TESTING THE COASTAL DECLINE MODEL WITH FLAKED STONE ARTIFACTS FROM THE SAN DIEGO REGION OF CALIFORNIA

By

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A thesis submitted in partial fulfillment of
the requirements for the degree of

MASTER OF ARTS IN ANTHROPOLOGY

WASHINGTON STATE UNIVERSITY
Department of Anthropology

May 2007

To the Faculty of Washington State University:

The members of the Committee appointed to examine the thesis of DAVID RICHARD IVERSEN find it satisfactory and recommend that it be accepted.

Chair

ACKNOWLEDGMENTS

I would like to sincerely thank my committee. Professor Lipe worked hard to get me through this process during difficult circumstances. His patience and hospitality were far more than could have been expected. The comments and guidance from Professor Andrefsky and Professor Ackerman were also greatly appreciated.

Stan Berryman, Camp Pendleton Archaeologist, allowed me to use the Las Pulgas collection for this study. The information provided from the Las Pulgas collection was invaluable to this project, and I hope the results will be helpful to further study on the base.

Finally, I owe a debt of gratitude to everyone I have worked with at ASM Affiliates and Larson Anthropological and Archaeological Services, past and present, for teaching me, inspiring me, and pushing me past my mental and physical bounds. Dr. Brian Byrd excited me about the prehistory of Coastal San Diego County and gave me the opportunity to use the San Elijo data for this project. Thanks to John Cook, ASM President, for allowing me to use laboratory space to conduct much of the analysis and for access to an extensive library of pertinent literature. Dr. Mark Becker, ASM Laboratory Director, added much needed input throughout this project; his willingness to share his extensive experience in lithic analysis and his overall mentorship were greatly appreciated.

The final version of this thesis would not have been possible without the help of everyone mentioned above. While the credit for any contributions or new insights into archaeology is shared with them, all inconsistencies, misrepresentations, or general blunders are entirely mine.

TESTING THE COASTAL DECLINE MODEL WITH FLAKED STONE ARTIFACTS

FROM THE SAN DIEGO REGION OF CALIFORNIA

Abstract

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May 2007

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Competing models describe the land-use of Coastal San Diego County during the Late Holocene. The Coastal Decline Model contends that coastal resources were utilized sparingly during the Late Holocene, concurrent with ecological changes resulting in the silting of many of the local lagoon environments. An intensified use of interior resources, including semi-permanent habitations, is thought to have accompanied the decline of coastal utilization. Conversely, the Coastal Intensification Model states that the San Diego Coastal environs were heavily exploited during the Late Holocene, with semi-permanent residences located in coastal contexts. This study attempts to use the analysis of flaked stone artifacts from two groups of sites in Northern San Diego County, San Elijo Lagoon and Las Pulgas Corridor, to test the validity of the Coastal Decline Model. Various methods, including the diversity and density of lithic artifacts, the change and continuity in lithic artifacts through time, and the ratios of cores to bifaces, are employed in the lithic analysis. The results of the lithic analysis appear to support the model of coastal decline in Northern San Diego County during the Late Holocene. However, the results also indicate a continuous use of coastal resources through time, though probably in lesser frequencies and for different purposes during the Late Holocene as opposed to the Early and Middle Holocene.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

Archaeologists have relatively recently begun to utilize lithic analyses in order to investigate not only tool types and functions, but also larger issues associated with prehistoric land use including mobility patterns and site functions (Andrefsky 1998; Bamforth and Becker 2000; Parry and Kelly 1987; Shott 1986, 1994; Sullivan III 2001; Tomka 2001). Excavations of archaeological sites in Northern San Diego County have uncovered high densities of lithic artifacts, which can be used in concert with supporting archaeological evidence to answer questions concerning prehistoric land use in the Southern California region. Two areas specifically, San Elijo Lagoon and the Las Pulgas Corridor, are selected here for this purpose (Figure 1.1). The San Elijo Lagoon archaeological excavations were undertaken as part of a National Science Foundation project (Byrd et al. 2004). ASM Affiliates, Incorporated (ASM) conducted archaeological testing of the Las Pulgas sites on Marine Corps Base Camp Pendleton for the Southwest Division of the Navy (Hale and Becker 2006).

A detailed analysis of finished tools and debitage from the San Elijo Lagoon and the Las Pulgas Corridor sites will address functional, technological, and chronological questions. Mobility patterns are examined through two competing models of prehistoric land use in the region, the Coastal Decline (Christenson 1992; Gallegos 1987, 1992; Gallegos and Kyle 1988; Rosenthal et al. 2001b; Warren et al. 1961, 1998; Warren and Pavesic 1963; Warren 1964, 1968) and the Coastal Intensification (Byrd 1998; Byrd and Reddy 1999) models using data from the lithic analyses. Tool forms will be assessed, and used to infer function where possible. Debitage will be analyzed in an attempt to determine what type of tool technologies, such as core and bifacial technologies, were employed at the sites. Comparative analyses, for example core to biface ratios, will also be utilized to determine site functions. The results of the lithic analyses from these sites are examined in concert with additional sites from San Diego County to address the question of prehistoric coastal adaptations and mobility in Northern San Diego County.

RESEARCH PROBLEM AND METHODS

Hunter-gatherers who live in coastal environments are often viewed as atypical (e.g., Jones 1991, 1992; Pálsson 1988; Torrence 1983). For example, coastal inhabitants often live in large settlements or "villages" that contain relatively high population densities. This is partially a result of the rich coastal environments they live in, which can support complex and resource-rich plant and animal communities. Despite this basic recognition of how coastal hunter-gatherers and fishers typically live, archaeological research in Southern California, and particularly San Diego County, has produced a debate on the subject of complex coastal hunter-gatherers. The debate is centered on competing ideas of whether there was a decline or alternatively, an intensification of the exploitation of coastal resources during the Late Holocene (see Byrd 1998; Byrd and Reddy 2001, 2002; Rosenthal et al. 2001b). The Coastal Decline Model posits that the use of interior resources increased during the Late Holocene, with limited and temporary land use of littoral environments (Christenson 1992; Gallegos 1987, 1992; Gallegos and Kyle 1988;

