleagues (2004) analyze coastal Luiseño settlement patterns. The authors conclude that the results of the study suggest

the emergence of more complex settlement patterns with Major Residential Bases along key drainages and more specialized sites clustered around them in a radiating organizational strategy (Binford 1980). These trends also suggest greater settlement permanence at Major Residential Bases, a decline in the territorial range of these sites, and more thorough exploitation of the littoral zone within foraging ranges. [Byrd et al. 2004:32]

As previously discussed, this thesis considers the relationships between site locations from a central place foraging theoretical perspective. Similar to the research conducted at Camp Pendleton by Byrd et al. (2004), I employ GIS to facilitate this study.
CHAPTER 3

METHODOLOGY

In this chapter, I describe the methodologies followed for the fieldwork, laboratory analysis, and GIS analyses performed for this thesis.

FIELD METHODS

A total of 47 FAR features have been recorded at CA-SDI-9595. In an attempt to reveal the functions of FAR features at Torrey Pines State Reserve, students from San Diego State University excavated two features at CA-SDI-9595 under the direction of Dr. Lynn Gamble in the spring of 2006. Carmen Lucas of the Kwaaymii band of Kumeyaay Indians monitored the project. Her many years of archaeological field experience, combined with her perspective as a Native American, were quite valuable in every step of the process.

Features D and F were selected for excavation because they appeared to be intact. Furthermore, excavation of these features would have relatively little impact on the fragile ecology of the reserve. Feature D appeared to be very large on the surface (approximately four meters in diameter), was not too heavily eroded, and would require minimal trimming of the surrounding vegetation. Feature F was selected for excavation because it was being heavily impacted by pedestrians. Also, its smaller size (approximately two meters in diameter) offered potential insight into formal differences of fire-affected rock features at the site.

While students began excavating Features D and F, other students resurveyed the site using a TPS Recon Pocket PC Handheld GPS with a Holux CF GPS Receiver. All features, including those previously recorded by Mealey and Jenkins (2003), and those
located during the 2006 survey, were recorded referencing the North American Datum of 1983, UTM Zone 11N. Students surveyed the entire site by walking in approximately five-meter interval transects parallel to the Margaret Fleming Nature Trail. All feature and artifact locations were recorded using the GPS and briefly described. No artifacts were collected during the survey.

The location of each test unit excavated during the 2006 excavation at CA-SDI-9595 is displayed in Figure 4. Test Unit 5 (Units 1-4 had been excavated previously by Mealey and Jenkins, 2003) measured one square meter and was aligned to true north along what appeared to be the northwest edge of Feature D. The unit was bisected along a north-south axis, and excavated in east and west halves in order to expose a profile of the feature. All provenience information was recorded as “Unit 5 east half,” or “Unit 5 west half.”

Test Unit 6, also one square meter and aligned to true north, was placed on the eastern portion of Feature D. Carmen Lucas requested that the unit be placed in a manner that would have as little effect on the surrounding vegetation as possible. Therefore, Units 5 and 6 were not aligned on a grid. Unit 6 was also bisected along a north-south axis, and excavated in east and west halves in order to expose a profile of the feature. All provenience information was recorded as “Unit 6 east half,” or “Unit 6 west half.”

Unit 7 was initially one meter by 59 centimeters, aligned to true north, on the southern edge of Feature F. The north and south walls measured one meter, while the east and west walls were 50 centimeters. The unit was laid out in this manner to bisect the feature, and avoid the adjacent (unauthorized) pedestrian trail immediately to the north. However, the excavation of Unit 7 revealed the presence of subsurface fire-affected rock in a matrix of charcoal rich soil that extended below the surface toward the trail. The unit was expanded to the north to expose more of the feature, creating a one square meter excavation unit. All provenience information was recorded as “Unit 7 south half,” or “Unit 7 north half.”
Figure 4. Test units excavated at CA-SDI-9595 during the 2006 San Diego State University archaeological field school.
Test Units 8, 9, 10, and 11 were placed in a row from west to east between Units 5 and 6 in order to expose more of Feature D. Units 8, 9, and 10 were 50 cm², and referenced to true north. Because Units 5 and 6 were not placed on a grid, Unit 11 only measured 50 cm by 36 cm.

Units 12, 13, 14, and 15 were then placed adjacent to, and due south, of Units 8, 9, 10, and 11. Again, because Units 5 and 6 were not placed on a grid, Unit 15 measured 50 cm by 36 cm. Due to time constraints, it was decided that the complete excavation of Unit 5 to a sterile layer, along with the collection of fire-affected rock from Units 6 and 9, provided sufficient representative samples of materials present in Feature D. However, Units 10 and 14 appeared to be in the center of the feature in the greatest concentrations of fire-affected rock, charcoal, and blackened soil. Therefore, these units were also excavated to sterile soil to recover the richest soils and charcoal samples for flotation and carbon dating.

Photographs and drawings in plan and profile, as well as detailed notes, were used to record the entire excavation process. Any charcoal or other datable materials were collected after their precise provenience was recorded. In situ artifacts were handled in the same manner. Fire-altered rocks were weighed, and the material type was recorded on site. In an attempt to mitigate accelerated soil erosion caused by the excavation, it was important that this procedure be accomplished in the field so that FAR could be promptly used as backfill.

For the majority of the excavations, soils were removed in arbitrary 10-centimeter levels. However, where cultural stratigraphy was identifiable, materials were excavated by stratigraphic layer. The soil was either dry screened through 1/8” hardware mesh, or placed in one-gallon plastic bags as samples for flotation. Float samples were selected based upon concentrations of charcoal, and upon location within the features. This method facilitated flotation procedures followed by associates of the Cotsen Institute of Archaeology at the
University of California, Los Angeles, under the direction of Dr. Virginia Popper. Fourteen flotation samples were processed at the facility.

Therese Muranaka, PhD., California State Parks Archaeologist, requested the collection of any cryptogamic crust that would be affected by the excavation. Cryptogamic crust is a highly specialized community of algae, lichens and mosses that form a relatively thin crust of soils and organic material (United States Geological Survey 2006). The material was collected and assigned provenience information. After the units were backfilled with the fire-altered rocks and screened soil, the cryptogamic crust was returned to its original location.

**LAB METHODS**

With the assistance of Dr. Lynn Gamble, Carmen Lucas, and Wendy Winger, I sorted and cataloged all of the artifacts collected during the excavation. Cultural items were divided into the following eight artifact classes: (1) charcoal, (2) chipped stone, (3) possible chipped stone, (4) FAR, (5) floral, (6) groundstone, (7) possible groundstone, and (8) soil samples.

Individual catalog numbers were assigned to single artifacts or to groups of items of the same artifact class and provenience. Artifact type and material, as well as any modification, was recorded for each catalog entry. Material types were defined following identification methods outlined by Hamblin and Howard (1989). Materials were described to the greatest level of detail whenever possible. However, due to the effects of heat exposure, the majority of material types were identifiable only to the level of igneous, metamorphic, or sedimentary rocks. Modifications included cultural modifications such as bifacial or unifacial work, if the item had been affected by fire and how the item had been fire-affected. The weight (rounded up to a tenth of a gram) of every catalog entry was also recorded. The quantity of items for each entry was recorded where feasible; charcoal samples, floral
remains recovered from the ethnobotanical analysis, and soil samples were not quantified. Finally, any relevant comments, such as charcoal or flotation sample number, were recorded.

Soil samples most suitable for macrobotanical analysis were selected from the dozens of samples collected in the field. Samples that had pin-point provenience, the greatest densities of carbon (and therefore the darkest), and were excavated from within the matrices of the features were submitted to the Cotsen Institute of Archaeology at the University of California, Los Angeles. Radiocarbon samples were also chosen based on location from within the features. Only the largest pieces of charcoal were submitted for radiocarbon analysis and, whenever possible, only single pieces of charcoal were selected. Each radiocarbon sample was also identified by Dr. Popper at the Cotsen Institute. Radiocarbon dating was performed by Beta Analytic Inc. in Miami, Florida.

Upon completion of the artifact catalog, the collection will be taken to the California Department of Parks and Recreation, Southern Service Center. The collection will ultimately be curated at the San Diego Archaeological Center. Therefore, the collection was prepared following guidelines suggested by the San Diego Archaeological Center (2005).

**Spatial Analysis Methods**

Background research was accomplished by accessing information through the San Diego State University Library, the California Department of Parks and Recreation, Southern Service Center, the South Coastal Information Center, and the Museum of Man. The South Coastal Information Center (SCIC) operates under the direction of the California Office of Historic Preservation and serves as an archive for all site records, maps, and archaeological project reports for San Diego County (South Coastal Information Center 2004). Prior to the establishment of the SCIC, site records were maintained at the Museum of Man. A total of 52 sites records within the study area are currently on file at the Museum.
of Man that are not archived at the SCIC. Most of the sites at the Museum of Man were recorded prior to 1960, and offer very little information that is relevant to this thesis. All of the site records at the Museum of Man were examined; however, none of them offered any quantification nor descriptions of FAR features in any detail. Therefore, although they are included in the total number of sites in the study area (n=219), they are not included in the spatial analysis.

Site records within the study area on file at the SCIC (a total of 167) were systematically examined in order to determine site type, if FAR features were present, and how many features had been recorded. Site descriptions were compared to the site typology suggested by Gallegos and colleagues (1999:2-3–2-4). As expected, there is a very wide range of site types suggested by the dozens of archaeologists that recorded the sites in the study area. Therefore, rather than attempting to group every site into one of the ten types offered by Gallegos et al. (1999:2-3–2-4), I created 14 categories for site types recorded in the study area. The site types and a brief description of their defining attributes are as follows:

- Chipped stone scatter: a scatter of chipped stone artifacts
- FAR features: fire-altered rock features with relatively few associated artifacts
- FAR scatter: a scatter of fire-altered rock that is not part of a defined feature and is associated with relatively few other artifacts
- Groundstone scatter: a scatter of whole and fragmented groundstone artifacts
- Habitation: a variety of artifacts and ecofacts within a well defined subsurface deposit representing a range of activities over short- or long-term periods
- Historic: remains of historic structures or activities greater than 45 years old.
- Isolate: three or less artifacts
- Multiple attribute scatter: a small scatter of different types of artifacts (such as shell, chipped stone and groundstone) with no well-defined subsurface deposit
- Petroglyphs: an incised, pecked, ground or carved rock art feature
• Quarry: a location where lithic materials were tested and collected for use in the creation of chipped stone tools

• Secondary deposition: a site that has been imported to its current location from another unknown location. Secondary depositions are often the result of development activities that predate the implementation of the California Environmental Quality Act (CEQA)

• Shell midden: a site where shellfish processing was the predominant activity. Shell middens have a well defined subsurface deposit

• Shell scatter: a site with no subsurface deposit where minimal shellfish processing occurred

• Undefined: sites that have no description; only their locations have been recorded

These site classifications were added to the GIS site location data in order to analyze spatial relationships between different site types in the study area.

I performed all GIS analyses using ESRI ArcGIS 9.0 and 9.1. I obtained archaeological site GIS data in the form of shapefiles from the SCIC. A shapefile is a GIS data format that stores the location, shape, and attributes of geographic features (ESRI 2004b:118). Site GIS data is managed at the SCIC by assigning either a Primary number or a Trinomial number to each historical resource. Primary numbers are assigned to historic structures and isolated artifacts, while Trinomial numbers are assigned to prehistoric archaeological sites and historic artifact scatters. Because I am not concerned with historic structures or isolated artifacts in this thesis, only the Trinomial shapefile was referenced.

In addition to the survey GPS data collected during the field class, and the SCIC GIS data, site and feature spatial data recorded by Mealey (2005) and Mealey and Jenkins (2003) were analyzed as well. All archaeological sites and exposed features within Torrey Pines State Reserve were recorded with a Trimble GeoExplorer III GPS (Mealey 2005; Mealey and Jenkins 2003), and plotted directly into shapefiles. Other major sources of GIS data used extensively in this project are the San Diego Association of Governments (SANDAG), and San Diego Geographic Information Source (SanGIS). SANDAG and
SanGIS provide the public with information regarding regional planning in San Diego County (San Diego Association of Governments 2005; San Diego Geographic Information Source 2006). GIS data from SANDAG and SanGIS that were used in the current project include a digital elevation model, as well as vegetation, streams, and lagoons shapefiles.

Thirty kilometers to the north of Torrey Pines State Reserve, Anderson and Byrd (1998) radiocarbon dated a sequence of pollen and spores collected from a very deep column sample at Las Flores Creek. Based on these studies (Anderson and Byrd 1998:178), the modern vegetation communities in the area have been in place since approximately 2,600 years before present. This study indicates that the comparison of archaeological sites (particularly those dated to the Late-Archaic and Late-Prehistoric periods) and modern vegetation communities may reveal valid and relevant spatial patterns.

Using the San Diego County vegetation shapefile (San Diego Geographic Information Source 2006), I extracted all of the vegetation communities within the study area and created a new shapefile named “Thesis_Veg.” Attributes of the SanGIS vegetation layer are coded according to the Holland vegetation classification system (Holland and Keil 1995; San Diego Geographic Information Source 2006). By cross-referencing ethnobotanic research (Hedges and Beresford 1986; Shipek 1991) to the Holland vegetation classification codes (Holland and Keil 1995), I created a shapefile representing locations of vegetation communities exploited by the Kumeyaay. However, since the study area has been heavily impacted by development, I only included vegetation communities located in open space reserves. This was accomplished in order to compare the locations of sites and features to the locations of native vegetation communities in the study area.

What if these sites with dense concentrations of FAR features were not resource processing sites? Binford (1978, 1980, 1982) describes the use of strategically located observation points to monitor the movement of game or humans in the surrounding area. These locations, described by Binford as “observation stands” (1978:282, 354), were
situated near salt licks, or in areas that offered a commanding view of game traveling in the distance. At observation stands positioned near salt licks, fires were never burned (Binford 1978:282). However, at the more remotely located observation stands, hunters would often burn a small fire for heat and cooking while waiting for distant game to approach (Binford 1978:355).