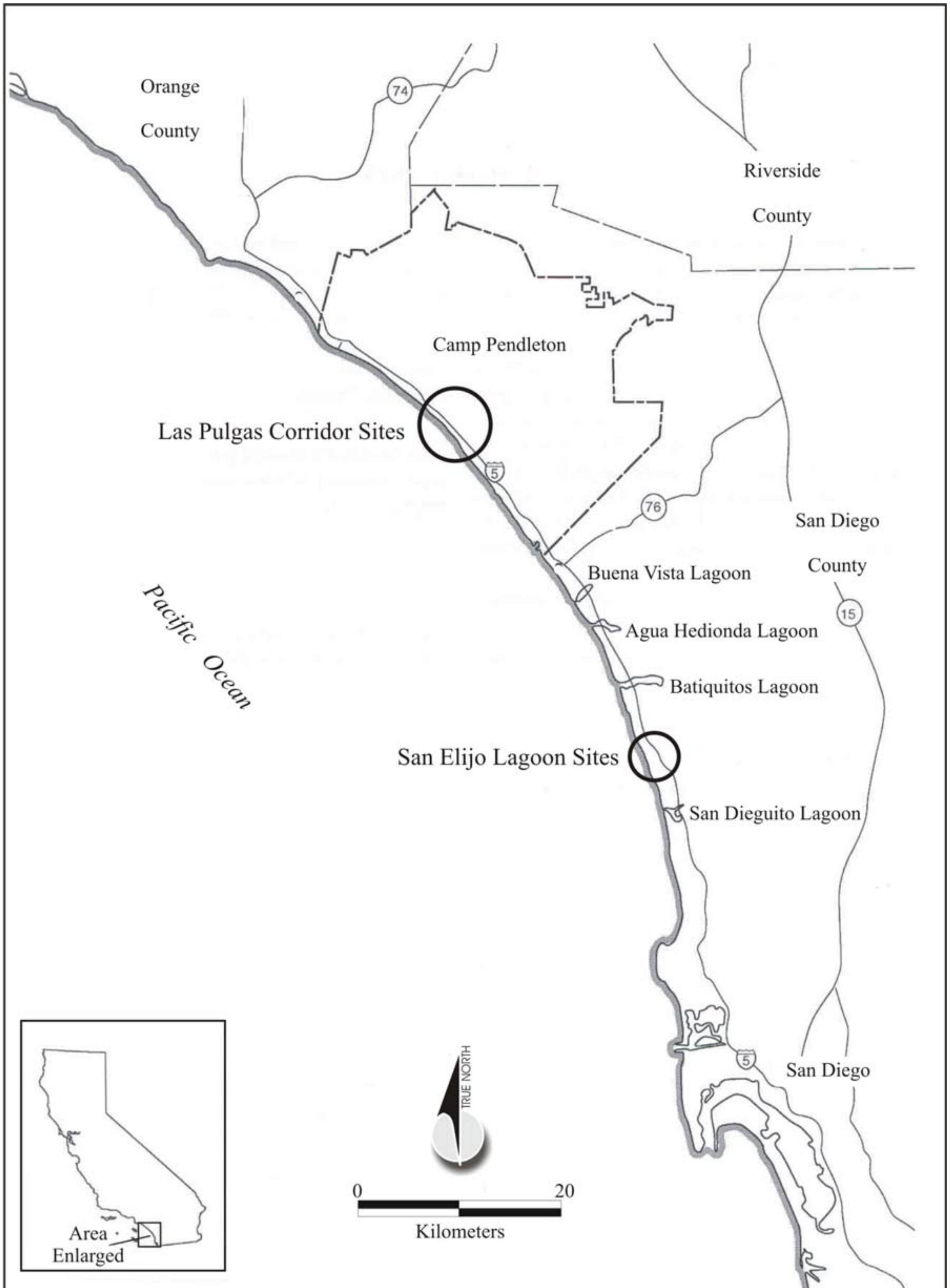

Figure 1.1: General location of the San Elijo Lagoon and Las Pulgas Corridor Sites

The following analyses attempt to test the validity of the Coastal Decline Model utilizing flaked stone material from San Diego County. Coastal and interior land use strategies in Southern California during the Holocene Period are dealt with here through the analysis of formed chipped stone tools and lithic debitage primarily from two groups of sites in Northern San Diego County, San Elijo and Las Pulgas (see Figure 1.1). The San Elijo sites consist of shell middens located on the coast, while the Las Pulgas sites include lithic scatters, bedrock milling features, and temporary campsites in inland settings, as well as two shell midden sites in coastal environments. The inland Las Pulgas sites are located between approximately 7.5 and 12.5 kilometers northeast of the coast. The San Elijo shell middens contain dates ranging from the Early to Late Holocene, with the majority of the deposits dating to the Early (9000-7600 BP) and Middle Holocene (7600-3650 BP). The majority of the Las Pulgas sites date to the Late Holocene (3650-300 B.P). The exception is one shell midden site that contains material dated to the Late Holocene, but also includes a deeper deposit that dates to the Early Holocene. These two groups of sites will be used in association with other sites in San Diego County to make broad comparisons of prehistoric land use throughout the Holocene.

The lithic analysis will be used to answer questions concerning functionality, technology, and chronology of the archaeological sites. Assessments of tool morphology are utilized to address tool function where possible. Debitage analysis will attempt to determine what types of tools were produced and utilized on site. Comparative analyses, such as core to biface ratios, artifact density, and assemblage diversity, will also be used to comprehend site function. If indeed the use of coastal environments declined during the Late

Holocene, changes in the way the sites are used should be seen in the material cultural left behind at the sites over time. Additional lines of evidence, such as floral and faunal remains, and ground stone implements, are used to strengthen the results of the lithic analyses.

Problems concerning chronology and sampling must be addressed here. First, the majority of the project sites probably result from multiple occupations. Second, artifacts recovered from the sites only represent a relatively small sample of the actual archaeological deposits. Because of the difficulty of making fine chronological distinctions among sites based on relatively small excavated samples, large time periods are used for comparative purposes. The basic premises of both the Coastal Decline and Intensification Models concern changes between the Middle to Late Holocene. Thus sites are examined as to how they fit into this broad chronological framework (i.e., Early, Middle, and Late Holocene). Sites that span both the Late Holocene and earlier time periods are therefore typically not considered for temporal comparisons. Although only relatively small samples were excavated for each site, a large number of sites are utilized to make generalizations concerning coastal and interior sites. Additionally, the C14 samples and artifacts types used for dating are from excavation units that yielded the assemblages used in the analysis. The particular methods of site sampling are addressed below in greater detail in individual site descriptions.

Previous research suggests that hunter-fisher-gatherer use of coastal environments along the Pacific Coast, and even in most parts of the world, increased during the Late

Holocene. This study aims to help determine if land use of Southern California coastal environments are possibly unique in the Late Holocene, as the Coastal Decline Model would suggest, or if the pattern of littoral use by hunter-fisher-gatherers in Southern California follows typical increases after approximately 4000 years ago, as presented by the Coastal Intensification Model. The results of this study, presented below, appear to support the Coastal Decline Model as it is currently stated. However, the results also indicate a continuous use of coastal resources through time, particularly at Las Pulgas, though probably in lesser frequencies and for different purposes.

ENVIRONMENTAL SETTING

Several related factors have shaped the current environmental conditions of the Northern San Diego County Coast. Landforms within the region typically consist of marine terraces grading into rolling hills to the east. Sediments accumulated through ocean, stream, wind, and gravitational activities characterize recent geologic deposits. Climatic change within Southern California coastal environments is associated with changes in seasonality, which in turn affected the amount and types of vegetation available to prehistoric people. The difference between annual high and low temperatures appears to have decreased throughout the Holocene, based on data recovered from geologic cores, including charcoal and pollen and spore remains (Pope et al. 2004). Sea level rise over time has also greatly affected the Southern California Coast. Sea level today is as much as 30 meters higher than it was in the Early Holocene. Sea level rose rapidly during this period, inundating much of the Early Holocene coastline (Byrd 1997:16).

A series of lagoons, fed by creeks and rivers from the mountains to the east, characterize the coastline of San Diego County (Figure 1.2). During the Early Holocene, these lagoons were much larger than those present today. The lagoon environments would have provided excellent opportunities for prehistoric peoples to procure food resources, including marine vertebrates and invertebrates, marine mammals, terrestrial mammals, marine and other bird species, and several types of marsh plant species. As sea levels stabilized over the past 4000 years, lagoons along the Southern California coast began to silt in as the rate of sea level rise became lower than the sedimentation rate (Pope et al. 2004:33). Lagoons became much smaller or were in some instances, such as at Las Pulgas, completed silted in, leaving only small swampy areas or stream channels emptying into the ocean. The infilling of the lagoons during the Late Holocene in turn would have changed the amount and type of marine shellfish available for people to collect. The locally occurring marine invertebrate *Donax* requires gently sloping sandy beaches, and would have thrived after the silting of the lagoons, while rocky beach marine invertebrate species, such as *Mytilus*, *Chione*, *Argopectin*, *Ostrea*, and *Protothac*a, would have become less abundant (Byrd 1997:16; Reddy 1996).

Figure 1.2: Physical map of Coastal Northern San Diego County

Figure 1.3: Overview of San Elijo Lagoon from SEL-1, view to the north

SAN ELIJO LAGOON

The San Elijo Lagoon drains Escondido Creek in Northern San Diego County. The lagoon is located within a Nature Reserve administered by San Diego County. The area immediately surrounding the reserve has been substantially developed for residential housing over the past 50 years. The San Elijo Lagoon sites are on relatively undeveloped landforms within the reserve on the southern edge of the lagoon (Figure 1.3). The sites are situated on Pleistocene terraces incised into older marine landforms, known as the Del Mar Formation, within varying amounts of later alluvial, colluvial, and aeolian deposits (Pope 2004:90). Native vegetation surrounding the lagoon consists of coastal sage scrub, including California sagebrush (*Artemisia californica*), black sage (*Salvia mellifera*), white sage (*Salvia apiana*), and California buckwheat (*Eriogonum fasciculatum*), as well as sparse Torrey Pines (*Pinus torreyana*). Saltwater marsh vegetation, including pickleweed (*Salicornia virginica*), salt grass (*Distichliis spicata*), and sea lavender (*Limonium californicum*), exists along the lagoon margins. The lagoon began to gradually silt in beginning around 2800 BP, with open conditions existing as late as 1000 BP in the southeastern portion of the lagoon. The lagoon has undergone various stages of siltation through the Late Holocene Period, with a smaller, closed lagoon existing today despite modern modifications (Byrd et al. 2004; Pope et al. 2004).

LAS PULGAS CORRIDOR

The Las Pulgas Corridor refers to the area around Las Pulgas Canyon, through which runs Las Flores Creek. The corridor is located on the Marine Corps base Camp Pendleton, and runs southwest for approximately 15 kilometers from the Margarita Mountains to the Pacific Ocean (Figure 1.4). The sites examined in this study are situated along the Las Pulgas Corridor, encompassing the Las Flores Canyon, Aliso Canyon, and Wood Canyon drainage systems, as well as the Santa Margarita River watershed. The farthest east of the Las Pulgas sites is situated on a ridge between Deluz Creek and the Santa Margarita River, approximately 16 km northwest of the coastline. The westernmost site is located on a terrace approximately 350 meters east of the coast and 450 meters north of where Las Flores Creek empties into the Pacific Ocean. The coastal terraces probably formed through coastal uplifting, and consist primarily of Pleistocene marine and non-marine sediments overlying older marine

Figure 1.4: Overview of Las Pulgas Corridor from SDI-10714, view to the west

deposits (Kaldenberg 1982; Weber 1963). Las Flores Creek is a relatively narrow drainage, incised through alluvial deposits. Vegetation ranges from a coastal sage scrub similar to that associated with the San Elijo Lagoon, to sparse oak (*Quercus* sp.) woodlands in upland settings. Willow (*Salix* sp.), cottonwood (*Populus fremontii*), and sycamore (*Platanus racemosa*) trees are common within riparian settings along the corridor between the ocean and the uplands. A fresh water lagoon probably existed at the mouth of Las Flores Creek by approximately 6000 BP, and was silted in by around 2400 BP (Byrd 2003; Pope 2004:33).

ETHNOGRAPHY

At the time of contact, Native American people speaking two distinct languages occupied the Coast of Northern San Diego County. The Shoshonean speaking Luiseño and Juaneño occupied the northern portion of San Diego County from Agua Hedionda to Riverside County, including the Las Pulgas Corridor (see Figures 1.1 and 1.2). The Juaneño were most likely part of the Luiseño rather than a separate group, based on similarities in language and cultural adaptations (Bean and Shipek 1978; Kroeber 1925). The Luiseño population probably ranged from 5000 to 10,000 around the time of contact (Bean and Shipek 1978; Kroeber 1925; Sparkman 1908). The Yuman speaking Kumeyaay occupied the territory within San Diego County from the Agua Hedionda Lagoon to the south, with San Elijo Lagoon encompassed by the northernmost portion of the territory (Gifford 1931; Spier 1923). The Kumeyaay spoke a different language than the Luiseño but conducted similar subsistence and settlement activities within the same environmental setting. The Kumeyaay population was probably similar to or larger than that of the Luiseño, and their range was probably greater, reaching the deserts to the east (Gifford 1931; Spier 1923).

Both the Luiseño and the Kumeyaay utilized seasonal resources from both coastal and inland environments. People hunted birds, such as quail, doves, and ducks, as well as mammals, including deer, antelope, and rabbit, often with bows and arrows (Bean and Shipek 1978; Luomala 1978; Sparkman 1908). Plants and seeds were gathered and processed, including the leaching and milling of acorns. Fresh and marine water fish were caught, and marine shellfish were gathered along the coast. Certain fish and shellfish could be exploited year round (Bean and Shipek 1978; Luomala 1978). The people lived in communities oriented to the procurement of these particular resources (Kroeber 1925; Sparkman 1908).

The first European contacts with Native American populations in San Diego County occurred as early as the 1500s during initial Spanish, English, and Portuguese exploration of the area (White 1963). Written accounts of early Spanish expeditions describe Indian settlements between the coast and mountains of San Diego County (Bolton 1926). Reports of a 1795 Spanish expedition mention two Luiseño villages in the Las Flores area (Englehardt 1921:6). Subsequent Spanish incursions resulted in the establishment of missions where Natives were forced to farm, practice the Catholic religion, and speak Spanish. The Luiseño village of *Huisme*, or *Ushmai*, is mentioned as early as 1815 in association with the San Luis Rey Mission (Schaefer 1992; Sparkman 1908). The area passed to control of Mexico in 1821, and cumulated in the annexation by the United States in 1847. Subsequently, Native Americans were forced to relocate to reservations established by the United States government, typically in the less productive interior regions of San Diego County. The introduction of disease, increased mortality rates due to slave labor, and outright conflict throughout the contact period greatly reduced the native populations in San Diego County (Englehardt 1921). This was especially true for coastal populations as they were “the first to suffer extermination by disease and other vicissitudes introduced by the Europeans” (White 1963:119). It is therefore likely that the life-ways of Native Americans were drastically altered during this period and populations were forced inland. Without exception, ethnographies of the region were compiled after these events occurred, possibly skewing the data toward patterns of resource procurement of inland areas.

LITHIC AND CERAMIC ARTIFACTS ASSOCIATED WITH CHRONOLOGICAL CLASSIFICATIONS IN COASTAL SAN DIEGO COUNTY

Archaeologists, beginning with Malcolm Rogers in the 1930s and 40s, have applied several culture-chronology classifications to San Diego County. Changes in chipped stone technology are commonly used as one of the defining factors in these classifications. Three major culture complexes have been defined for coastal San Diego County, the San Dieguito (Paleoindian), La Jolla (Archaic), and Late Prehistoric, equating roughly with the Early, Middle, and Late Holocene (Figure 1.5). Below, I describe the major chipped stone artifacts associated with each traditional chronological period for coastal San Diego County. While different archaeologists use distinct nomenclatures and subdivisions for these time periods, these three major periods provide the general culture-historical framework used here.

SAN DIEGUITO/PALEOINDIAN PERIOD

The San Dieguito Period encompasses human occupation of the San Diego area prior to 7500 BP (see Figure 1.5). This time period roughly equates with the Early Holocene (9000-7600 BP). Defining characteristics of the San Dieguito artifact assemblage include distinctive types of scrapers, bifacial knives, projectile points, and an absence of ground

Table 1.1. San Diego County Chronological Classifications (after Byrd 1996)

Years B.P.	Reddy (1998)	Rogers (1939, 1945)	Moriarity (1966)	Meighan (1954); True (1958, 1966, 1970)		Warren (1968)		Byrd (1996)
		Yuman III Culture		Luiseno	Dieguenon	Yuman	Shoshonean	
		Yuman II Culture		San Louis Rey II San Louis Rey I	Cuyamaca Complex			Late Prehistoric
1000		Yuman I Culture		Shoshonean Intrusion				
2000	Late Holocene			Transition or Hiatus ?				Archaic
3000			La Jolla III					
4000		La Jolla II Culture				Encinitas Tradition		
5000	Middle Holocene		La Jolla II	La Jolla/Pauma Complexes				
6000		La Jolla I Culture						
7000			La Jolla I					
8000	Early Holocene	San Dieguito Culture	San Dieguito	San Dieguito		San Dieguito Tradition		Paleoindian
9000								
10,000								
	Pleistocene							

stone implements. However, recent research suggests that ground stone technology was used at least to some degree at San Dieguito sites (Hale and Becker 2006). The artifact assemblage is thought to represent a heavy emphasis on hunting (Meighan 1954; Moriarty 1966; Rogers 1939, 1945; True 1958, 1966, 1970; Warren, 1966, 1967, 1987; Warren and True 1961; Warren et al. 1961). The San Dieguito time frame overlaps the latter part of the Paleoindian Period (11,500 BP-8500/7500 BP) as defined by Byrd (1996). Much of the information concerning this time period was recorded from the C.W. Harris Site, known as the San Dieguito "type" site (Kaldenberg 1976; Warren 1967, 1966; Warren and True 1961; Warren et al. 1961).

The major chipped stone tools traditionally assigned to the San Dieguito artifact assemblage consist of retouched flakes, bifaces, and projectile points. These artifacts are typically made on volcanic/metavolcanic material, though some quartz, quartzite, and cryptocrystalline tools are present (Kaldenberg 1976; Moriarty 1966,1969; True and Bouey 1990; Warren 1966, 1967; Warren and True 1961; Warren et al. 1961). While cores are evident in the time period, descriptions of them are rare in the literature. Cores that are described range in size from very large (103 x 103 x 64 mm) to relatively small (21 x 15 x 21 mm). Recorded cores are typically multidirectional and often display signs of battering (Warren 1966, 1967).