In order to determine if CA-SDI-9595 may have been used as an observation stand, I employed the viewshed function in ArcGIS 9.0. I created a polygon shapefile representing the site boundaries of CA-SDI-9595. Then, using ET Geo Wizard for ArcGIS, I converted the CA-SDI-9595 polygon into a point shapefile in which the point was placed at the center of the site. From that point, I used the viewshed function to determine what areas could be seen from CA-SDI-9595. If the view from CA-SDI-9595 is suitable for monitoring movement, perhaps the area was used as an observation stand.

Following HBE principles, specifically central place foraging theory, I analyzed the spatial relationships between the locations of different types of contemporary sites. I copied all of the sites that are within (or intersect) the boundary of the study area from the SCIC Trinomial shapefile. I used the copied site data to create a new shapefile named “Thesis_Sites” referenced to the same coordinate system as the Trinomial shapefile (North American Datum of 1927, Albers projection). The following columns were then added to the attribute table of the “Thesis_Sites” shapefile:

- site type (as described above)
- presence of FAR
- number of FAR features
- radiocarbon dates
- general phase of prehistory (Paleo-Indian, Archaic, or Late Prehistoric)

As discussed in the introduction to this thesis, many site records that were written in the 1960s and 1970s offer very little information regarding quantities, forms, interpretations of FAR features, or radiocarbon dates. For sites where FAR features were noted, but not quantified, it is assumed that there were at least two features present. Therefore, at sites
where the number of features is not recorded, I have assigned a quantity of one to the
“number of FAR features” column in the attribute table.

Only 24 of the sites in the study area have been radiocarbon dated. However, 41 of
the sites were assigned a relative age by the archaeologists that recorded them. The
relative ages described in the site forms were typically based upon artifact assemblages
considered to be diagnostic of the San Dieguito, La Jolla, and Late-Prehistoric cultural
traditions.

Based upon the absolute dates and relative ages recorded in the site forms, I
assigned codes to all 65 sites representing the general phase of prehistory for each site.
The following cultural phase intervals (Table 2) were derived from Morratto (2004:146) and
applied to the “Thesis_Sites” shapefile:

<table>
<thead>
<tr>
<th>Before Present</th>
<th>Culture</th>
<th>Phase</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000-7500</td>
<td>San Dieguito</td>
<td>Paleo-Indian</td>
<td>PI</td>
</tr>
<tr>
<td>7500-1200</td>
<td>La Jolla</td>
<td>Archaic</td>
<td>AC</td>
</tr>
<tr>
<td>1200-Contact</td>
<td>Yuman</td>
<td>Late Prehistoric</td>
<td>LP</td>
</tr>
</tbody>
</table>

Of course, some of the sites in the study area are transitional between cultural
phases. These transitional sites were interpreted as such from a range of radiocarbon dates
from different cultural items recovered on-site, or from artifact assemblages that were
considered by previous archaeologists to represent multiple cultural horizons. To address
complications related to site chronology, analyses of site locations were based upon cultural
components. For example, a site that dates to both the Paleo-Indian phase and Archaic
phase was analyzed as being contemporaneous with all other Paleo-Indian sites, as well as
all other Archaic sites, not just all other sites that were transitional between the two phases.
The addition of these attributes to the “Thesis_Sites” shapefile facilitated several spatial analyses. First, I performed a simple cluster analysis to determine if the FAR features are grouped near vegetal resources, particularly Torrey Pines. This was accomplished by selecting all sites with FAR features from the “Thesis_Sites” shapefile, and exporting them to a new shapefile named “Thesis_Sites_FAR.” Then, I set the symbology of the FAR shapefile to display bar charts for each site. The bar charts represent the percentage of the total number of FAR features in the study area. The “Thesis_Veg” shapefile was then added to the GIS to determine if greater densities of FAR features are grouped near particular vegetal resources.

As discussed in Chapter 2, a basic premise of CPF theory is that foragers will exploit resources that require the least energy expenditure while maximizing energy intake (Kennett 2005). Therefore, sites where resource processing was the primary (if not only) activity should be easily accessed from logistically located habitation sites. As described by Bettinger et al. (1997:895) and Binford (1982:7), the average daily foraging radius is within a two-hour walk of the residential base. Assuming a walking speed of five kilometers per hour, the average daily foraging radius from a central place (a habitation site) should be 10 kilometers (Bettinger et al. 1997:895; Binford 1982:7). On its longest axis, the study area is 14.5 kilometers from northwest to southeast. Therefore, there should be sites located within the study area that are within the daily foraging range of known habitation sites.

In order to analyze the accessibility of resource processing sites in relation to habitation sites, a series of calculations were performed using the spatial analyst extension for ArcGIS 9.1. These analyses loosely follow methodologies described by Reddy and Brewster (1999) for creating a predictive model of archaeological sites at Camp Pendleton. However, I have somewhat modified their methodologies for the current analyses, applying a more conservative approach to the spatial data, and omitting any predictive interpretations.
First, I created shapefiles representing all habitation sites for each phase of prehistory in the study area. Many of the habitation sites were occupied during more than one phase. Therefore, shapefiles were created for Paleo-Indian/Archaic, Archaic, Archaic/Late-Prehistoric, and Late-Prehistoric habitation sites. Then, I calculated the degree of slope within the study area. Next, I created distance measurements to every habitation site for each phase of prehistory. Then, I used the cell statistics function to create a map that represents which sites are most easily accessed from habitation sites. Finally, I compared the locations of all non-habitation sites to the accessibility map in order to determine which sites were most easily reached from contemporaneous habitation sites. Figures 5 through 9 (pp. 46, 47, and 49) provide examples of the different types of rasters created for this analysis.

A digital elevation model (DEM) is the basis for this analysis of the physical landscape (Figure 5). The DEM used in this thesis was downloaded from SANDAG, but was originally created by the San Diego State University Department of Geography in the 1970s. Graduate students created the elevation grid (commonly referred to as a raster) for San Diego County by referencing USGS 7.5-minute Quadrangle elevation contours. Each cell within the grid measures 10 square meters (10 m²), and has been assigned a value that represents its elevation in feet (San Diego Association of Governments 2005). Longley et al. (2001:288) consider the digital elevation model to be the most useful representation of terrain in a GIS. Since every cell within the grid is assigned a numerical value, a GIS can process several statistical analyses by comparing individual cell values (ESRI 2004).

First, I created a degree of slope raster from the DEM. For this type of analysis, the GIS calculates the rate of change in elevation between a cell and its eight surrounding neighbors (Figure 6). The result is a new grid covering the entire study area. Every 10 m² cell in the raster is assigned a value that represents its slope in degrees.
Cost surface analysis (Figure 7), also referred to as cost weighted distance mapping, defines the least accumulative cost from one location to a defined source in a GIS (ESRI 2004a:126). Applying this type of measurement “provides a more relevant and accurate reflection of the effort which prehistoric populations had to expend to obtain a given resource” (Duncan and Beckman 2000:42). For this analysis, slope is considered to effect energy expenditure. Following this logic, I calculated the cost weighted distance from every cell in the study area to every habitation site based on the degree of slope. The result is a raster in which every 10 m² cell is assigned an abstract value representing its cost-weighted distance to habitation sites. I repeated this process for all of the habitation sites in each phase of prehistory, thus creating three cost weighted distance rasters.

Although cost surfaces offer a more accurate representation of how people may have moved through the landscape, straight line distance should also be considered
(Figure 8). A cost surface based upon slope will have similar values for all cells that occupy a relatively level plain. Over this hypothetical plain, the GIS will assign the same value to a cell that is immediately adjacent to a source (in this case a habitation site) as a cell that is several kilometers away. Therefore, in an attempt to avoid this misrepresentation, I calculated the straight line distance to every habitation site for each phase of prehistory. The GIS assigns a value that represents distance in meters to every 10 m² cell in the grid. I symbolized the straight line rasters by dividing distance values into 1,000-meter intervals.

![Figure 7. Example of a cost distance raster to a river, based upon degree of slope, and classified into five equal intervals.](image)

![Figure 8. Example of a straight line distance raster to a river classified into five equal intervals.](image)

In order to make the cost weighted and straight line distance measurements compatible, I had to reclassify each raster. I assigned values representing distance in kilometers from habitation sites for all three straight line distance rasters. The cost weighted
distance rasters were reclassified into equal intervals based on the greatest straight line distance between contemporaneous habitation sites. For example, none of the Archaic habitation sites were more than four kilometers apart. In order to combine the Archaic distance rasters, I reclassified the cost weighted distance into four equal intervals. This was done to facilitate the use of the cell-statistics function to calculate the mean value of every cell in the cost weighted and straight line distance rasters (Figure 9). The final product is a raster in which every 10m² cell is assigned a value representing its relative level of accessibility from habitation sites, based upon the mean of the cost weighted and straight line distance rasters. This calculation was computed for each phase of prehistory analyzed, resulting in three “accessibility” rasters.

Finally, I used the zonal statistics function to address the temporal and spatial relationships of features and sites. The locations of contemporaneous non-habitation sites were compared to the accessibility rasters to determine the quantities and types of sites that were easily reached from contemporaneous central places.

By performing the multiple spatial analyses described above, patterns of site and feature locations in time and space become apparent. These patterns, when considered in conjunction with the results of the excavation and ethnobotanical analyses, should provide a better understanding of the prehistoric cultural landscape in San Diego County.
Figure 9. Example of a raster representing the average cost distance and straight distance to a river.
CHAPTER 4

RESULTS AND DISCUSSION

This thesis employs archaeological and geospatial techniques to attempt to reveal the functions of FAR features at Torrey Pines State Reserve, and to explore possible temporal and spatial relationships of these features. The results of these investigations are presented in this chapter in the following order.

First, I describe the results of the archaeological field work conducted by San Diego State University at CA-SDI-9595. This discussion is divided into the results of the pedestrian survey, and the results of excavations at Features D and F. Quantities, weights, material types, and artifact types of each category of cultural item recorded during the survey and recovered from the excavations at Features D and F are described in detail.

Then, I present the results of the spatial analyses performed using ArcGIS 9.0 and 9.1. I begin reviewing these results by describing the spatial relationships between FAR features and vegetation communities. Then I describe the results of the viewshed analysis, which was performed in order to determine if CA-SDI-9595 was used as a lookout, or for signaling. Finally, I describe the results of the temporal and spatial analyses of different types of sites throughout the study area. By examining site record forms on file at the South Coastal Information Center, I assigned sites in the study area to three major phases of San Diego prehistory: Paleo-Indian, Archaic, or Late-Prehistoric. Using ArcGIS Spatial Analyst, I created rasters representing the most accessible areas from habitation sites in the study area. Three rasters were created; one for each phase of prehistory. Non-habitation sites were added to the analysis in order to determine if spatial patterns regarding the accessibility of resource processing sites from contemporaneous habitation sites changed.
over time. This temporal and geospatial analysis was accomplished following Central Place Foraging theory in an attempt to reveal patterns regarding use of the landscape in coastal areas of prehistoric San Diego County.

After describing the results of each of the archaeological and geospatial investigations, I discuss my interpretations. In this discussion, I follow multiple lines of evidence in an attempt to reveal the possible functions of FAR features at Torrey Pines State Reserve. Also, following Human Behavioral Ecology and Central Place Foraging theories, I discuss the spatial and temporal relationships of sites in the study area. When considered from the perspective of Central Place Foraging theory, the geospatial relationships of these sites may support interpretations of the functions of the FAR features. The discussion is presented in the same order as the results section.

Survey Results

The pedestrian survey at CA-SDI-9595 resulted in the recordation of three new features and 29 surface artifacts. The site boundaries were expanded slightly to include the additional artifacts and features. Among the cultural items recorded were three possible metate fragments, five cores of various materials, five manos, two flakes, one possible pestle, and several individual pieces of FAR. The locations of all GPS points recorded during the 2006 survey are shown in relation to the new, expanded site boundary in Figure 10.

Excavation Results

During the spring of 2006, students from San Diego State University under the direction of Dr. Lynn Gamble excavated Features D and F at CA-SDI-9595. Feature D was a very broad, but shallow concentration of fire-altered cobbles, surrounded by very dark soils with dense concentrations of charcoal and a burnt clay surface. Feature F was a much
Figure 10. Features and artifacts recorded at CA-SDI-9595 during the 2006 archaeological field school.
smaller jumble of fire-altered rocks, with relatively lighter concentrations of carbonized materials. Soils from Feature F were also lighter in color than soils from Feature D. Neither Feature appeared to have any discernable structural form.

Excavations at both features resulted in a total of 14 carbon rich flotation samples, and the recovery of over 150 charcoal samples recorded in situ. Figure 11 displays the total weights for each type of cultural item excavated. The artifact catalog generated from this excavation is available in the Appendix.

![Figure 11. All artifacts recovered during 2006 San Diego State University excavations at CA-SDI-9595.](image)

Ten soil samples (48.8 L) were submitted to the Cotsen Institute of Archaeology at the University of California, Los Angeles for macrobotanical analysis. Soil samples were selected based upon provenience and the presence of high densities of carbonized
material. The provenience and volume of the soil samples submitted for macrobotanical analysis is presented in Table 3.

Table 3. Provenience and Volume of Soil Samples Submitted to the Cotsen Institute of Archaeology at the University of California, Los Angeles, for Macrobotanical Analysis

<table>
<thead>
<tr>
<th>UCLA Lab Accession #</th>
<th>Sample Provenience</th>
<th>Volume (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4248</td>
<td>Feature D/Unit 5 East Half/10-20</td>
<td>3.8</td>
</tr>
<tr>
<td>4246</td>
<td>Feature D/Unit 6 West Half/10-20</td>
<td>3.8</td>
</tr>
<tr>
<td>4247</td>
<td>Feature D/Unit 8/10-20</td>
<td>4.6</td>
</tr>
<tr>
<td>4243</td>
<td>Feature D/Unit 9/0-10</td>
<td>5.6</td>
</tr>
<tr>
<td>4251</td>
<td>Feature D/Unit 10/10-20</td>
<td>8.0</td>
</tr>
<tr>
<td>4244</td>
<td>Feature D/Unit 13/0-10</td>
<td>5.0</td>
</tr>
<tr>
<td>4245</td>
<td>Feature D/Unit 14/4-10/4-8-2006</td>
<td>8.0</td>
</tr>
<tr>
<td>4252</td>
<td>Feature D/Unit 14/10-20</td>
<td>2.8</td>
</tr>
<tr>
<td>4249</td>
<td>Feature D/Unit 14/10-20/Feature Soil</td>
<td>2.8</td>
</tr>
<tr>
<td>4250</td>
<td>Feature F/Unit 7 North Half/10-20</td>
<td>4.4</td>
</tr>
</tbody>
</table>

All excavated fire-affected rock was identified by material type and weighed, either in the field, or in the laboratory. Students of the field class were instructed to collect any possible groundstone artifacts. Closer inspection of these artifacts at the San Diego State University Laboratory for North American Archaeology resulted in the classification of many of the possible groundstone artifacts as merely fire-affected rock, and therefore cataloged as such. All artifacts and cultural items excavated from each feature are described in detail in the following pages.

Feature D

Excavations at Feature D revealed a large concentration of fire-affected rock and charcoal measuring approximately four meters in diameter on the surface and only 20 to 25 centimeters below the surface (Figure 12). Soils at Feature D were light brown, friable sandy loam on the surface, over a layer of dark brown to nearly black sandy loam within the
feature. The dark soils were present just below the surface, and between the fire-affected rocks throughout the feature. The greatest concentrations of blackened material was in what appeared to be the approximate center of the feature, in Test Units 9, 10, 13 and 14 (Figure 13). A profile of the east wall of Test Units 10 and 14, from 10 to 20 centimeters below the surface of the excavation is displayed in Figure 14.

Figure 12. Feature D overview, facing north.
Figure 13. Center of Feature D facing south.

Figure 14. Profile of east wall of Test Units 10 and 14.
FIRE-AFFECTED ROCK

Two hundred thirty-seven pieces of fire-affected rock were excavated from Feature D. Most of the fire-altered rocks excavated (49%, n=116) were igneous, weighing a total of 28,559.9 grams. Quartzite was the second most commonly identified material (10%, n=24), followed by metamorphic (3%, n=7), sandstone (2%, n=5), and metavolcanic materials (.4%, n=1). Many of the fire-affected rocks were intact, making material identification extremely difficult. Therefore, for 35% (n=84) of the cataloged FAR, material type is unknown.

Each of these materials is found in abundance at Torrey Pines State Reserve. The total weights and quantities of all FAR materials excavated from Feature D are displayed in Figure 15.

![Figure 15. All fire-affected rock materials excavated from Feature D by weight and quantity.](image)

As described above, students were instructed to collect any possible groundstone artifacts. Upon closer inspection in the laboratory after cleaning, 140 of the possible groundstone artifacts were determined to be merely fire-affected rock. Examination of these
fire-affected rocks in a laboratory setting facilitated the recordation of greater details regarding the degree of fire alteration on several of the rocks. Whenever discernable, these details were recorded following the descriptions offered by Gallegos and colleagues (1999:3-89), as reviewed in Chapter 2 of this thesis.

Discoloration was the primary indication used to determine that a rock had been affected by fire. Eleven of the fire-affected rocks excavated from Feature D and examined in the laboratory displayed other characteristics that indicate varying degrees of exposure to heat. Of those 11, 64% (n=7) were pocked, 18% (n=2), one was crazed, and one was spalled. The fire-affected rocks in Feature D do not appear to have been placed in any particular order. Size, shape, or material types do not appear to have dictated their placement.

Baked clay was present below the layers of dark soils, charcoal concentrations, and fire-affected rocks in Feature D. Baked clay and oxidized soils have been identified in other archaeological contexts in Southern California (King 1993; King et al. 1982), and has been described as being resultant of heat generated from fires burned within FAR features. The hardened clay was most prevalent at the eastern edge of the feature, in the southeastern corner of Test Unit 6 (Figure 16). Small patches of baked clay were also present at 20 cm below datum in Test Units 10 and 14.

GROUNDSTONE

In total, 15 pieces of groundstone and possible groundstone were recovered from Feature D, 9 of which were fire-affected. One possible metate fragment had a heat rind, and one possible groundstone fragment was pocked. Almost all of the groundstone artifacts excavated from Feature D displayed only minor evidence of grinding, often only discernable in the presence of broad, relatively smooth surfaces as compared to the rough edges of the
cobbles. The groundstone artifacts were not intentionally shaped, did not have prominent shoulders, and no pecking was evident, indicating that they were not frequently reused.

Quartzite was the most common material identified (53%, n=8), followed by igneous (13%, n=2) and metavolcanic (7%, n=1). Each of these materials is locally available within Torrey Pines State Reserve. The material types of four (27%) of the excavated groundstone fragments were not identifiable. Groundstone artifact types recovered from Feature D are shown in Figure 17.

Figure 16. Test Unit 6, 0-20 cm facing north. Baked clay was exposed in the southeastern corner of the test unit.
Figure 17. All groundstone artifacts excavated from Feature D by weight and quantity.

CHIPPED STONE

Thirty chipped stone artifacts were recovered from Feature D. Twenty-two of the chipped stone artifacts were flakes, while the remaining eight pieces were identified as shatter. Another four pieces of possible chipped stone were recovered as well. No tools were recovered, nor did any of the chipped stone flakes appear to have any indications of utilization when viewed under 10x magnification. All of the chipped stone lithic materials are available locally, and may have come from a quarry site (CA-SDI-15557) approximately 150 meters northwest of CA-SDI-9595. Hundreds of large quartzite and igneous cobbles litter the surface of CA-SDI-15557 and were apparently used to manufacture chipped stone artifacts (Gamble 2002: 4-5). The distribution of chipped stone material types is presented in Figure 18.
Figure 18. Chipped stone artifact materials excavated from Feature D by weight and quantity.

CHARCOAL

A total of 355.8 grams of charcoal was excavated from Feature D. The weights and percentages of charcoal that was collected either in situ, from the screen, or from the flotation analysis, is presented in Figure 19. Figure 20 depicts the weights and percentages of charcoal excavated from each test unit at Feature D. The light grey columns represent the weight of the charcoal; the dark grey columns represent the percentage of the total charcoal recovered. A total of 114 charcoal samples with precise provenience were collected.

Figure 19. Weights and percentages of all charcoal recovered from Feature D.
Figure 20. Weights and percentages of all charcoal recovered from each test unit at Feature D.
Following the decanting procedure, soil flotation was performed on nine soil samples (Table 3) at the Paleoethnobotany Laboratory at the Cotsen Institute of Archaeology at the University of California, Los Angeles, under the direction of Dr. Virginia Popper. Both the light and heavy fractions produced during the flotation were examined for the presence of carbonized materials. Botanical evidence recovered from Feature D included seeds, high densities of charcoal, but relatively few different species. Wood charcoal dominated the botanical remains with a total weight of 136.99 grams, 13.79 grams of which were identifiable (Popper 2006). Wood charcoal weights and quantities per taxa are displayed in Figure 21.

![Feature D Wood Charcoal by Weight and Quantity](image)

**Figure 21.** Weights and quantities of wood charcoal from Feature D identified by macrobotanical analysis of soil samples.

A total of 101 seeds and seed fragments were identified, 96 of which were *Adenostoma* sp. (chamise). The remaining five were too fragmentary or distorted to identify. Forty-six leaf fragments also identified as *Adenostoma* sp. were recovered from Feature D as well (Popper 2006). Carbonized plant materials by volume are presented in Figure 22.
While dry-screening material from the west half of Test Unit 6 from a depth of 10 to 20 centimeters, one half of a Torrey Pine nutshell was recovered. This provenience places the pine nutshell in direct association with an undisturbed portion of Feature D. The shell was cracked in half along the seam, and fractured at the narrow end. Two other Torrey Pine nutshell fragments, also fractured along the seam, were recovered while dry-screening the 0-10 level of the east half of Test Unit 5. Since these nutshell fragments were collected in the field, they were not officially submitted to the Cotsen Institute of Archaeology for analysis. However, one of the nut shell fragments from Test Unit 5, and the nut shell fragment from Test Unit 6 were informally identified by Dr. Popper as Torrey Pine nut shells. All three of the Torrey Pine nutshell fragments were sent to Dr. Eric Wohlgemuth at Far Western Anthropological Research Group in Davis, California, in order to determine if the shell fragments were carbonized. None of the Torrey Pine nutshell fragments were carbonized, and therefore, their presence in Feature D is most likely due to natural causes (Eric Wohlgemuth, Ph.D., personal communication, March 14, 2007).
**Radiocarbon Analysis**

Four of the 114 charcoal samples collected from Feature D were selected for radiocarbon dating, but due to a lack of funding, only two were analyzed. As described in Chapter 3, radiocarbon samples were chosen based upon provenience and size. Only the largest pieces of charcoal were selected for radiocarbon analysis, and, whenever possible, only single pieces of charcoal were submitted. Also, each radiocarbon sample was also identified by Dr. Popper at the Cotsen Institute of Archaeology at the University of California, Los Angeles. Radiocarbon dating was performed by Beta Analytic Inc. in Miami, Florida. All charcoal samples submitted to Beta Analytic Inc. from Feature D are displayed in Table 4.

**Table 4. All Feature D Charcoal Samples Submitted for Radiocarbon Dating**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Unit</th>
<th>Sample #</th>
<th>Carbon Type</th>
<th>Depth Below Datum (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>6</td>
<td>7</td>
<td><em>Adenostoma fasciculatum</em> and <em>Ceanothus</em> sp. charcoal</td>
<td>15</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
<td>17</td>
<td><em>Ceanothus</em> sp. charcoal</td>
<td>11</td>
</tr>
<tr>
<td>D</td>
<td>14</td>
<td>5</td>
<td><em>Adenostoma fasciculatum</em> and <em>Ceanothus</em> sp. charcoal</td>
<td>6</td>
</tr>
<tr>
<td>D</td>
<td>14</td>
<td>8</td>
<td><em>Rhamnus</em> sp. charcoal</td>
<td>8</td>
</tr>
</tbody>
</table>

Beta Analytic, Inc. provided AMS dates for two of the charcoal samples listed above. The calibrated dates for each sample, listed by conventional radiocarbon age and 2 Sigma calibrated age (95% probability), are displayed in Table 5.

**Feature F**

Feature F measured approximately one and a half meters in diameter on the surface, and approximately twenty centimeters from the surface to sterile soil at the bottom of the feature. Soil from Feature F was a fine sandy loam that was light brownish red in color with inclusions of charcoal. Charcoal concentrations were densest in the northeast
Table 5. Calibrated Radiocarbon Dates of Charcoal Samples Collected from Feature D

<table>
<thead>
<tr>
<th>Beta Analytic Laboratory No.</th>
<th>Feature</th>
<th>Unit</th>
<th>Sample #</th>
<th>Depth</th>
<th>Conventional Age</th>
<th>2 Sigma Calibrated Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta - 217807</td>
<td>D</td>
<td>6</td>
<td>7</td>
<td>15 cm bd</td>
<td>1190±50 BP</td>
<td>Cal AD 700 to 900 (Cal BP 1250 to 970)</td>
</tr>
<tr>
<td>Beta - 217808</td>
<td>D</td>
<td>10</td>
<td>17</td>
<td>11 cm bd</td>
<td>830 ±50 BP</td>
<td>Cal AD 1050 to 1100 (Cal BP 900 to 850) and Cal AD 1140 to 1280 (Cal BP 810 to 670)</td>
</tr>
</tbody>
</table>
corner of Test Unit 7. Similar to Feature D, though much smaller, Feature F had no defined structural form; it appears to be a small concentration of fire-affected rocks. Soils from Feature F were generally lighter in color, and contained less carbonized materials than soils from Feature D. Also, no burned clay was noted below Feature F. Feature F is shown prior to excavation in Figure 23. Figure 24 is a plan drawing of Feature F, Test Unit 7, from 0-20 cm below datum.

Figure 23. Feature F, Unit 7 south half prior to excavation.
FIRE-AFFECTED ROCK

In total, 76 pieces of FAR were excavated from Feature F. The most common material identified was igneous (60%, n=45), followed by sandstone (18%, n=14), quartzite (13%, n=10), quartz (1%, n=1) and metamorphic (1%, n=1). Only two pieces of FAR were unidentifiable. Again, each of these materials is found in abundance at Torrey Pines State Reserve. The total weights and quantities of all FAR materials excavated from Feature F are displayed in Figure 25.

Like Feature D, 11 pieces of FAR, examined in the laboratory, displayed varying degrees of exposure to heat. However, the great majority (82%, n=9) of the FAR from Feature F had a heat rind. Of the remaining two pieces of FAR, one was crazed, while the other was pocked. Similar to Feature D, the fire-affected rocks in Feature F did not appear
to have been placed in any particular order. Size, shape, or material types do not appear to have dictated their placement either.

**Figure 25. All fire-affected rock materials excavated from Feature F by weight and quantity.**

**GROUNDSTONE**

A total of six pieces of groundstone and possible groundstone were recovered from Feature F, all of which were fire-affected. One whole mano and one possible fragment had heat rinds. Material types of three of the artifacts were identified as igneous, two were identified as quartzite, and one was identified as metamorphic. Counts and weights of groundstone from Feature F are presented in Figure 26.