The majority of flake and core tools from San Dieguito sites are classified as scrapers. Terms used to describe scrapers associated with the time period include ovoid, domed, and scraper plane (Kaldenberg 1976; Moriarty 1969; True and Bouey 1990; Warren 1966, 1967; Warren and True 1961; Warren et al. 1961). Ovoid scrapers are oval to circular in shape, and are typically obversely retouched. The tools are unifacially reworked on the distal end of the flake (Moriarty 1969:Figure 3; Warren 1966:14; 1967:173). Ovoid scrapers from the San Dieguito type-site range in size from 40-78 x 31-74 x 11-26 mm (Warren 1966). Domed scrapers are described as plano-convex in cross section, with flakes removed from the edges and distal end of the tool. Flakes are removed steeply to give the tools a domed appearance, which is formal and regular in shape. Domed scrapers typically range between 34-99 x 15.5-75 x 6.5 x 25 mm in size (Moriarty 1969:Figure 3; True and Bouey 1990:2; Warren 1966:14; 1967:173). Scraper planes are also domed in shape, but are apparently larger and less formally worked than ovoid and domed scrapers, ranging in size from 34-82.5 x 33-66 x 15-45 mm (Moriarty 1969:Figure 3; True and Bouey 1990; Warren 1966, 1967). These scrapers are described as being “made from a thick flake and steeply flaked around the periphery” (Warren 1966:14). Various end and side scrapers are also recorded for San Dieguito phase sites. These scrapers are usually unifacially retouched on either a lateral edge and one end of a flake (side scrapers) or distally or proximally in the case of end scrapers (Warren 1966:14; 1967:173).

Relatively long bifaces (ranging from approximately 62-162 mm in length), traditionally called knives, are considered fundamental attributes of San Dieguito sites (Kaldenberg 1976; Moriarty 1969; True and Bouey 1990; Warren 1966, 1967; Warren and True 1961; Warren et al. 1961). Two main morphological shapes are recorded for San Dieguito knives. Leaf shaped knives are typical of the San Dieguito assemblage. These knives are thin in cross section with rounded bases and narrow tips. A knife with parallel edges, thick cross section, and two rounded ends is also known for the time period (Moriarty 1969:Figure 3; True and Bouey 1990:13; Warren 1966:15; 1967:173). However, Warren states that several knives from the Harris Site “fall between these two forms so a clear-cut division between the two is difficult to make” (1966:174). The knife types together range from approximately 9 to 20 mm in width (True and Bouey 1990; Warren 1966).

Large projectile points, typically greater than five centimeters in length, are noted at several San Dieguito sites. Projectiles with slight shoulders and large stemmed bases, typical of Lake Mojave Points, are included in the assemblage (True and Bouey 1990:13;

Warren 1967:174). Leaf shaped projectile points, described as smaller versions of the leaf shaped San Dieguito knife, are also noted. The leaf shaped points have lenticular cross sections and round bases (Warren 1966:15; 1967:174). Eared projectile points, morphologically similar to Elko points, are also found at some sites (Moriarty 1969).

LA JOLLA/ARCHAIC PERIOD

The La Jolla Culture encompasses the time frame of approximately 7500BP-3000BP, equating roughly with the Archaic Period (8500BP-1300/800BP), and even more closely with the Middle Holocene, which ranges between 7600-3650 BP (Byrd 1996). The La Jolla tradition is thought to represent an increased emphasis on littoral resources, evidenced by shell midden sites. Rough cobble tools and the appearance of ground stone implements define the artifact assemblage (Gallegos 1985, 1987, 1992; Meighan 1954; Moriarty 1966; Rogers 1939, 1945; True 1958, 1966, 1970; Warren 1967, 1966, 1987; Warren and True 1961; Warren et al. 1961). Meighan (1954) and True (1958, 1966, 1970) label the inland manifestation of the La Jolla time period as the Pauma Complex of the Milling Stone Substratum, while Warren (1968) refers to the entire complex as the Encinitas Tradition. Gallegos (1987:30) suggests that the differences between the San Dieguito and La Jolla cultures might actually represent functional rather than temporal differences, stating that “site location, resources exploited, influence, innovation and adaptation to a rich coastal region over a long period of time” may account for differences between the two complexes. Although a number of La Jolla period sites have been dated, sites containing the following artifact types are typically assigned to the La Jolla period, even in the absence of dates or datable contexts.

Chipped stone artifacts associated with the La Jolla Complex are similar in many ways to San Dieguito type tools, but are considered less sophisticated (Warren and True 1961). Tools made from cortical flakes or flaked cobbles and distinctive utilized flakes, known as Teshoa flakes, are commonly assigned to this time period (Kaldenberg 1976; Moriarty 1966; Meighan 1954; Rogers 1939, 1945; True et al. 1974; 1991; Warren 1966, 1967, 1968; Warren and True 1961; Warren et al. 1961). While most of these tools are made of volcanic/metavolcanic material, more quartz, quartzite, and cryptocrystalline materials are utilized than in San Dieguito assemblages (Kaldenberg 1976; Warren 1966, 1967; Warren and True 1961; Warren et al. 1961). Descriptions of cores are also rare in the literature for La Jolla sites. The cores that are reported are multidirectional and range between 49-79 x 47-70 x 15-65 mm in size (Warren 1966).

Teshoa flakes are relatively large primary flakes (those with greater than 50 percent of the dorsal surface covered with cortex) with edge damage from use on the distal end. The flakes are unmodified except for this macro use-wear, apparently representing scalar edge damage (Kaldenberg 1976; Warren 1966:Plate 21, 1967; Warren and True 1961; Warren et al. 1961). Kaldenberg (1976) defines Teshoa flakes as being made of quartzite, while Warren (1966:17) lists them as being "struck from water worn cobble[s]." Warren (1966) describes a small sample of Teshoa flakes as ranging between 76-115 x 70-80 x 15 mm in size.

Scrapers from La Jolla sites are typically described as primary flakes or split cobbles with unifacial retouch along the edge (Kaldenberg 1976; Warren 1966, 1967; Warren and

True 1961; Warren et al. 1961). Domed scrapers occur in La Jolla contexts, but are described as being made on thick flakes, and fashioned in a more “crude” manner than San Dieguito domed scrapers, some with a “D” shaped outline (Warren 1966:17). A relatively small sample of these scrapers from a La Jolla component of the C.W. Harris site is recorded as ranging in size from 26-90 x 26-55 x 12-35 mm (Warren 1966).

While bifaces are rare in La Jolla contexts, knives and projectile points do occur (Kaldenberg 1976; Warren 1966, 1967; Warren and True 1961; Warren et al. 1961). Large bifacial knives, morphologically similar to San Dieguito types, are found in some La Jolla sites. Warren (1966:16-17) suggests that some of these knives may actually be San Dieguito in origin and therefore either intrusive or curated. Kaldenberg (1976:266) excavated a Lake Mojave point, described in San Dieguito assemblages, in a La Jolla context at the Far Western Site. Other projectiles from La Jolla sites include a leaf shaped point with a flat base (Warren 1966:16) and side notched points (True and Beemer 1982:238), as well as relatively small triangular shaped points, some serrated, typically associated with Late Prehistoric contexts (Warren 1966; Kaldenberg 1976).

LATE PREHISTORIC

The time period from the end of the La Jolla (3000 BP) to the historic period (approximately 1700 AD) is broken down into various culture-classification schemes (see Figure 1.5). These classifications generally correlate to the Late Holocene (3650 BP-Present), while the Late Prehistoric Period as defined by Byrd (1996) begins somewhat later (1300/800BP-200BP). Rogers (1939, 1945) classifies this time period into Yuman

Culture I-III for the San Diego County coast. Meighan (1954) and True (1958, 1966, 1970) break the north interior into San Luis Rey and Luiseño periods and the southern interior into the Cuyamaca and Diegueño periods, with Luiseño and Diegueño representing ethnohistoric populations in the north and south, respectively. Warren (1968) combines the coast and interior in a Yuman and Shoshonean period (see Figure 1.5). The Late Prehistoric Period includes the introduction of the bow and arrow, use of pottery, and a theorized greater emphasis on inland plant resources (Meighan 1954; Rogers 1945; True 1958, 1966, 1970; True and Waugh 1982; Warren 1964, 1968). Although there is ample evidence of coastal sites dated to the Late Prehistoric Period (Byrd et al. 1995; Byrd 1996, 1997; Reddy et al. 1996) the majority of the sites used to define this period have come from inland contexts.

While other lithic tools are represented, projectile point types seem to be the defining characteristic of Late Prehistoric site chipped stone tool assemblages. Relatively small projectile points were introduced in San Diego County during the Late Prehistoric Period, probably between 1300 and 800 BP (Byrd 1996). These smaller sized points, probably associated with bow and arrow technology, include several different diagnostic forms, most notably Cottonwood Triangular projectile points, which appear in San Diego County some time after 800 BP (Jones 1993:32-33; Meighan 1954; Rogers 1939, 1945; True et al. 1974; 1991; Warren 1968). While volcanic/metavolcanic material is still prevalent for chipped stone tools, projectile points from this time period are typically made on quartz, quartzite, or chert, and obsidian material is introduced (True et al. 1991).