**CHIPPED STONE**

Eleven chipped stone artifacts were recovered from Feature D. Nine of these were flakes, while the remaining two artifacts were identified as shatter. Two other fragments of
possible chipped stone were recovered as well. One of the possible chipped stone artifacts was identified as a possible igneous core, and one was identified as an igneous flake. None of the chipped stone appeared to have any indications of utilization when viewed under 10x magnification. The weights and counts of chipped stone material types are presented in Figure 27.

Figure 26. All groundstone artifacts excavated from Feature F by weight and quantity.

Figure 27. Chipped stone artifact materials excavated from Feature F by weight and quantity.
CHARCOAL

A total of 17.8 grams of charcoal was excavated from Feature F. The weights and percentages of charcoal that was collected either in situ, from the screen, or from the flotation analysis are presented in Figure 28. Figure 29 depicts the weights and percentages of charcoal excavated from each test unit at Feature F. The light grey columns represent the weight of the charcoal; the dark grey columns represent the percentage of the total charcoal recovered from Feature F.

![Weights and Percentages of Charcoal Recovered from Feature F]

**Figure 28. Weights and percentages of charcoal recovered from Feature F.**

Under the direction of Dr. Virginia Popper, soil flotation was performed on one soil sample (Table 3) at the Cotsen Institute of Archaeology at the University of California, Los Angeles. Both the light and heavy fractions produced during the flotation were examined for the presence of carbonized materials. Very few botanical remains were recovered from Feature F. Only two leaf fragments and 1.38 grams of wood were recovered. Of the 1.38 grams of wood, 20 pieces were identifiable (Popper 2006). Weights and quantities of carbonized materials recovered from Feature F are displayed in Figure 30 (p. 73).
Figure 29. Weights and percentages of charcoal recovered from each test unit at Feature F.
Figure 30. Weights and quantities of wood charcoal from Feature F identified by macrobotanical analysis of soil samples.

**Radiocarbon Analysis**

Five charcoal samples with sound provenience were collected for radiocarbon dating, one of which was submitted to Beta Analytic Inc. As described above, radiocarbon samples were chosen based upon provenience, and size. Only the largest pieces of charcoal were selected, and, whenever possible, only single pieces of charcoal were submitted for radiocarbon analysis. Also, each radiocarbon sample was identified by Dr. Popper at the Cotsen Institute of Archaeology at the University of California, Los Angeles. Radiocarbon dating was performed by Beta Analytic Inc. in Miami, Florida. An AMS date was provided for Unit 7, charcoal sample number 5 (an unidentifiable piece of charcoal), which was collected at 14 cm below datum. The sample was dated to a conventional radiocarbon age of 830±40 B.P. The 2 Sigma calibrated result for the same sample is Cal AD 1160 to 1270 (Cal B.P. 790-680).
**Spatial Analyses Results**

Site locations where FAR features have been recorded were compared to the locations of vegetation communities that were ethnographically exploited by the Kumeyaay.

**Relationships Between Site Locations and Vegetation Communities**

Plant resources, as well as their Kumeyaay names and uses (Hedges and Beresford 1986; Shipek 1991), are displayed by vegetation community in Tables 6 through 13 (pp. 75-77). The data in these tables only applies to vegetation communities within the study area; the Kumeyaay collected resources from many other vegetation communities throughout San Diego and Imperial Counties, as well as Baja California. Locations of vegetation communities within open space reserves in the study area are displayed in Figure 31 (p. 78). Locations of sites where FAR features have been recorded are shown in Figures 32 through 34 (pp. 79-81). In Figures 32 through 34, bar graphs at each site location represent a percentage of the total FAR features in the study, while callout figures are the actual number of FAR features recorded at each site. As seen in Figures 33 and 34, FAR features in the study area are densely concentrated near Torrey Pine Forests and Southern Maritime Chaparral.

Eight vegetation communities exploited by the Kumeyaay are located in the study area, and all eight communities contained sites where FAR features are recorded (Figure 35, p. 82). The greatest number of sites (43%, n=38) are located within Southern Maritime Chaparral communities, followed by Torrey Pine Forests (19%, n=7), and Diegan Coastal Sage Scrub (16%, n=15). Southern Maritime Chaparral communities occupy larger areas than any other vegetation communities in the study area. Therefore, I calculated the density of features per vegetation community by dividing the number of FAR features within each community by the total area of each vegetation community (Figure 36, p. 83).
### Table 6. Kumeyaay Resources Within Diegan Coastal Sage Scrub Communities  
(Based on Hedges and Beresford, 1986, and Shipek, 1991)

<table>
<thead>
<tr>
<th>Botanical Resources Exploited</th>
<th>Common Name</th>
<th>Kumeyaay Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artemisia californica</td>
<td>Sage</td>
<td>Kuchash</td>
<td>Medicine</td>
</tr>
<tr>
<td>Atriplex californica</td>
<td>Saltbush</td>
<td>Nahekwi</td>
<td>Medicine</td>
</tr>
<tr>
<td>Encelia californica</td>
<td>Sunflower</td>
<td>Hamill</td>
<td>Unknown</td>
</tr>
<tr>
<td>Eriodictyon trichocalyx</td>
<td>Yerba Santa</td>
<td>Meshkatull</td>
<td>Beverage, Medicine</td>
</tr>
<tr>
<td>Eriogonum fasciculatum</td>
<td>Buckwheat</td>
<td>Mellat</td>
<td>Medicine</td>
</tr>
<tr>
<td>Eriophyllum confertiflorum</td>
<td>Golden Yarrow</td>
<td>Huusill, Huutat</td>
<td>Beverage, Food, Medicine</td>
</tr>
<tr>
<td>Mirabilis californica</td>
<td>Four O’clock</td>
<td>Pestaay</td>
<td>Food</td>
</tr>
<tr>
<td>Opuntia occidentals</td>
<td>Prickly Pear</td>
<td>Millikumaay</td>
<td>Food</td>
</tr>
<tr>
<td>Rhamnus californica</td>
<td>Coffeeberry</td>
<td>Huusill</td>
<td>Medicine</td>
</tr>
<tr>
<td>Rhus integrifolia</td>
<td>Lemonadeberry</td>
<td>Huusill, Huutat</td>
<td>Beverage, Food, Medicine</td>
</tr>
<tr>
<td>Salvia apiana</td>
<td>White Sage</td>
<td>Pestaay</td>
<td>Food</td>
</tr>
<tr>
<td>Salvia melliflora</td>
<td>Black Sage</td>
<td>Ha’anya yul</td>
<td>Medicine</td>
</tr>
<tr>
<td>Yucca whipplei</td>
<td>Yucca</td>
<td></td>
<td>Food, Medicine</td>
</tr>
</tbody>
</table>

### Table 7. Kumeyaay Resources Within Maritime Succulent Scrub Communities (Based on Hedges and Beresford, 1986, and Shipek, 1991)

<table>
<thead>
<tr>
<th>Botanical Resources Exploited</th>
<th>Common Name</th>
<th>Kumeyaay Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhus integrifolia</td>
<td>Lemonadeberry</td>
<td>Huusill, Huutat</td>
<td>Beverage, Food, Medicine</td>
</tr>
<tr>
<td>Encelia californica</td>
<td>Sunflower</td>
<td>Nahekwi</td>
<td>Unknown</td>
</tr>
<tr>
<td>Dudleya edulis</td>
<td>Dudleya</td>
<td>Millykumil</td>
<td>Food</td>
</tr>
<tr>
<td>Dudleya lanceolata</td>
<td>Dydketa</td>
<td>Miltikumaay</td>
<td>Food</td>
</tr>
<tr>
<td>Opuntia occidentals</td>
<td>Prickly Pear</td>
<td>Mellat</td>
<td>Food</td>
</tr>
</tbody>
</table>

### Table 8. Kumeyaay Resources Within Southern Coastal Scrub Bluff Communities  
(Based on Hedges and Beresford, 1986, and Shipek, 1991)

<table>
<thead>
<tr>
<th>Botanical Resources Exploited</th>
<th>Common Name</th>
<th>Kumeyaay Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artemisia californica</td>
<td>Sage</td>
<td>Kuchash</td>
<td>Medicine</td>
</tr>
<tr>
<td>Eriogonum fasciculatum</td>
<td>Buckwheat</td>
<td>Hamill</td>
<td>Beverage, Medicine</td>
</tr>
<tr>
<td>Eriophyllum confertiflorum</td>
<td>Golden Yarrow</td>
<td>Chanewan</td>
<td>Medicine</td>
</tr>
</tbody>
</table>
Table 9. Kumeyaay Resources Within Southern Coastal Salt Marsh Communities (Based on Hedges and Beresford, 1986, and Shipek, 1991)

<table>
<thead>
<tr>
<th>Botanical Resources Exploited</th>
<th>Common Name</th>
<th>Kumeyaay Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atriplex californica</td>
<td>Saltbush</td>
<td>Millykami</td>
<td>Medicine</td>
</tr>
<tr>
<td>Batis maritima</td>
<td>Saltwort</td>
<td>Haakwal pehaa</td>
<td>Unknown</td>
</tr>
<tr>
<td>Cuscuta salina</td>
<td>Dodder</td>
<td>Chayaaw</td>
<td>Medicine</td>
</tr>
<tr>
<td>Distichlis spicata</td>
<td>Salt Grass</td>
<td></td>
<td>Food</td>
</tr>
<tr>
<td>Frankenia grandifolia</td>
<td>Frankenia</td>
<td></td>
<td>Medicine</td>
</tr>
<tr>
<td>Jaumea carnosa</td>
<td>Fleshy Jaumea</td>
<td></td>
<td>Food, Medicine</td>
</tr>
<tr>
<td>Limonium californicum</td>
<td>Sea-Lavender</td>
<td></td>
<td>Medicine</td>
</tr>
<tr>
<td>Salicornica pacifica</td>
<td>Glasswort</td>
<td>Semull</td>
<td>Food</td>
</tr>
<tr>
<td>Salicornica virginica</td>
<td>Glasswort</td>
<td>Semull</td>
<td>Food</td>
</tr>
<tr>
<td>Spartina foliosa</td>
<td>Marsh Grass</td>
<td>Tapish</td>
<td>Medicine, Utility</td>
</tr>
</tbody>
</table>

Table 10. Kumeyaay Resources Within Southern Maritime Chaparral Communities (Based on Hedges and Beresford, 1986, and Shipek, 1991)

<table>
<thead>
<tr>
<th>Botanical Resources Exploited</th>
<th>Common Name</th>
<th>Kumeyaay Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenostoma fasciculatum</td>
<td>Chamise, Greasewood</td>
<td>Hamuchi</td>
<td>Unknown</td>
</tr>
<tr>
<td>Ceanothus leucodermis</td>
<td>Wild Lilac</td>
<td>‘Ipewii</td>
<td>Medicine, Utility</td>
</tr>
<tr>
<td>Quercus agrifolia</td>
<td>Coast Live Oak</td>
<td>‘Esnyaaw</td>
<td>Food</td>
</tr>
<tr>
<td>Rhamnus californica</td>
<td>Coffeeberry</td>
<td>Inyekhaay</td>
<td>Utility</td>
</tr>
<tr>
<td>Salvia mellifera</td>
<td>Black Sage</td>
<td>Ha’anya yul</td>
<td>Medicine</td>
</tr>
</tbody>
</table>

Table 11. Kumeyaay Resources Within Southern Mixed Chaparral Communities (Based on Hedges and Beresford, 1986, and Shipek, 1991)

<table>
<thead>
<tr>
<th>Botanical Resources Exploited</th>
<th>Common Name</th>
<th>Kumeyaay Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenostoma fasciculatum</td>
<td>Chamise, Greasewood</td>
<td>Hamuchi</td>
<td>Unknown</td>
</tr>
<tr>
<td>Ceanothus leucodermis</td>
<td>Wild Lilac</td>
<td>‘Ipewii</td>
<td>Medicine, Utility</td>
</tr>
<tr>
<td>Heteromeles arbutifolia</td>
<td>Toyon</td>
<td>Huuchih</td>
<td>Food, Medicine</td>
</tr>
<tr>
<td>Prunus ilicifolia</td>
<td>Wild Cherry</td>
<td>‘Etut</td>
<td>Food</td>
</tr>
<tr>
<td>Rhamnus californica</td>
<td>Coffeeberry</td>
<td>Inyekhaay</td>
<td>Utility</td>
</tr>
<tr>
<td>Rhamnus crocea</td>
<td>Redberry</td>
<td>TAT</td>
<td>Utility</td>
</tr>
</tbody>
</table>
Table 12. Kumeyaay Resources Within Torrey Pine Forests (Based on Hedges and Beresford, 1986, and Shipek, 1991)

<table>
<thead>
<tr>
<th>Botanical Resources Exploited</th>
<th>Common Name</th>
<th>Kumeyaay Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pinus torreyana</em></td>
<td>Torrey Pine</td>
<td>‘Ehwiiw’</td>
<td>Food</td>
</tr>
</tbody>
</table>

Table 13. Kumeyaay Resources Within Valley and Foothill Grasslands (Based on Hedges and Beresford, 1986, and Shipek, 1991)

<table>
<thead>
<tr>
<th>Botanical Resources Exploited</th>
<th>Common Name</th>
<th>Kumeyaay Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Avena fatua</em></td>
<td>Wild Oat</td>
<td><em>Nyipaay</em></td>
<td>Food</td>
</tr>
<tr>
<td><em>Cryptantha intermedia</em></td>
<td>Popcorn Flower</td>
<td><em>Shemap</em></td>
<td>Unknown</td>
</tr>
<tr>
<td><em>Hemizonia ramosissima</em></td>
<td>Tarweed</td>
<td><em>Hatuun</em></td>
<td>Medicine</td>
</tr>
<tr>
<td><em>Trifolium</em> sp.</td>
<td>Clover</td>
<td></td>
<td>Food, Medicine</td>
</tr>
</tbody>
</table>

As described in Chapter 3, site records were systematically examined in order to determine site type, if FAR features were present, and how many features had been recorded. Many of the sites were characterized primarily by the presence of fire-altered rock features with relatively few associated artifacts. The 17 sites primarily characterized by the presence of FAR features were also compared to vegetation communities separately. Interestingly, all of these sites were located in Southern Maritime Chaparral, Torrey Pine Forests, or Diegan Coastal Sage Scrub communities (Figure 37, p. 84). Three of the sites were located within more than one vegetation community. Again, to correct for misleading figures based upon the number of sites per vegetation community, I calculated the number of FAR features per square meter in each vegetation community. As seen in Figure 38 (p. 84), FAR features at sites that are primarily characterized by the presence of FAR features are most densely concentrated within Torrey Pine Forests.
Figure 31. Open space vegetation communities within the study area ethnographically exploited by the Kumeyaay.
Figure 32. Densities of FAR features in study area. Bar graphs represent the percentage of the total number of FAR features in the study area. Callout figures are the absolute counts of FAR features at that location.
Figure 33. Detail of densely concentrated FAR features in the northern portion of the study area. Bar graphs represent the percentage of the total number of FAR features in the study area. Callout figures are the absolute counts of FAR features at that location.
Figure 34. Detail of densely concentrated FAR features in the southern portion of the study area. Bar graphs represent the percentage of the total number of FAR features in the study area. Callout figures are the absolute counts of FAR features at that location.
Figure 35. Vegetation communities containing sites with FAR features.
Figure 36. Density of FAR features per vegetation community.
As discussed in Chapter 1, many archaeologists working in the study area prior to the 1960s recorded very little information regarding burned features. Many early site record forms simply note the presence of FAR features, offering no quantification, nor description of their structural qualities. To ensure that the high densities of FAR features recorded in association with Torrey Pine forests are not a reflection of more conservative field techniques recently demonstrated by archaeologists working at the Reserve (Barter 1987; Gamble 2001, 2002; Mealey 2006; Mealey and Jenkins 2003), a nearby archaic habitation site was re-surveyed. Dr. Patricia Masters, Dr. Glenn Russell, Dr. Lynn Gamble, and I re-
surveyed CA-SDI-4670, which is located on a seven-acre mesa, adjacent to the Pacific Ocean in one of the few undeveloped locations within the study area. The site is a major coastal midden that was initially described in 1929 by Malcolm Rogers (Hanna1980:28). Although Rogers did mention the presence of FAR features at CA-SDI-4670, he did not describe their quantities or forms whatsoever (Hanna1980:29). If FAR features were as ubiquitous in the entire study area as they are within Torrey Pine forests, and were simply never recorded, we would have expected to locate dozens of FAR features at CA-SDI-4670. Only one possible FAR feature was identified during this survey. If the features had been destroyed by various activities that occurred on the mesa since 1929, one would still expect to see FAR scattered about the area. Other than the possible FAR feature, no fire-affected rocks were observed. Therefore, I argue that the densities of FAR features recorded at Torrey Pines State Reserve are not a reflection of recent, more conservative site recordation practices.

**Viewshed Analysis of CA-SDI-9595**

Figure 39 displays the results of the viewshed analysis from CA-SDI-9595. Areas shaded in dark grey are not visible from the center of the site, while areas shaded in light grey are visible. As seen in Figure 27, relatively little of the surrounding area can be seen from CA-SDI-9595.

**Accessibility of Non-Habitation Sites from Contemporaneous Habitation Sites**

The greatest straight line distance between Paleo-Indian habitation sites in the study area is five kilometers. Therefore, I classified the accessibility raster into five equal intervals (Figure 40, p. 87). Sites that are within the areas coded as one are within one kilometer, and are easiest to access from habitation sites, based on the degree of slope. Higher codes represent areas that are more distant from Paleo-Indian habitation sites, and are located on
Figure 39. Viewshed analysis of study area from CA-SDI-9595.
Figure 40. Accessibility of non-habitation sites from Paleo-Indian habitation sites. Areas that are white are the most easily accessible, while areas that are black are the most difficult to access.
terrain that is increasingly difficult to traverse. Figure 41 represents the mean accessibility values of the different types of Paleo-Indian sites in the study area. Sites that are located in areas with lower mean scores are more easily accessed from habitation sites than those with higher scores. According to the results of this analysis, it appears that Paleo-Indian peoples would travel relatively long distances over fairly difficult to terrain to access various resources.

More sites in the study area are dated to the Archaic period than the Paleo-Indian and Late-Prehistoric periods. The greatest distance between any two archaic habitation sites is four kilometers, so I coded the accessibility raster into four equal intervals (Figure 42). Figure 43 (p. 90) displays the mean accessibility scores for all Archaic non-habitation sites. The results suggest that most resources, with the exception of chipped stone scatters, were easily accessed by peoples living at Archaic sites.

Habitation sites dating to the Late-Prehistoric period were no more than six kilometers apart, and therefore the accessibility raster was divided into six equal intervals (Figure 44, p. 91). No Late-Prehistoric non-habitation sites are located in areas that score higher than three (Figure 45, p. 92). The results of this spatial analysis suggest that during
Figure 42. Accessibility of non-habitation sites from Archaic habitation sites. Note: Areas that are white are the most easily accessible, while areas that are black are the most difficult to access.
the Late-Prehistoric period, although no resources were difficult to access, bedrock milling features, multiple attribute artifact scatters, and chipped stone quarries were more easily accessed by peoples traveling from centrally located habitation sites.

Figure 43. Mean accessibility scores of non-habitation sites from Archaic habitation sites.

The results of the spatial analyses of contemporaneous sites in the study area indicate that the accessibility of resource processing sites from habitation sites varied through time. According to these results, people living at Paleo-Indian habitation sites would travel over relatively difficult terrain for fairly long distances to access resources. An exception to this statement is the relatively easy access (mean=2.0) to sites primarily characterized by the presence of FAR features. During the Archaic period, all site types are easily accessed, except chipped stone scatters. In the Late-Prehistoric period, bedrock milling features, multiple attribute scatters, and quarries are all easily accessed by people living at centrally located habitation sites. However, chipped stone scatters, fire-affected rock feature sites, and shell middens were somewhat more difficult to access during the Late-Prehistoric phase.
Figure 44. Accessibility of non-habitation sites from Late-Prehistoric habitation sites. Note: Areas that are white are the most easily accessible, while areas that are black are the most difficult to access.
DISCUSSION/INTERPRETATION

CA-SDI-9595 appears to be an area that was used for resource procurement and processing. This is evident in several ways.

Burned Feature Functions

There are 47 fire-affected rock features of varying dimensions that are currently visible on the surface at CA-SDI-9595. There is also a general lack of other artifacts (the quarry site at CA-SDI-15557 is an exception) and food remains associated with these features (Mealey and Jenkins 2003). Perhaps these areas were used for resource procurement and processing by gatherers residing at nearby village sites (Gamble 2001, 2002).

Close examination of the structural forms of the features, as well as the results of the spatial analyses described above, may expose patterns that reveal the functions of FAR features at CA-SDI-9595 and Torrey Pines State Reserve. Mealey (2006) synthesized the forms of 20 (not including Features D and F at CA-SDI-9595) FAR features excavated at Torrey Pines State Reserve. The most frequent type of FAR feature at the Reserve (35%,
n=7 [Mealey 2006:64]) is most similar to what Gallegos and his colleagues (1999:3-92) classified as Type 2. Features D and F at CA-SDI-9595 also resemble the Type 2 feature described by Gallegos and colleagues (1999:3-92) in that they have no definable structure and are less than 30 cm in depth. The majority of the rocks used to construct Features D and F were fairly uniform in size and shape. These rocks were almost certainly collected from the immediate vicinity, as there are fortuitous cobbles present on the surface throughout Torrey Pines State Reserve Extension.

The ambiguous configuration of this type of feature may suggest its frequent reuse for processing resources (Gallegos et al. 1999:3-92; True and True 1992:12). Three charcoal samples excavated from Feature D were radiocarbon dated. The ranges of radiocarbon dates from charcoal collected from within Feature D suggest that the feature was reused at least three times over a period of approximately 600 years. Only one charcoal sample from Feature F was submitted for radiocarbon analysis, and therefore it is difficult to determine if the feature had been used more than once.

It is unlikely that the use of old, dead wood as fuel could have effected the results of the radiocarbon analysis. Even if dead chamise and wild lilac were used as fuel, their branches and trunks are small enough that they decay too rapidly to skew radiocarbon dates. Furthermore, chamise and lilac are easily harvested without the use of tools. Branches are easily broken off using bare hands and feet (King 1993:297). Charcoal samples excavated from deeper within the feature had radiocarbon dates that were earlier than samples collected from levels closer to the surface, suggesting that the feature was not severely disturbed by rodent activity or vandalism. The radiocarbon dates of the charcoal samples do not overlap.

It is possible that the appearance of Features D and F at CA-SDI-9595 could be a result of either cultural or natural transformations. The diameter of Feature D (approximately four meters) is much larger than most other Type 2 features. The broad diameter of
Feature D could be a result of being dismantled after use. However, it is unlikely that they were ever elaborately constructed features. Feature D does not appear to have been built in a pit, and was not lined with larger stones. If Feature D were a dismantled oven, similar in form to the Type 3 ovens described by Gallegos and colleagues (1999:3-94), one would expect to find the larger stones used for lining a sizeable pit. It is most likely that the rocks in Feature D were reused frequently in the vicinity of Test Units 9, 10, and 14, resulting in a very large, but shallow FAR feature.

Also, it is unlikely that erosion caused FAR at Features D and F to migrate downward into their configuration prior to excavation. CA-SDI-9595 is located along a ridge of Torrey sandstone capped by the Linda Vista Formation. Topography at the southwestern potion of the site is greater than at the northeastern portion of the site, where Features D and F are located. While the Torrey sandstone found along the southern and western edge of the site is actively eroding, the Linda Vista Formation, upon which Feature D and F rest, is relatively resistant to erosion (Johnson 2004:14). Furthermore, the presence of dense concentrations of charcoal within soils between the fire-affected rocks suggests that Feature D had not eroded into its current configuration. If the feature had been a stone lined oven and eroded into its current state, the larger stones that would have once lined the feature would have been apparent. No such stones were identified during the excavation.

Although the ambiguous structures of Features D and F offer little insight into their functions, it is apparent that heating the cobbles used in these features to relatively high temperatures was an important step in treating the resources that were processed in them. At Feature D, fires burned hot enough to bake the clay soils below the feature, but not hot enough to calcine any of the rocks. The presence of the FAR in both Features D and F in direct association with dense concentrations of charcoal indicates that the rocks were burned in hot fires. It does not appear that the cobbles were heated in another location before being placed in either of the features. The wide diameter of Feature D, which
surrounds a very dense concentration of charcoal and FAR just above baked clay subsoil, may indicate that cobbles were piled low and heated in order to process a botanical resource in the central area of the feature. After its final use, Feature D may have been dismantled and the cobbles used in the process may have been scattered about the center of the feature, resulting in its wide, shallow appearance. It is possible that jumbled order of Feature F is a result of the same cultural transformations as Feature D, only on a smaller scale.

Close examination of the fire-affected rocks that were brought into the San Diego State University Laboratory for North American Archaeology revealed that the level of exposure to heat was discernable on 22 pieces of FAR and four pieces of groundstone excavated from Features D and F. Of those, most of the cultural items recovered from Feature D were pocked, while most of the Feature F artifacts displayed heat rinds. The different affects of heat on the fire-altered rocks and groundstone at each feature is also most likely a reflection of the number of times the feature was used. Pocking is resultant of exposure to high temperatures, while heat rinds develop during low intensity burns (Gallegos et al. 1999:3-88–3-89). Logically then, pocking should also develop as the rocks continue to break down with their continued reuse. The higher quantities of pocked rocks associated with Feature D suggest that relatively hot fires may have been burned within the feature more than once. The higher frequency of heat rinds identifiable on some of the cultural items collected from Feature F may indicate that cooler, or fewer, fires were burned within that feature. Only one piece of FAR from Feature D appeared to be crazed, indicating that it is highly unlikely that either of the features were used for boiling or steaming.

The results of the macrobotanical analysis offered limited information as to the use of these features. Similar to previous macrobotanical analyses of FAR features at Torrey Pines State Reserve, high densities of wood charcoal and relatively few seeds or other plant remains were recovered and identified (Barter 1987; Gamble 2001, 2002; Mealey 2006;
The total volume of soil samples submitted for macrobotanical analyses at sites within Torrey Pines State Reserve is displayed in Table 14.