Once again cores are rarely described, but appear to fall in the same size range as the La Jolla cores, measuring between 49-79 x 47-70 x 15-65 mm (True et al. 1991).
Domed scrapers and scraper planes are present in Late Prehistoric sites (Meighan 1954:218, Plate 1; True et al. 1974:54; 1991:20), but True et al. (1991:20) state that domed scrapers are rare at these sites and probably represent curated technology. Large bifaces, including leaf shaped knives, also continue into the Late Prehistoric time period, though they are less frequent than previously (Meighan 1954:218, Plate 1; True et al. 1974:54; 1991:20). True et al. (1974; 1991) describe knives from late sites ranging between 28-59 mm long, and between 4-25 mm wide, and domed scrapers between 25-82 x 25-68 x 15-34 mm in size.

Triangular shaped projectile points, typical of the Cottonwood Triangular morphological type, are prevalent in Late Prehistoric Sites. These triangular points typically have shallow to deep U or V shaped concave bases, though some variations have straight or convex bases. The majority of the Cottonwood points have straight, thin edges, but some are side notched and/or serrated (Meighan 1954:218, Plate 2; True et al. 1974:49; 1991:18-19). Rectangular to triangular shaped points with side notches are sometimes recovered from Late Prehistoric sites. These projectiles are morphologically the same as the Desert Side-notched point (Meighan 1954:218, Plate 2;True et al. 1974:50; 1991:18-19). Also found in Late Prehistoric contexts are leaf shaped projectile points, though these are uncommon and are not well made (Meighan 1954:218, Plate 2;True et al. 1974:50; 1991:19).

Archaeologists have typically suggested that ceramic use in northern San Diego County began between approximately A.D. 1750-1850 (Meighan 1954; True 1966). Early ethnographic accounts have also assumed a "relatively recent" diffusion of pottery use from the Kumeyaay of southern San Diego County to the north (Rogers 1936:21), although "the Luiseños themselves say positively that they were pottery makers" (Sparkman 1908:201). Accounts of early Spanish explorations into the region do note pottery use among the native populations as early as 1769 (Bolton 1926; Sparkman 1908). Based on a number of radiocarbon dates from Fry Creek in northern San Diego County, True and Waugh (1983) argue that ceramic use did not become common until the 1700s, although they demonstrate some usage as early as A.D. 1600. Griset (1996) has pushed the date for the use of ceramics back to as early as A.D. 1400 for coastal northern San Diego County using radiocarbon dates from soot taken directly from pottery sherds, with the dates typically ranging between A.D. 1515-1665, and dated sherds from interior sites in northern San Diego County to A.D. 1275-1630. Ceramics recently recovered from archaeological sites on Camp Pendleton in the Las Flores area have produced AMS dates ranging between A.D. 1445-1655 and A.D. 1645-1950 (Schaefer 2003). Ceramics appear to have been introduced slightly earlier, between A.D. 1200-1300, in the Kumeyaay territory of coastal northern San Diego County (Schaefer 2003). However, ceramics are not common for archaeological contexts in the region until approximately A.D. 1500-1600 (True et al. 1974). While the use of ceramics in northern San Diego County may not have been common until sometime after A.D. 1500-1600, the evidence strongly suggests at least some usage occurred in the area by the A.D. 1200-1300s.

The most commonly found ceramic type in San Diego County is Tizon Brownware. Tizon Brown was generally fired from residual clays, which are considered "self tempering" owing to high mineral contents (Schaefer 1996:200). Some ethnographers have suggested that it was unlikely that potters in the region purposely utilized temper in their clays. Rogers (1936:22) stated that if the Luiseño potters did use temper it would be the "only instance of this practice among any group of the Western Division" of Yuman and Shoshonean speaking people. However, Sparkman (1908:202) suggested that the Luiseño potters did utilize tempered clay, and Kroeber (1922) described potters from the region using crushed rock as a clay temper. Petrographic analysis from aboriginal ceramics at Camp Pendleton sites near the mouth of Las Flores Creek suggest that intentional tempering may have been practiced (Schaefer 2003). The results of the analysis indicated that the raw material for the ceramic artifacts was acquired locally from Las Flores clay. Yet the pottery contained a higher percentage of quartz inclusions than did the actual clay source, possibly demonstrating the use of crushed quartz to temper the clay (Schaefer 2003:170).

GEOLOGIC TIME PERIODS

Geological nomenclature is also often used to describe specific archaeological time periods, and may be better suited for describing time periods of sites that cannot be accurately assigned to particular cultural associations (Reddy 1998:13). Based on wide spread environmental and climatic changes, geologists typically subdivide the time sequence of human occupation in the region into the Late Pleistocene (20,000-10,000 BP) and the Holocene, or recent geologic time period (Byrd 1996; Gates 1993; Reddy 1998;

Pope et al. 2004). The Holocene Period, beginning roughly 10,000 years ago, has been subdivided into the Early Holocene, ending approximately 7600 BP, the Middle Holocene, ranging between 7600-3650 BP, and the Late Holocene, beginning around 3650 BP (Pope et al. 2004). Each of these geologic subdivisions equate roughly to one of the archaeological time periods described above (see Figure 1.5). These subdivisions are also based on climatic changes resultant in environmental and vegetation changes, such as the retreat of the glaciers in North America by 9000 years ago, the rise and stabilization of sea levels, and a general warming during the altithermal by approximately 6000 years ago (Gates 1993; Pope et al. 2004). These changes in turn affected the types and amount of resources and environments available to prehistoric peoples.

CHAPTER TWO

SITE DESCRIPTIONS AND CHRONOLOGY

The following chapter describes the sites used for the proceeding analysis. A brief history of each group of sites and excavation is presented. Site descriptions include a synopsis of the site's location, artifacts recovered, and amount of material excavated. The sites are also placed in chronological context. All dates are presented in radiocarbon years BP where possible. Each site is assigned to one of two periods, Early-Middle Holocene or Late Holocene, in order to facilitate comparative analysis of culture change between these time periods (Table 2.1). A total of 16 sites were selected for the analysis, eight assigned to the Late Holocene Period and eight to the Early-Middle Holocene. Six of the Late Holocene Period sites are located in inland settings and two are on the coast, while all of the Early-Middle Holocene sites are coastal.

SAN ELIJO LAGOON SITES

Archaeological excavation of the San Elijo Lagoon sites was carried out in association with a National Science Foundation Archaeology Program Grant (Byrd et al. 2004). The archaeological work was conducted between 2001-2002, and was completed through a cooperative effort between ASM Affiliates, Inc. (ASM) and the University of California San Diego. A total of 58.84 m^3 of archaeological material was excavated from the San Elijo Lagoon sites. Archaeological work consisted of the excavation of 1 x1 and 1 x 2