Table 14. Total Volume of Macrobotanical Soil Samples from Torrey Pines State Reserve

<table>
<thead>
<tr>
<th>Site Trinomial</th>
<th>Report</th>
<th>Total Liters of Soil Analyzed</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA-SDI-9595</td>
<td>This thesis</td>
<td>48.8</td>
</tr>
<tr>
<td>CA-SDI-9595</td>
<td>Mealey and Jenkins 2003</td>
<td>0.9</td>
</tr>
<tr>
<td>CA-SDI-10636</td>
<td>Barter 1987</td>
<td>8.0</td>
</tr>
<tr>
<td>CA-SDI-10637</td>
<td>Mealey 2006</td>
<td>5.1</td>
</tr>
<tr>
<td>CA-SDI-14448</td>
<td>Mealey 2006</td>
<td>2.8</td>
</tr>
<tr>
<td>CA-SDI-14451</td>
<td>Mealey and Jenkins 2003</td>
<td>0.9</td>
</tr>
<tr>
<td>CA-SDI-14452</td>
<td>Mealey and Jenkins 2003</td>
<td>0.4</td>
</tr>
<tr>
<td>CA-SDI-15557</td>
<td>Gamble 2002</td>
<td>70.3</td>
</tr>
<tr>
<td>CA-SDI-16404</td>
<td>Mealey 2006</td>
<td>1.2</td>
</tr>
<tr>
<td>CA-SDI-16507</td>
<td>Mealey 2006</td>
<td>6.0</td>
</tr>
<tr>
<td>CA-SDI-16409</td>
<td>Mealey 2006</td>
<td>1.5</td>
</tr>
</tbody>
</table>

*Ceanothus* sp. (wild lilac) and *Adenostoma fasciculatum* (chamise) charcoal are the most commonly identified botanical remains from FAR features at the Reserve (Gamble 2001, 2002; Mealey 2006; Mealey and Jenkins 2003; Popper 2006). All identifiable macrobotanical items excavated from within FAR features at the Reserve are presented in Table 15. CA-SDI-10636 was not included because Barter (1987) does not define the absolute quantities of botanical remains recovered. However, Barter (1987:15) does state that the “carbonized leaves and fruits” of *A. fasciculatum* were identified.

*Ceanothus* sp. and *A. fasciculatum* are ethnographically known to be exploited by the Kumeyaay for medicine and utility purposes. While both types of wood are excellent as fuel (Popper 2006:5), wild lilac was also used as a medicinal treatment for itch. The leaves, branches and berries of the wild lilac were boiled and the decoction was applied to the affected area (Hedges and Beresford 1986:15). Since only one wild lilac seed was recovered and the fire-affected rocks from Features D and F do not appear to have been used for boiling water, it is highly doubtful that wild lilac seeds were processed there.
Table 15. All Identifiable Macrobotanical Remains Recovered from FAR Features at Torrey Pines State Reserve

<table>
<thead>
<tr>
<th>Macrofloral Remains</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenostoma sp. charcoal</td>
<td>208</td>
</tr>
<tr>
<td>Adenostoma sp. leaves</td>
<td>47</td>
</tr>
<tr>
<td>Adenostoma sp. seeds</td>
<td>114</td>
</tr>
<tr>
<td>Asteraceae charcoal</td>
<td>1</td>
</tr>
<tr>
<td>Brassicaceae seed pod</td>
<td>1</td>
</tr>
<tr>
<td>Ceanothus seeds</td>
<td>1</td>
</tr>
<tr>
<td>Ceanothus sp. charcoal</td>
<td>418</td>
</tr>
<tr>
<td>Convolvulaceae seeds</td>
<td>1</td>
</tr>
<tr>
<td>Cuscuta seeds</td>
<td>3</td>
</tr>
<tr>
<td>Cyperaceae seeds</td>
<td>1</td>
</tr>
<tr>
<td>Galium sp. seeds</td>
<td>3</td>
</tr>
<tr>
<td>Pinus sp. charcoal</td>
<td>5</td>
</tr>
<tr>
<td>Polygonum seeds</td>
<td>1</td>
</tr>
<tr>
<td>Quercus sp. charcoal</td>
<td>6</td>
</tr>
<tr>
<td>Rhamnaceae charcoal</td>
<td>11</td>
</tr>
<tr>
<td>Rhamnus sp. charcoal</td>
<td>36</td>
</tr>
<tr>
<td>Rhus sp. charcoal</td>
<td>7</td>
</tr>
<tr>
<td>Rosaceae charcoal</td>
<td>15</td>
</tr>
<tr>
<td>Salvia sp. charcoal</td>
<td>2</td>
</tr>
<tr>
<td>Salvia sp. seeds</td>
<td>1</td>
</tr>
</tbody>
</table>

*Ceanothus* sp. and *A. fasciculatum* were most likely used as a fuel at CA-SDI-9595 (Popper 2006). A relatively high number of chamise seeds and leaves collected from FAR features have been identified at Torrey Pines State Reserve (Barter 1987; Mealey 2006; Mealey and Jenkins 2003). However, they may have been attached to branches used for fuel. Also, chamise is abundant in and around the Reserve, and their presence within the FAR features may be a result of natural fires in the recent past (Popper 2006:5).

Although the macrobotanical evidence from FAR features at Torrey Pines State Reserve identifies the fuels used in the features, we must turn to additional lines of evidence to attempt to reveal the functions of these features. Examining palynological, archaeological, ecological, ethnographic, nutritional, and spatial data should aid archaeologists in understanding why there are such dense concentrations of FAR features at the Reserve.
As discussed in the second chapter of this thesis, FAR features in South Central and Southwestern America are frequently interpreted as being associated with *Agave deserti* and *Yucca whipplei* processing (Dering 1999; King 1993; Phippen 1999; Texier and King 1991; True and True 1992). These interpretations are often well supported by the wealth of ethnographic data that describes the importance of *A. deserti* and *Y. whipplei* as food and utilitarian resources (Castetter et al. 1938:9; Hedges and Beresford 1986:45-48; Hicks 1963:108-109; Michelsen 1974). However, vegetation communities in which *A. deserti* grow naturally do not occur anywhere within the study area (San Diego Geographic Information Source 2006). Other species of agave and yucca (*Agave shawii* and *Yucca schidigera*) do occur in the study area. However, *A. shawii* doesn't appear to have been used as a resource at all, and *Y. schidigera* was used mainly for its strong fibers (Hedges and Beresford 1986:45). The process of extracting Yucca fibers involved leaving the leaves buried in wet soil long enough that the fleshy parts would rot away, leaving only the fibers behind (Hedges and Beresford 1986:45). Also, sometimes the leaves were simply split into strips for lashing things together (Shipek 1991:98). While Hedges and Beresford (1986:45) describe the use of *Y. schidigera* as a food as being culturally inappropriate, Delfina Cuero states that some people did eat the flowers (Shipek 1991:98). Cuero also notes that the seeds were used in tea, or ground and eaten as mush (Shipek 1991:98). None of these processes appear to have warranted the construction of roasting features.

Palynological research at Torrey Pines State Reserve (Cole and Wahl 2000) and Las Flores Creek (Anderson and Byrd 1998) indicates that modern vegetation communities in San Diego County have been in place for approximately the last 2600 years. Higher water levels in Los Peñasquitos Lagoon between 3,600 and 2,750 yr B.P. (Cole and Wahl 2000:349) are indicative of the moister and cooler conditions of the Medithermal climatic period, which spans from 4000 yr B.P. to present (Moratto et al. 1978:148). Warmer and dryer conditions existed between 7,500 and 4,000 yr B.P. during the Altithermal (also
referred to as the Xerothermic, or Hypsithermal period), which replaced the cool, moist climate of the Anathermal, occurring between 10,000 and 7,500 yr B.P. (Axelrod 1981; Ledig and Conkle 1983; Moratto et al. 1978:148).

Pollen samples collected from the Santa Barbara Basin indicate that interior woodland and chaparral communities replaced most Southern California coastal pine forests during the Altithermal (Heusser 1978). Although the climate did become dry enough to support the spread of inland woody taxa into the coastal strip (Axelrod 1981; Heusser 1978; Holland and Keil 1995:77), and arid conditions during the Altithermal may have reduced mainland Torrey pines to only a few individuals (Ledig and Conkle 1983:81), it is unlikely that these dry conditions were severe enough on the coast to support the desert vegetation communities in which agave occur naturally (Masters and Gallegos 1997).

Archaeological evidence from early and middle Holocene sites at Agua Hedionda Lagoon (approximately twenty kilometers north of Torrey Pines State Reserve) and at the Reserve support this statement. Ecofacts from the Allan O. Kelly site (CA-SDI-9649), just east of Agua Hedionda Lagoon, were radiocarbon dated to between 7,160 and 8,030 RCYBP (Koerper et al. 1991). Based on archaeofaunal evidence, Koerper and colleagues argue that the environmental setting during the early Holocene at CA-SDI-9649 was “broadly similar to the vegetation and physiography of the area today” (Koerper et al. 1991:58).

Mealey (2006) excavated three FAR features and a shell midden at CA-SDI-10637, also located within Torrey Pines State Reserve. Several charcoal and shell samples were submitted for radiocarbon analysis which indicated that the site was used frequently between 5,780 and 1,470 RCYBP. Macrobotanical analysis of soils collected from the same features resulted in the identification of *Adenostoma* sp., *Ceanothus* sp., and *Rhus* sp., indicating that the same vegetation communities currently found at the site were present throughout the middle and late Holocene (Mealey 2006).
Based on the palynological, macrobotanical, and archaeofaunal evidence described above, vegetation communities in coastal Southern California have probably experienced relatively little change throughout the Holocene (Anderson and Byrd 1998; Cole and Wahl 2000; Koerper et al. 1991; Mealey 2006; Moratto et al. 1978). The nearest modern communities that support *A. deserti* are more than 70 kilometers to the east of the reserve, on the eastern side of the Tecate Divide (San Diego Geographic Information Source 2006). Therefore, I argue that it is unlikely that FAR features at Torrey Pines State Reserve were used for agave processing. To date, no agave remains have been identified from contexts associated with FAR features in the study area.

As noted above, fire-affected rock features are also associated with yucca processing activities (Gallegos et al. 1999; King 1993; Texier and King 1991). While *Y. whipplei* and *Y. schidigera* were both used as resources by many Native American peoples, only *Y. whipplei* was roasted (Hedges and Beresford 1986:45). During the winter, the bases of *Y. whipplei* were harvested and roasted in large earth ovens (Texier and King 1991). Also, the young bud of the *Y. whipplei* was gathered in the spring and roasted (Hedges and Beresford 1986:45), much like agave. The flavor is said to be similar to pineapple (Hedges and Beresford 1986:45).

Diegan Coastal Sage Scrub supports the natural growth of *Y. whipplei*, and is found in disjointed locations throughout the study area. However, very few *Y. whipplei* (perhaps only two individuals) are found at Torrey Pines State Reserve currently, and may have been recently introduced. It is unlikely that *Y. whipplei* ever grew in such great concentrations at the Reserve (Darren Smith, California State Parks Environmental Scientist, personal communication, February 22, 2007) to have been an important food source, and therefore it is unlikely that the dense concentrations of FAR features at the Reserve are associated with *Y. whipplei* roasting.
Although no carbonized Torrey Pine remains have been positively identified by macrobotanists (Gamble 2001, 2002; Mealey 2006; Mealey and Jenkins 2003; Popper 2006), Torrey Pine nut impressions have been excavated within the study area. At CA-SDI-9595, Mealey and Jenkins (2003) recorded pine nut molds in soils adhering to a fire-affected rock. These molds were interpreted as areas where nuts from small pines were once located (Mealey and Jenkins 2003). A similar mold was noted within an FAR feature at CA-SDI-14452 as well (Mealey and Jenkins 2003).

Pine remains have been identified from at least two other coastal sites in San Diego County. At CA-SDI-9821, just three kilometers northeast of the Reserve, Hanna (1983) excavated several FAR features. Charcoal samples were submitted to the Biology Department at California State University, Los Angeles for identification. One of the charcoal samples was positively identified as *Pinus* sp. (Hanna 1983). Due to the site location’s proximity to Torrey Pines State Reserve, Hanna (1983) suggests that people using this site traveled to the Reserve to collect firewood. Approximately 20 km to the north of the current study area, on a bluff overlooking Agua Hedionda Lagoon, Gallegos (1991) excavated at CA-SDI-10965. At this site, Gallegos (1991:36) reports the recovery one whole pine nut and 12 pine nut fragments from four different test units.

I argue that the Kumeyaay actively exploited Torrey Pines, and that the FAR features at Torrey Pines State Reserve may have been used to field process Torrey pine nuts by collectors traveling from nearby village sites. The majority of the features are densely concentrated within Torrey Pine forests and in the immediately adjacent Southern Maritime Chaparral communities (Figures 32-34). Torrey Pine nuts are the only resources in these two communities that would warrant field processing. Also, at sites that are characterized primarily by the presence of FAR features and few other cultural items, features are only located in Torrey Pine forests, Southern Maritime Chaparral, and Diegan Coastal Sage Scrub communities. Fire-affected rock features at these sites are greater than
three times more densely concentrated within Torrey Pine forests than the neighboring Southern Maritime Chaparral and Diegan Coastal Sage Scrub communities (Figure 38).

Pine nut exploitation throughout the Holocene has been well documented in California and the Great Basin (Bettinger 1977; Campbell 1999; G. Farris 1993; G. J. Farris 1982, 1992; Hildebrandt and Ruby 2006; McGuire and Garfinkle 1976; Rhode and Madsen 1998; Simms 1985; Sullivan et al. 2001). Pine nuts were widely recognized by many different Native American peoples as valuable resources, in part, because of their availability in almost all ecological zones (G. J. Farris 1982). Besides being widely available, pine nuts were valued as a very nutritious food source, high in polyunsaturated fat content (G. Farris 1993:230-231). Comparative nutritional values of common aboriginal food items as presented by G. Farris (1993:230-231) are displayed in Table 16. Although pine nuts were never a staple food item, they were an important auxiliary resource. Important enough that, in some cases, entire villages would be involved in the collection process (G. J. Farris 1982). Pine nuts were not only valuable food items, but were also used to make beads that were traded over great distances in Northern California, Oregon, and Nevada during the late-prehistoric and historic periods (G. J. Farris 1982, 1992).

Table 16. Comparative Nutritional Values of Common Native American Foods (Adapted from G. Farris, 1993:230-231)

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Water</th>
<th>Protein</th>
<th>Fat</th>
<th>Carbohydrates</th>
<th>Fiber</th>
<th>Ash</th>
<th>Kcal/100 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar Pine</td>
<td>3.3</td>
<td>21.4</td>
<td>53.6</td>
<td>17.5</td>
<td>0.0</td>
<td>4.2</td>
<td>594.0</td>
</tr>
<tr>
<td>Gray Pine</td>
<td>3.6</td>
<td>25.0</td>
<td>49.4</td>
<td>17.5</td>
<td>0.0</td>
<td>4.5</td>
<td>571.0</td>
</tr>
<tr>
<td>Big Cone Pine</td>
<td>3.7</td>
<td>25.4</td>
<td>51.0</td>
<td>14.4</td>
<td>0.0</td>
<td>5.5</td>
<td>574.0</td>
</tr>
<tr>
<td>Italian Stone Pine</td>
<td>5.6</td>
<td>31.1</td>
<td>47.4</td>
<td>11.6</td>
<td>0.9</td>
<td>4.3</td>
<td>556.0</td>
</tr>
<tr>
<td>Piñon</td>
<td>10.2</td>
<td>8.1</td>
<td>23.0</td>
<td>56.3</td>
<td>1.1</td>
<td>2.4</td>
<td>450.0</td>
</tr>
<tr>
<td>California Valley Oak</td>
<td>8.7</td>
<td>4.8</td>
<td>18.6</td>
<td>65.9</td>
<td>0.0</td>
<td>2.0</td>
<td>440.0</td>
</tr>
<tr>
<td>California Black Oak</td>
<td>11.3</td>
<td>3.8</td>
<td>19.8</td>
<td>64.8</td>
<td>2.1</td>
<td>0.3</td>
<td>443.0</td>
</tr>
<tr>
<td>Hazel</td>
<td>2.7</td>
<td>11.7</td>
<td>65.6</td>
<td>17.8</td>
<td>0.0</td>
<td>2.2</td>
<td>656.0</td>
</tr>
<tr>
<td>Black Walnut</td>
<td>3.1</td>
<td>20.5</td>
<td>59.3</td>
<td>14.8</td>
<td>0.0</td>
<td>0.0</td>
<td>628.0</td>
</tr>
<tr>
<td>Corn Flour</td>
<td>12.0</td>
<td>7.8</td>
<td>2.6</td>
<td>76.8</td>
<td>0.0</td>
<td>0.0</td>
<td>361.0</td>
</tr>
<tr>
<td>Wheat Flour</td>
<td>12.0</td>
<td>13.3</td>
<td>2.0</td>
<td>71.0</td>
<td>0.0</td>
<td>0.0</td>
<td>352.0</td>
</tr>
<tr>
<td>Salmon</td>
<td>58.9</td>
<td>21.6</td>
<td>9.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>153.0</td>
</tr>
<tr>
<td>Venison</td>
<td>74.0</td>
<td>21.1</td>
<td>4.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>106.0</td>
</tr>
</tbody>
</table>
Pinus torreyana (Torrey Pine), Pinus sabiniana (Gray Pine), and Pinus coulteri (Big-Cone Pine) comprise the Pinus subsection Sabinianae (eFloras.org 2007). Gray and Big-Cone Pine are both known to have been valuable supplementary food sources to several ethnographic Native Californian communities, and as seen in Table 15, are highly nutritious (G. J. Farris 1982). To date, no studies concerning the nutritional value of Torrey Pine nuts have been conducted. However, the relatively large nut of the Torrey Pine, when compared to other edible pine nuts (Table 17), is most likely to be highly nutritious as well.

Kumeyaay living in the area of Sierra-Juarez, Mexico, are known to have established camps near pine forests in the fall, when the nuts were ready to harvest (Campbell 1999:160-161). To the north, within the current study area, Delfina Cuero briefly described pine nut processing in an area just north of La Jolla (Shipek 1991). The Kumeyaay word for the Torrey Pine is ‘ehwiiw, and is translated as “pine nut.” According to Cuero: “The pine nuts are generally collected in September (when ripened), sometimes the cones had to be roasted to get the seeds out. Eaten as nuts raw or roasted; they are also ground and cooked as pinole or added to other seed flours for flavoring” (Shipek 1991:94)

Table 17. Comparison of Average Seed Lengths of Edible Pine Nuts (Adapted from G. J. Farris, 1982:89, and eFloras.org, 2006)

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Seed Length</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. coulteri</em></td>
<td>Big-Cone Pine</td>
<td>15-22 mm</td>
</tr>
<tr>
<td><em>P. jeffreyi</em></td>
<td>Jeffrey Pine</td>
<td>≈10 mm</td>
</tr>
<tr>
<td><em>P. lambertiana</em></td>
<td>Gray Pine</td>
<td>10-20 mm</td>
</tr>
<tr>
<td><em>P. monophylla</em></td>
<td>Piñon Pine</td>
<td>15-20 mm</td>
</tr>
<tr>
<td><em>P. ponderosa</em></td>
<td>Ponderosa Pine</td>
<td>4-9 mm</td>
</tr>
<tr>
<td><em>P. sabiniana</em></td>
<td>Sugar Pine</td>
<td>≈20 mm</td>
</tr>
<tr>
<td><em>P. torreyana</em></td>
<td>Torrey Pine</td>
<td>17-24 mm</td>
</tr>
</tbody>
</table>

As noted in Chapter 2, roasting pine cones does not actually open the cone; it only facilitates easier extraction of the nut. According to ethnographic evidence from Central and
Northern California, this process simply involved stacking the cones together upside down, covering them with a fuel such as pine needles, brush, or sage and igniting them in order to burn off most of the pitch (Campbell 1999:157-160; G. J. Farris 1982:21).

This type of firing would not require an elaborate oven, only a scattering of rocks to contain the fire similar to many of the features at Torrey Pines State Reserve. Although Delfina Cuero describes pine nut gathering (Shipek 1991:27-28), and states that the cones often had to be roasted (Shipek 1991:94), there are no ethnographic descriptions of the actual roasting process of Torrey Pine cones. Perhaps heated rocks, similar to those comprising FAR features at Torrey Pines State Reserve, were a useful aid in processing green Torrey Pine cones. Farris conducted experiments in pine cone processing and states:

The cones were then processed by heating them to remove the pitch using the traditional Indian method of piling the cones and covering them with pine needles which were then ignited. Alternatively, cones were placed on a hibachi over low coals to let the pitch melt off. The first method was a bit chancy since it often resulted in charred cones and charred seeds inside. [G. J. Farris 1982:90]

It is possible that the Kumeyaay had similar experiences, and therefore chose to roast the cones with heated cobbles, rather than directly on the ground in a pine needle or brush fire.

The remainder of the process involved splitting the cone lengthwise with a cutting tool, extracting the nuts, and cracking the shells between a hammer and anvil (G. Farris 1993; G. J. Farris 1982). Farris describes the evidence of such activities by stating:

The probable artifacts one might expect to find in such a processing site would be discarded stone cobbles, cobble choppers, and crude flat stones on which to chop or pound the cones. There is occasional mention of the cones being cut off the tree with a knife. Kroeber speaks of the Hill Patwin using a lint [obsidian?] to cut off the digger pine cones. If such a tool needed re-sharpening or simply broke and was discarded, one might expect some remains, particularly in the form of trimming flakes or the broken remnants of a biface which may have been used as a knife. Finally, if the burning of the cones did get out of control, there may be charred remnants of the cones or nuts. This would require ideal conditions, however, since such small processing sites would most likely be thin deposits with no midden accumulation. [G. J. Farris 1982:131]

Farris also states that, "in areas where there are adequate rock outcrops and/or fortuitous cobbles lying about, it may be well difficult to note sufficient wear to identify
certain sites as processing stations” (G. J. Farris 1982:137). Except for the absence of charred remains of pine cones or nuts, sites at Torrey Pines State Reserve with dense concentrations of FAR features are almost identical to the pine nut processing sites described by Farris (1982). The presence of the FAR features, their proximity to the pines, and direct ethnographic evidence (Shipek 1991), all strongly suggest the use of these sites as Torrey Pine nut processing areas.

The relative paucity of shell, ceramics, faunal remains, and chipped stone artifacts eliminates the possibility that features were used for shellfish processing, kilns, animal roasting, or heat treatment of lithic materials. No human bone or ritual items have been recovered from any of the features either. Therefore it is unlikely that they were used for cremations, nor in ritual contexts. Also, the location of CA-SDI-9595 does not provide a commanding view of the surrounding area (Figure 39). Viewshed analyses from several other sites at the Reserve have similar results, indicating that these features were not used by individuals utilizing these locations as observation stands. A view of the entire lagoon and much of the Scripps Plateau is afforded from atop a ridge just half a kilometer to the southeast of CA-SDI-9595. No prehistoric sites are recorded at that location.

Temporal and Spatial Relationships of Features and Sites in the Study Area

The results of the spatial analyses of contemporaneous sites in the study area could be interpreted in several ways. One interpretation is that Paleo-Indian peoples were continuously moving through the landscape foraging for resources near short-term campsites, resulting in fewer central place habitation sites. Following this line of interpretation, prehistoric peoples of the Archaic period preferred habitation areas in close proximity to a wide range of resources. Finally, during the Late-Prehistoric phase, as population pressure increased and resources dwindled, collectors began traveling to more
distant locations over relatively difficult terrain to exploit resources before returning to centrally located habitation areas. I find it particularly interesting that this interpretation fits well with general overviews (Moratto 2004; Wallace 1978) of culture change in prehistoric San Diego County.

The information provided in site record forms is often fragmentary, and in many cases unreliable for this type of temporal and spatial analysis, which may result in skewed interpretations. Too few sites in the study area were actually excavated, and therefore had no associated radiocarbon dates, which resulted in the assignment of many sites to very broad time periods. Many of those sites may not have been contemporary at all. As described earlier, the level of detail recorded on the site forms varied between the individual recorders, and over time. The study area has a long history of suburban development, and therefore many of the site records date between the 1920s and the 1970s, before the implementation of environmental regulations which strictly dictate site recordation procedures. Early site records frequently describe only the location of the site, and little else. Later site forms often contain bold interpretations about the age of the site based upon relatively little data. However, recent site forms (those dating from the late 1980s to present) are often very detailed and informative sources of site information.

Also, habitation sites located outside of the study area were most likely additional central places from which collectors traveled into the area to exploit resources. These habitation sites outside of the study area obviously were not included, which may have affected the results of the spatial analyses as well.

However, temporal and spatial analyses of sites with associated radiocarbon dates offer valuable insight into coastal adaptation in the study area. As described in the introductory chapter of this thesis, Wallace (1978) divides culture change in prehistoric San Diego County based upon shifts in artifact assembles that reflect changes in dietary patterns. During the Late-Prehistoric phase, diet breadth was expanded considerably to
include a wide range of botanical and animal food resources (Wallace 1978). Dietary expansion to include more periphery resources has been described as resource “intensification” by human behavioral ecologists, and is often a result of population growth and the over exploitation of staple resources (Winterhalder and Smith 2000:58). Interpreted as pine nut processing areas, the sites at Torrey Pines State Reserve reflect resource intensification in Late-Prehistoric coastal San Diego County. Of the 24 FAR features from which cultural items have been radiocarbon dated, 21 date to less than 3,000 RCYBP. These dates fall within Wallace’s third cultural period of “diversified subsistence” (1978:30), and include the entire Late-Prehistoric and transitional phases of Kumeyaay prehistory. The greater quantities of FAR features at the Reserve during the last 3,000 years may very well reflect the increasing importance of the Torrey Pine nut as a supplementary dietary item, or as an important trade item during the Late-Archaic and Late-Prehistoric periods.

Also, several radiocarbon dates suggest that CA-SDI-9595 and the Kumeyaay village of Ystagua were contemporaneous (Carrico and Taylor 1983; Harris et al. 1999). Furthermore, CA-SDI-9595 was relatively easy to access from Ystagua. Collectors residing at Ystagua could have easily traveled along the eastern and northern shores of the Los Peñasquitos Lagoon and north through the canyon that bisects the Extension to the ridge where CA-SDI-9595 is located. Interestingly, the site form on file at the San Diego Museum of Man for one of the sites identified as a portion of Ystagua states that the name translates to “trees are there,” and that it was the village that “would have had control of Torrey Pines” (Shipek 1976).

The relationship between CA-SDI-9595 and Ystagua fits well with predictions of central place foraging theory. The village of Ystagua is a logistically located central place between two major drainages and less than five kilometers from Los Peñasquitos Lagoon and the Pacific Ocean. This location facilitated the exploitation of a wide range of marine and terrestrial resources. The site designated as CA-SDI-9595 is representative of an
outlying processing location in that the majority of the artifacts and features there are indicative of a single type of activity.

Also of particular relevance to this argument is Farris’s statement that:

In virtually all accounts of the collecting of digger pine cones one reads that the cones were processed in the immediate vicinity where they were obtained. This was due to the heavy pitch accumulation that had to be removed from the cones, plus the sharp nature of the scales, and, finally, the fact that the edible kernels amounted to only 5% or less of the total weight of the cones (Cf. Tables 4-5 and 4-6). Rather than process the cones back at camp, it made more sense to extract the seeds near the place where the cones were obtained. [G. J. Farris 1982:129].

Descriptions of green pine cone processing sites used by the Paiute of Eastern California support this statement (Eerkens et. al 2002). Eerkens and his colleagues state that one of the benefits of green-cone processing (as compared to collecting nuts from brown cones that have fallen) is that it reduces competition with rodents. Eerkens and his colleagues note that, “some of the extracted nuts may have been consumed in the piñon zone, but a large fraction of unshelled nuts were transported to the valley bottom” (Eerkens et. al 2002:23).