Table 2.1. Radiocarbon Dates for San Elijo Lagoon Sites

Site #	Provenience	Material	Conventional Age	Calibrated Age Sigma 1 (68% probability)	Calibrated Date Sigma 2 (95% probability)
SEL-1A	Unit 1, 60-70 cm	*Argopecten*	8396 ± 50 BP	BC 6819-6631	BC 6924-6564
	Unit 2, 40-50 cm	*Argopecten*	8324 ± 50 BP	BC 6698-6413	BC 6817-6460 BC 6879-6856
	Unit 10, 50-60 cm	*Mytilus*	8616 ± 51BP	BC 7014-6890	BC 7078-6807 BC 7325-7302
SEL-1B	Unit 5, 64-74 cm	*Argopecten*	6225 ± 51 BP	BC 4578-4439	BC 4649-4365
	Unit 6, 30-40 cm	*Argopecten*	7498 ± 63BP	BC 5848-5714	BC 5924-5654 BC 5952-5945
	Unit 7, 30-40 cm	*Argopecten*	7944 ± 57 BP	BC 3086-2908	BC 3198-2875 BC 3248-3201
	Unit 7, 50-60 cm	*Argopecten*	4944 ± 57 BP	BC 4680-4487	BC 4771-4388
	Unit 8, 30-40 cm	*Argopecten*	6322 ± 81 BP	BC 5768-5610	BC 5862-5524
SEL-1C	Unit 14, 20-30 cm	*Argopecten*	7387 ± 66 BP	BC 2187-2039	BC 2272-1973
SEL-2	Unit 1, 40-50 cm	*Argopecten*	7437 ± 47 BP	BC 5777-5673	BC 5832-5630
	Unit 2, 40-50 cm	*Argopecten*	4281 ± 51 BP	BC 2221-2044	BC 2313-1970
SEL-3	Unit 1, 50-60 cm	*Argopecten*	7427 ± 50 BP	BC 5768-5662	BC 5827-5621
	Unit 2, 40-50 cm	*Argopecten*	7724 ± 91 BP	BC 6102-5897	BC 6208-5815
	Unit 2, 50-60	*Chione*	7566 ± 52 BP	BC 5914-5784	BC 5973-5733
	Unit 2, 110-115	*Chione*	7213 ± 87 BP	BC 5614-5470	BC 5694-5378
	Unit 7, 50-60 cm	*Argopecten*	7509 ± 43 BP	BC 5838-5733	BC 5904-5699
	Unit 7, 110-120 cm	*Argopecten*	7266 ± 42 BP	BC 5625-5537	BC 5662-5485
SEL-4	Unit 1, 40-50 cm	*Argopecten*	4369 ± 63 BP	BC 2381-2181	BC 2458-2084 BC 2075-2067
	Unit 1, 40-50 cm	Charcoal	317 ± 47 BP	AD 1514-1600 AD 1615-1642	AD 1468-1657
	Unit 2, 30-39 cm	*Argopecten*	7246 ± 74 BP	BC 5626-5497	BC 5706-5449
	Unit 3, 140-150 cm	*Argopecten*	2802 ± 40 BP	BC 369-251	BC 394-184
	Unit 3, 70-80 cm	*Argopecten*	7475 ± 42 BP	BC 5807-5711	BC 5867-5666
	Unit 6, 40-50 cm	*Chione*	7458 ± 43 BP	BC 5796-5699	BC 5849-5648
SEL-5	Unit 1, 30-40 cm	*Argopecten*	3941 ± 49 BP	BC 1762-1614	BC 1855-1544
	Unit 2, 30-40 cm	*Argopecten*	3918 ± 72 BP	BC 1757-1555	BC 1870-1486
	Unit 3, 20-30 cm	*Argopecten*	7402 ± 78 BP	BC 5768-5623	BC 5863-5552
	Unit 5, 60-70 cm	*Argopecten*	6694 ± 43 BP	BC 5079-4934	BC 5192-4890
	Unit 6, 40-50 cm	*Argopecten*	7399 ± 44 BP	BC 5729-5640	BC 5789-5612
SEL-6	Unit 1, 20-30 cm	*Argopecten*	4412 ± 80 BP	BC 2443-2216	BC 2560-2100
	Unit 1, 60-70 cm	*Argopecten*	7634 ± 46 BP	BC 5979-5869	BC 6026-5800
	Unit 2, 60-70 cm	*Argopecten*	7733 ± 44 BP	BC 6073-5967	BC 6150-5909
	TU 1, 10-20 cm	Shell	7270 ± 80 BP	BC 5600-5455	BC 5670-5400
	TU 1, 60-70 cm	Shell	7810 ± 80 BP	BC 6130-5960	BC 6200-5885
	TU 1, 120-130 cm	Shell	6560 ± 70 BP	BC 4920-4720	BC 5015-4670
SEL-9	Unit 2, 130-140 cm	*Argopecten*	5235 ± 67 BP	BC 3501-3345	BC 3616-3268
	Unit 2, 140-146 cm	*Chione*	5256 ± 55 BP	BC 3502-3364	BC 3599-3330
	Unit 6, 130-140 cm	*Ostrea*	4539 ± 41 BP	BC 3693-3595	BC 3733-3522
	Unit 7, 130-140 cm	*Astrea*	5206 ± 41 BP	BC 3459-3340	BC 3512-3294

meter test units, 20 cm diameter auger probes, and 40 x 40 cm column samples abutting and adjacent to each test unit. Units were excavated in natural stratigraphic levels where possible, and in 10 cm levels within natural strata, while sediments from augers were examined in 20 cm levels. All sediments from units and augers were screened through 1/8-inch mesh, while sediments from column samples were subjected to flotation and water screening.

Excavations were conducted at eight sites, labeled SEL-1 through SEL-7, and SEL-9, within the San Elijo Lagoon Reserve (Figure 2.1). Three loci, A-C, were recorded for SEL-1. Each of these loci is treated as a separate site because each distinct locus contained individual components dated to different time periods. All of the San Elijo Lagoon sites consisted primarily of shell middens, except for SEL-2 and SEL-7, which were characterized as shell scatters. Table 2.2 summarizes the cultural material recovered from the San Elijo Sites. Calibrated C^{14} dates were obtained for all of the sites except SEL-7 (see Table 2.1). Only two lithic artifacts, both interior debitage, were recovered from SEL-7; the site was therefore disregarded for this study. Based on conflicting evidence for assignment to a specific time period, SEL-4 and SEL-5 are also not considered in the analysis. Dated materials from the sites were almost exclusively individual shells, with one charcoal sample from SEL-4 providing the lone date of non-shell origin. *Mytilus*, *Chione*, *Argopectin*, *Ostrea*, and *Protohaca* were the most abundant invertebrate species recovered from the San Elijo Lagoon sites, with a limited amount of *Donax* recovered from SEL-1A, SEL-2, SEL-4, SEL-5, and SEL-6. SEL-4