From the perspective of central place foraging theory, sites with FAR features at Torrey Pines State Reserve may very well have been used by inhabitants of Ystagua to field process Torrey Pine cones. In a discussion on the basic principles of central place foraging models, Bettinger and colleagues (1997:888) state that the decision to field process depends upon the amount of time involved in processing the resource; if field processing would increase the utility of the resource; and if the foragers had to travel to the location of the resource from the central place. All of the requirements described by Bettinger and colleagues (1997:888) that are involved in the decision to field process appear to have been met in the situation described in this thesis. First, the majority of the FAR features at the Reserve may have been useful for containing small, hot, short-term fires, like those used to remove pine pitch. Second, because of the ratio of pine nut to cone weight, field processing
of Torrey Pine cones would have been a logical decision for people traveling to these locations from nearby habitation sites. Cracking the nut shell and extracting the seed was probably not done in the field because the shell is relatively small and lightweight. The collector’s time would have been more efficiently spent extracting the pine nuts from the cones, and taking the nuts back to the central place for further processing. This may aid in explaining why no carbonized Torrey Pine nuts or shells associated with FAR features in the study area have been identified by macrobotanists to date. Finally, the Torrey Pine forests are less than a two hour walk over relatively easy terrain from Ystagua.

When considered in a larger context, CA-SDI-9595 displays several attributes that offer insight into its use and meaning in the past. The density of fire-affected rock features in proximity to the Torrey Pines, and the relative paucity of other types of artifacts, botanical remains, or faunal remains. Combined with direct ethnographic evidence (Shipek 1991), and the site’s proximity to Ystagua, each of these lines of evidence strongly suggests that CA-SDI-9595 represents a Torrey Pine Nut processing area.
CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Archaeological research in San Diego County often recognizes only the major resources exploited by the Kumeyaay, such as acorns, game, and shellfish, in part because of the abundance of milling tools, projectile points, animal bone, and shells recovered from many archaeological contexts. Turning our attention to other, more peripheral, and in some cases previously unrecognized resources, will offer a better understanding of Kumeyaay complexity. This can be a challenging task, however, since many of these marginal resources are perishable, and may only be recognizable through the few relatively imperishable items used to process them.

In this thesis, I have offered a detailed analysis of the forms and functions of fire-altered rock features at Torrey Pines State Reserve. Through this research, as well as previous investigations (Barter 1987; Gamble 2001, 2002; Mealey 2006; Mealey and Jenkins 2003), it has become apparent that there are greater densities of FAR features at the Reserve than in the surrounding areas. Following the theoretical perspective of human behavioral ecology, which focuses on aspects of human interaction with the environment, I have argued that FAR features are densely concentrated at Torrey Pines State Reserve because of their use as Torrey Pine cone processing locations. I base this argument on several lines of evidence.

Archaeological evidence from Torrey Pines State Reserve indicates that the majority of the FAR features there are relatively small, shallow, groupings of burned rocks constructed in no particular order (Mealey 2006; Mealey and Jenkins 2003). Generally, almost no faunal remains and only a few chipped stone and groundstone artifacts are
associated with these features (Gamble 2001, 2002; Mealey 2006; Mealey and Jenkins 2003). This lack of associated artifacts and food remains indicates that the features were not used for roasting meat or fish, firing ceramics, processing shellfish, cremating the deceased, or heat treating lithic materials. Also, the lack of midden soils at these sites further suggests that the Kumeyaay would temporarily travel to these sites only to process a botanical resource, carrying out few other activities. Macrobotanical analyses of soils collected from FAR features at 11 different sites in the Reserve have only revealed that chamise and wild lilac were used as fuels. Although FAR features are often associated with *Agave deserti* and *Yucca whipplei* processing (Dering 1999; King 1993; Phippen 1999; Texier and King 1991; True and True 1992), no agave or yucca have been identified in association with FAR features at the Reserve. Very few other botanical remains have been recovered (Gamble 2001, 2002; Mealey 2006; Mealey and Jenkins 2003; Popper 2006). Lacking definitive material evidence, I examined data on the Kumeyaay use of plant resources (Hedges and Beresford 1986; Shipek 1991) to attempt to reveal the functions of these features.

Utilizing geographic information systems, I investigated the spatial relationships of FAR features, sites, and vegetation communities in the study area. Referencing ethnobotanical studies (Hedges and Beresford 1986; Shipek 1991), I mapped vegetation communities that were exploited by the Kumeyaay. The results of the spatial analyses revealed unambiguous patterns regarding FAR feature locations. Specifically, FAR features are more than three times more densely concentrated in Torrey Pine forests than in any other vegetation community.

Palynological, macrobotanical, and archaeological evidence suggest that although the environment did change during the Holocene, the effects of those changes on vegetation communities at Torrey Pines State Reserve were minimal. Therefore, comparing the locations of FAR features to vegetation communities that supported Kumeyaay
resources is a valid method in determining the use of the features. As noted above, no agave or yucca remains have been identified in association with FAR features in the current study area. Furthermore, since *A. deserti* does not occur naturally at the Reserve, and *Y. whipplei* is only found in two locations, it is highly unlikely that the features would have been used for processing these resources.

The results of the viewshed analysis demonstrate that very little of the surrounding area can be seen from CA-SDI-9595, much like many other sites where FAR features are recorded at the Reserve. Therefore, these sites could not have been used as observation stands.

Ethnographic accounts of pine nut exploitation support the argument that the FAR features at Torrey Pines State Reserve were used for pine nut processing. G. J. Farris (1982) describes pine nut processing throughout Northern and Central California, stating that small fires were often used to remove the pitch from the pine. Farris (1982) also notes that few tools are necessary to remove the nut from the cone, and therefore, in archaeological contexts, very few artifacts will be associated with pine nut processing sites.

The southern Kumeyaay actively collected pine nuts from the Sierra Juarez Mountains in Mexico (Campbell 1999), and therefore were obviously familiar with the techniques required to successfully process pine seeds. Furthermore, Delfina Cuero, a Kumeyaay elder that lived in Mission Valley in the early part of the twentieth century, spoke of traveling to a place north of La Jolla to collect pine nuts, often roasting them to extract the nut. In fact, ‘*ehwiw*, the Kumeyaay word for the Torrey Pine, means pine nut (Shipek 1991:94).

I also analyzed the spatial relationships of different types of contemporaneous sites, following central place foraging theory. Terrain and distance were used as variables to measure the accessibility of resource processing sites from habitation sites of the same relative age. Interestingly, the results appear to fit well within general overviews of San
Diego County prehistory (Moratto 2004; Wallace 1978) which reflect shifts in diet and cultural complexity through time. The results can be interpreted to suggest that Paleo-Indian peoples frequently relocated to different resource patches, resulting in fewer long-term habitation sites. Archaic habitation sites were centrally located in areas that facilitated logistical exploitation of both marine and terrestrial resources. As populations increased and staple resources became scarcer during the Late-Prehistoric period, collectors would travel to relatively less accessible areas to field process resources before returning to centrally located habitation areas.

However, the fragmentary information provided in site record forms may have affected the spatial analyses just described. Since radiocarbon dates were available for very few sites in the study area, I assigned sites to three generally accepted (Moratto 2004) cultural phases. Sites were assigned to a relative period based on interpretations made by the archaeologists that recorded the sites. The shifts in cultural patterns reflected in the results of the spatial analyses described above may actually be a reflection of changes in archaeological method and theory over time in San Diego County.

Where radiocarbon dates were available, spatial and temporal analyses of FAR features and sites provided important results. Not only are FAR features most densely concentrated within Torrey Pine Forests, they occur most frequently during the last 3,000 years. From an HBE theoretical perspective, the increase in the number of FAR features at the Reserve over time may very well reflect the intensification of the Torrey Pine nut as either a dietary supplement or trade item during the Late-Archaic and Late-Prehistoric periods.

Also, radiocarbon dates from CA-SDI-9595 and Ystagua indicate that Features D and F were used during the time that Ystagua was occupied. When considered within the framework of HBE, CA-SDI-9595 and Ystagua fit very well within central place foraging models. The village of Ystagua represents a logistically located central place from which
collectors would travel to resource patches, such as CA-SDI-9595, to exploit resources. The FAR features at Torrey Pines State Reserve may have been used to field process Torrey Pine cones, which significantly lightened the load to be returned to the central place, thereby increasing the net value of the pine nuts.

To summarize, although no carbonized Torrey Pine remains have been recovered from FAR features to date, I argue that there is substantial supplementary evidence suggesting that the FAR features at the Reserve may have been used to process Torrey Pine cones.

- If these features were used to process other resources, to fire ceramics, or for cremations, the artifacts used to carry out these activities would be found in association. It is the lack of associated artifacts and food remains at these sites that strongly suggests their use as pine nut processing areas.

- Also, it is highly unlikely that the paleoclimate was arid enough at Torrey Pines State Reserve to support Agave deserti. It is also unlikely that enough Yucca whipplei ever grew in the area to be considered a dominant species that would attract collectors.

- Direct ethnographic accounts describe the use of the Torrey Pine as a food resource, which was often roasted while processing.

- Spatial comparisons of the FAR feature locations demonstrate that they are most densely concentrated within Torrey Pine Forests.

- When considered in the theoretical framework of human behavioral ecology, these sites at Torrey Pines State Reserve appear to represent field resource processing areas that collectors would travel to from centrally located habitation areas.

- Features D and F at CA-SDI-9595, as well as many other features at the Reserve, were used during the time that the village of Ystagua was occupied, and travel between the areas was relatively easy.

In conclusion, I argue that all of these lines of evidence strongly suggest that CA-SDI-9595 represents a field processing area, where the Kumeyaay living at Ystagua would collect, roast, and extract Torrey Pine nuts from their cones.

The FAR features described in this thesis are rapidly eroding, and eventually, a majority of the materials in and around these features will be out of context. It is impossible
to stop this process, and therefore more of the FAR features at Torrey Pines State Reserve should be excavated so that as much data as possible can be collected.

Archaeologists should continue to collect soil samples from FAR features for macrobotanical analysis. Continued macrobotanical analyses of large volumes of soils associated with FAR features at the Reserve may eventually reveal direct evidence of their functions. In order to maintain the uniformity of macrobotanical analyses, which will aid in intra-site and inter-site comparisons, the soil samples should be submitted, whenever possible, to the Cotsen Institute of Archaeology at the University of California, Los Angeles.

Archaeologists should continue to describe the structural forms of FAR features in detail, much like the descriptions provided by Mealey (2006). The formal qualities of the features are most likely indicative of their functions. Experimental burns should be conducted by recreating each different type of feature, using wild lilac and chamise as fuel. Each resource known to be collected at the Reserve (and at least partially processed through the application of heat) could be roasted in each different type of FAR feature to determine if certain forms of FAR features are more efficient for processing particular resources.

The two grams of shell recovered from FAR features at CA-SDI-16404 and CA-SDI-16409 (Mealey 2006) should be submitted for oxygen isotope analysis to determine the season during which the shellfish were collected (Mannino et al. 2003), and therefore the time of year that the features were used. According to Delfina Cuero, pine nuts were gathered in the fall (Shipek 1991). If the features were used in the fall, the argument for their use to process Torrey Pine nuts will be further supported as well.

Radiocarbon samples should continue to be submitted for analysis. If it can be determined that more of the features date to the Late-Prehistoric period, the argument that resource intensification occurred over time at coastal locations in San Diego County will be further supported.
Experimentation in pine cone processing may offer greater insight into the use of FAR features at Torrey Pines State Reserve. Burning Torrey Pine cones for archaeological experimentation would not be prudent, considering that the Torrey Pine has the smallest population of any known pine, occurring only at the Reserve and on Santa Rosa Island off the coast of Santa Barbara, California (Ledig and Conkle 1983:79). However, the cones of the Big-Cone Pine are very similar in size to Torrey Pine cones. Therefore Big-Cone Pine cones, which do occur in the Peninsular Ranges of San Diego County, should serve as an effective proxy for experimentation in Torrey Pine nut processing techniques. Both green-cones and brown-cones should be collected and roasted in pine needle and brush fires following ethnographic descriptions available from Northern and Central California. Also, cones should be roasted in recreated FAR features, using chamise and wild lilac for fuel, in order to determine how the cones react when processed in features similar to those at Torrey Pines State Reserve. Temperatures of each type of fire, as well as the degree of fire-alteration on the cobbles used in the experimental feature, and the amount of charred cone and pine nut remains that may be lost in the fire, should all be recorded. Finally, the nuts should be extracted following ethnographic descriptions. The extraction process should be accomplished in order to determine if any other tools are required, or if crushing the treated cone between two cobbles is effective for nut extraction. For safety reasons, these experiments should be carried out in a controlled environment.

As noted above, the only other location where Torrey Pines occur naturally is on Santa Rosa Island, in the Santa Barbara Channel off the coast of Southern California (Ledig and Conkle 1983:79). Archaeologists should survey the areas in and around the Torrey Pine forests on Santa Rosa Island to determine if FAR features are present. If FAR features are identified there as well, the argument that the features may be used to process Torrey Pine cones will be strengthened. Furthermore, if FAR features are in association with Torrey
Pines on Santa Rosa Island, the argument that Torrey Pine nuts were an important and valuable food resource in prehistoric Southern California will be upheld as well.

The spatial analysis of the relationships of different site types presented in this thesis can be effective, but cannot rely solely on the data recorded in site record forms. Ideally, this type of spatial analysis would be most effective when included in the research design of a large scale archaeological testing project in a relatively undisturbed area. This would ensure consistency in the level of detail recorded at each site, and, if properly funded, dates would be based on excavated, radiocarbon dated cultural items. With this level of control, the spatial analyses conducted in this thesis would surely provide valuable results.

Sites where dense concentrations of fire-affected rock features are found in association with few other artifacts are valuable cultural resources. The functions of these sites and their spatial and temporal relationships with other types of sites offer important information regarding human interaction with the environment in the past. Recognizing these relationships, and understanding the use of these sites, will allow archaeologists to develop a more detailed interpretation of the complex prehistoric Kumeyaay cultural landscape, and the archaeological record as a whole.
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