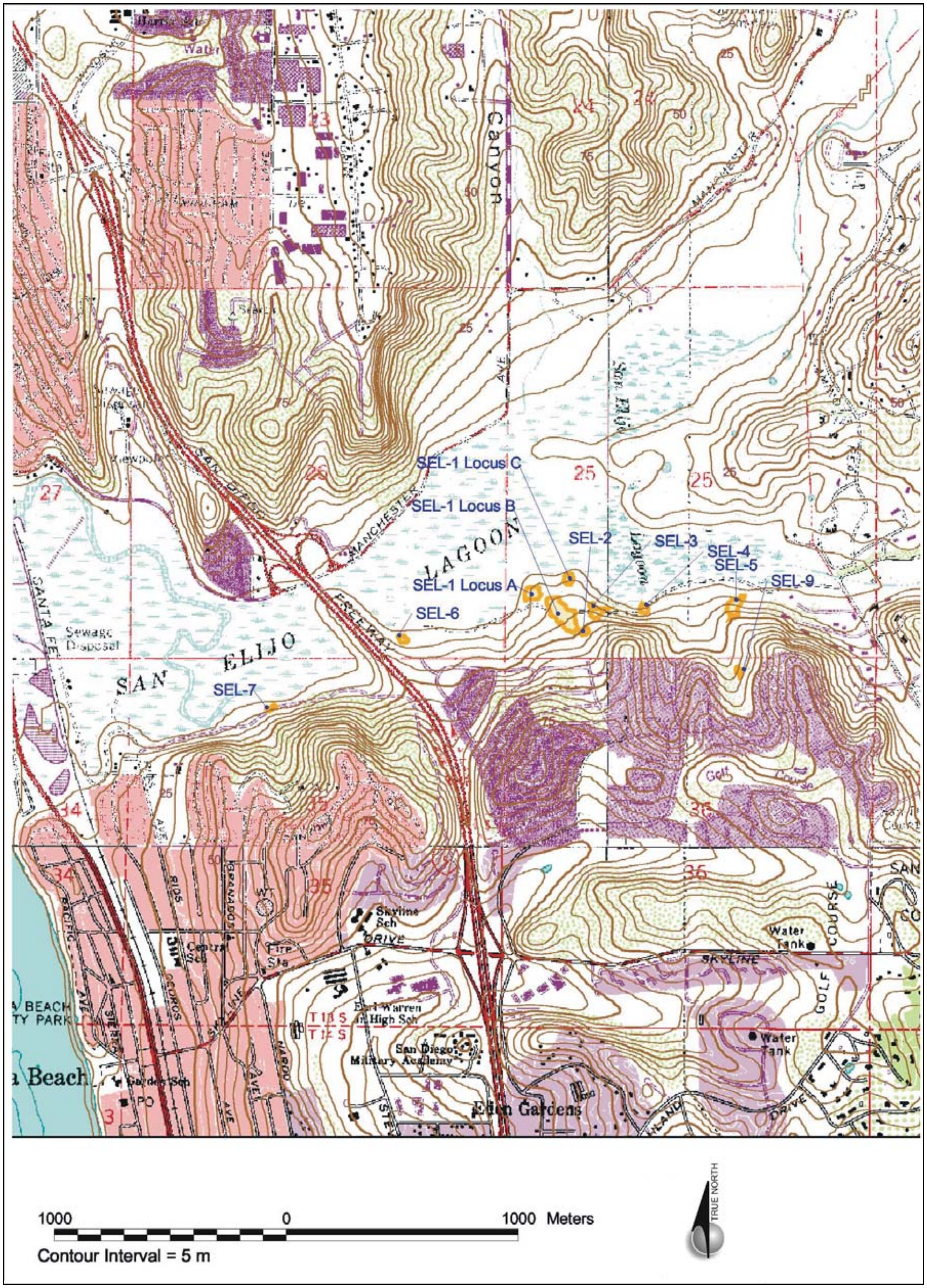

Figure 2.1. Location of SEL sites

Table 2.2. Artifact Summaries of Sites Selected for Analysis

Site #	Bone Artifact	Ceramic	Debitage	Ground Stone	Lithic Tool	Manuport	Percussing Tool	Shell Artifact	Total
Early-Mid Holocene									
Coastal Sites									
SEL-1A	1		642	6	19		6	4	678
SEL-1B	3		232	4	5		3	5	252
SEL-1C			22		1		1	1	25
SEL-2	2		53	2	4			1	62
SEL-3			178	28	14		5	8	233
SEL-6	1		100	3			2	3	109
SEL-9	3		405	6	2		2		418
SDI-10,723 EH			82	3	2				87
Subtotal	**10**		**1714**	**52**	**47**		**19**	**22**	**1864**
Late Holocene									
Coastal Sites									
SDI-812/H		18	350	2	4	1		1	376
SDI-10,723 LH	1		418	68	24		4	3	518
Interior Sites									
SDI-10689			73	7	5				85
SDI-10714		165	650	10	11		1		837
SDI-12983			113		3				116
SDI-14571		13	412	12	14		1		452
SDI-14659			40		2				42
SDI-14686			140	4	3		1		148
Subtotal	**1**	**196**	**2196**	**103**	**66**	**1**	**7**	**4**	**2574**
Grand Total	**11**	**196**	**3910**	**155**	**113**	**1**	**26**	**26**	**4438**

and SEL-5 contained substantially more *Donax* than the other SEL sites, all of which could be assigned to the early period (i.e., Early-Middle Holocene).

SEL-1A

Locus A of SEL-1 appears to be a multi-component site, containing the earliest dates of all the San Elijo Lagoon sites. SEL-1A is a relatively large site, encompassing approximately 3000 m^2. Seven 1 x 1 meter units were excavated at the site, with a total of 8.12 m^3 of material investigated. Cultural materials recovered from the site include flaked and ground stone, percussion tools, shell artifacts, and one bone tool (see Table 2.2), in addition to vertebrate and invertebrate faunal remains. Although the site probably represents multiple occupation episodes, radiocarbon dates from SEL-1A indicate the occupations occurred during the Early Holocene, at approximately 8300 BP, based on three radiocarbon dates (see Table 2.1). The northwest edge of SEL-1A is adjacent to a cutbank of alluvial deposits above the existing lagoon.

SEL-1B

This locus is located to the southeast and slightly upslope of SEL-1A. The locus is the largest of all the shell middens, measuring 10,617 m^2, and also contained the densest artifact assemblage (see Table 2.2). A total of 4.64 m^3 of material was excavated from four 1 x 1 meter units at the site (Byrd et al. 2004:74). Radiocarbon dates from Locus B of SEL-1 indicate a multi-component site with Early to Middle Holocene occupations, with five dates ranging from approximately 6225 to 7944 BP (see Table 2.1).

SEL-1C

Locus C is on the edge of an alluvial terrace above the existing lagoon, northeast of SEL-1A. The site encompasses approximately 1425 m^2. SEL-1C has the lowest artifact frequency of SEL-1. However, only one 1 x 1 meter unit was excavated at the locus, resulting the excavation of 1.16 m^3 of sediment (Byrd et al. 2004:74). Additionally, only one C^{14} date was obtained from this portion of the site (see Table 2.1). The site is dated to approximately 7387 BP, within the Middle Holocene. Cultural materials identified at the site consist of vertebrate and invertebrate remains, shell artifacts, percussion tools, and flaked stone (see Table 2.2).

SEL-2

This site is approximately 20 meters south of SEL –1B, on an east trending slope extending to the south edge of the lagoon. The site is a relatively sparse shell scatter (see Table 2.2), and measures approximately 817 m^2. A total of 2.32 m^3 of sediment was excavated from two 1 x 1 meter units at the site (Byrd et al. 2004:74). SEL-2 is a multiple component site, dated to between 4300 and 7400 BP by two radiocarbon dates, falling within the Early and Middle Holocene (see Table 2.1).

SEL-3

Fifty meters to the northeast of SEL-2 lies SEL-3, on a relatively steep south-north trending slope. SEL-3 measures 2097 m^2, and is located approximately 29.44 meters above mean sea level (amsl). Cultural materials recovered from the site include debitage, flaked stone, percussion tools, ground stone implements, and shell artifacts (see Table 2.2). Seven 1 x 1 meter units, one 1 x 2 meter unit, and 10 auger samples excavated at the site investigated a total of 10.44 m^3 of sediment (Byrd et al. 2004:74-75). Cultural materials recovered from the site include debitage, flaked stone, percussion tools, ground stone implements, and shell artifacts (see Table 2.2). Six dates ranging from approximately 7200 to 7700 BP were recovered from six shell samples, and place SEL-3 in the Early Holocene (see Table 2.1).

SEL-4

The site is approximately 200 meters east of SEL-3, to the north and northeast of a relatively large hill. SEL-4 covers 943 m^2, and is at the lowest elevation of the San Elijo Lagoon sites, approximately 6.05 meters amsl. Four 1x1 m units, two 1 x 1 m units, and 15 auger samples were excavated at the site. A total of 10.44 m^3 of material was investigated through excavation activities (Byrd et al. 2004:75). SEL-4 contains multiple components, with three Early Holocene dates of 7200 BP, and three later dates of 4400, 2800, and 300 BP, indicating some amount of Late Holocene occupation (see Table 2.1).

Additionally, numerous disturbances associated with modern activities and natural sedimentation were recorded at the site, potentially resulting in date reversals and discrepancies noted in Units 1 and 3 (see Table 2.1). The site was therefore discarded from the analysis.

SEL-5

SEL-5 is situated on the north-facing slope near the base of a hill. Six 1 x 1 meter units were excavated at the site, which measures 3664 m^3. Excavation efforts at the site produced a total of 6.96 m^2 of sediment (Byrd et al. 2004:76). Five radiocarbon dates from SEL-5 range from 3900-7400 BP (see Table 2.1), indicating multiple periods of occupation. Cultural materials recovered at the site include ground stone, flaked stone, percussion tools, ceramics, and shell artifacts, as well as vertebrate and invertebrate remains. SEL-5 was not considered for the analysis based on the occurrence of ceramic artifacts and high density of *Donax* marine shell, both indicators of Late Holocene occupations, mixed in with the deposits dating to the Early and Middle Holocene.

SEL-6

This multi-component site is west of SEL-1, approximately 50 meters from the existing lagoon. Two 1 x 1 meter units were excavated at the site, resulting in the recovery of 2.32 m^3 of material (Byrd et al. 2004:76). Dates from the site are within the Early to Middle Holocene, ranging between approximately 4400 and 7800BP. SEL-6 is 983 m^2 in area. Cultural material collected from the site includes flaked stone and ground stone artifacts (see Table 2.2), and animal bone and marine shell ecofacts. A total of six dates were reported for the site, two of which fall into the Early Holocene, and four in the Middle Holocene (see Table 2.1). However, the two early dates are on the edge of the Early Holocene (7700 and 7800 BP), with another two on the edge of the Middle Holocene (7200 and 7600 BP), suggesting occupations took place in the transition between the Early and Middle Holocene, and continued into the Middle Holocene (see Table 2.1).

SEL-9

This shell midden is located on the east side of a relatively deep alluvial gully. The site measures 1686 m^2 in area. A total of 10.44 m^3 of sediment was examined from seven 1 x 1 meter units, one 1 x 2 meter unit, and 21 auger tests excavated at the site (Byrd et al. 2004:76), resulting in the recovery of 418 artifacts (see Table 2.2). SEL-9 is dated at 4500 to 5200 BP, within the Middle Holocene, by four radiocarbon dates (see Table 2.1).

LAS PULGAS CORRIDOR SITES

ASM tested a series of sites along the Las Pulgas Corridor within the Las Flores Creek Drainage on Marine Corp Base Camp Pendleton (Hale and Becker 2006). The archaeological excavations were conducted between 2004 and 2005. A total of 25 sites were tested for the project (Figure 2.2). Only those sites containing at least 20 pieces of debitage were included in this study. Additionally, only those sites that could be securely dated to either the Early-Middle Holocene or Late Holocene periods were considered for this analysis. Hence, a total of eight sites from the Las Pulgas Corridor were analyzed for this study (see Table 2.1). Two of these sites were on the coast and the remaining sites were located in the interior. Both of the coastal sites contained relatively thick, subsurface shell lenses, characteristic of shell midden sites. The Las Pulgas sites were classified as one of four site types: shell middens; bedrock milling sites; artifact scatters; and lithic scatters. Excavation techniques included 0.5 x 0.25 m shovel test pits (STP); 1 x 0.5 m, 1 x 1 m, and 1 x 2 m control units; 40 x 40 cm column samples taken from the northwest corner outside of and abutting selected control units; and 20 cm auger probes. STPs were excavated in 20 cm levels to a maximum depth of 80 cmbs. Auger holes were also excavated in 20 cm increments, while arbitrary 10 cm levels were excavated for control units. Sediments from STPs, units, and augers were screened through 1/8-inch mesh, while artifacts from column samples were recovered through flotation and water screening. Additionally, mechanical coring was conducted at SDI-812/H, consisting of 14 cm diameter metal bores mounted on the back of a drilling rig; bore holes excavated to depths of up to 230 cm. Matrix from each borehole was collected and water screened. The majority of the Las Pulgas sites date to the Late Holocene Period, with the exception of one Early Holocene component identified at the SDI-10723 shell midden site. Radiocarbon dates were obtained for four of the sites (Table 2.3) while the remaining four sites were dated though the occurrence of diagnostic artifacts and/or ecofacts. Brief descriptions of the Las Pulgas sites are given below.

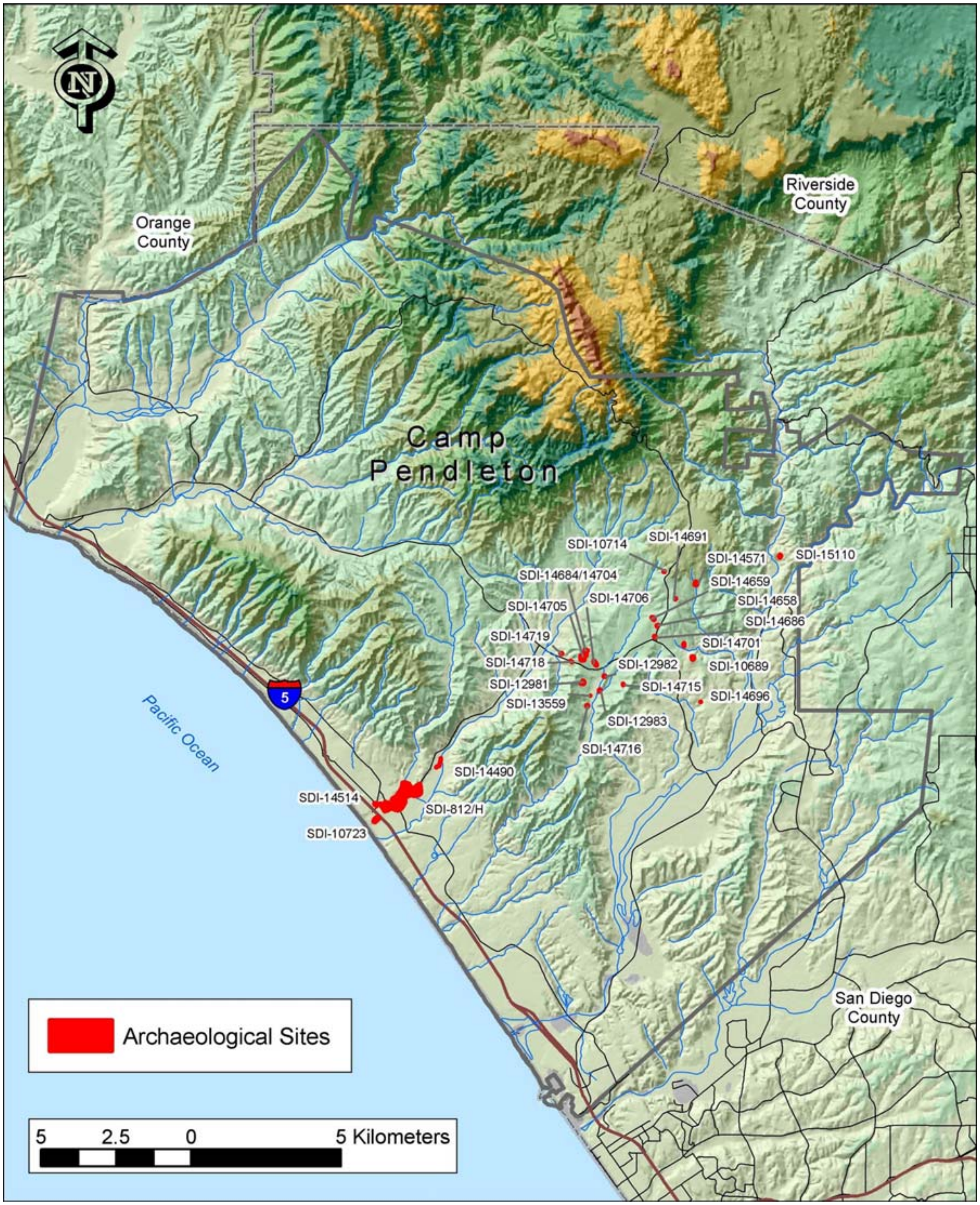

Figure 2.2. Location of Las Pulgas sites

Table 2.3. Radiocarbon Dates for Las Pulgas Corridor Sites

Site #	Provenience	Material	Conventional Age	Calibrated Age Sigma 1 (68% probability)	Calibrated Date Sigma 2 (95% probability)
SDI-812/H	Unit 1, Column, 80-90 cm	*Donax*	1030 ± 40 BP	AD 1460 - 1530	AD 1440 - 1620
	Unit 5, Column, 40-50 cm	*Donax*	1580 ± 40 BP	AD 1010 - 1070	AD 960 - 1160
	Unit 5, Column, 80- 90cm	*Donax*	870 ± 50 BP	AD 1620 - 1690	AD 1520 - 1810
	Unit 7, Column, 60-70 cm	*Donax*	960 ± 80 BP	AD 1480 - 1660	AD 1430 - 1710
	Unit 8, Column, 30-40cm	*Donax*	880 ± 40 BP	AD 1620 - 1680	AD 1530 - 1710
	Unit 8, Column, 70-80 cm	*Donax*	1050 ± 50 BP	AD 1450 - 1520	AD 1420 - 1620
	Unit 10, Column, 70-80 cm	*Donax*	930 ± 50 BP	AD 1520 - 1660	AD 1480 - 1690
	Unit 18, Dry Screen, 70-80 cm	*Donax*	870 ± 50 BP	AD 1620 - 1690	AD 1520 - 1810
	Unit 19, Column, 50-60 cm	*Donax*	580 ± 60 BP	-	-
	Unit 22, Dry Screen, 80-90 cm	*Donax*	880 ± 70 BP	AD 1540 - 1700	AD 1490 - 1830
	Unit 24, Dry Screen, 90-100 cm	*Donax*	790 ± 50 BP	AD 1670 - 1820	AD 1640 - 1910 AD 1910 - 1950
SDI-10723	Unit 1, Column, 40-45 cm	*Donax*	1060 ± 60 BP	AD 1440 - 1520	AD 1400 - 1630
	Unit 1, Dry Screen, 60-70 cm	*Chione*	8070 ± 40 BP	BC 6410 - 6330	BC 6440 - 6240
	Unit 3, Column, 30-40 cm	*Donax*	1310 ± 60 BP	AD 1260 - 1340	AD 1190 - 1420
	Unit 3, Dry Screen, 50-60 cm	*Chione*	7800 ± 40 BP	BC 6150 - 6120 BC 6110 - 6020	BC 6200 - 5980
SDI-12983	Unit 1, 80-90 cm	Charcoal	770 ± 40 BP	AD 1240 - 1280	AD 1200 - 1290
	Unit 1, 90-100 cm	Charcoal	750 ± 40 BP	AD 1260 -1290	AD 1220 - 1300
SDI-14571	Unit 1, 20-30 cm	Charcoal	380 ± 40 BP	AD 1450 - 1520 AD 1590 - 1620	AD 1440 - 1640

Coastal Sites

SDI-812/H

SDI-812/H is a large and intensely tested site containing both historic and prehistoric components (Cagal et al. 1996; Rasmussen-Foster and Woodman 2001; Rosenthal et al. 2001a; Schaefer 1992). Five loci, A-E, are recorded for the site, which measures in excess of 227,000 m^2. Locus A consists of a Spanish Period *Estancia*, and may also include the remains of the ethnohistoric Luiseño village of *Huisme*. Locus B consists of an historic Adobe Ranch House above a Late Prehistoric/protohistoric archaeological deposit. Relatively low density deposits of marine invertebrates (primarily *Donax*) vertebrate remains, aboriginal ceramics, ground stone, and lithic artifacts characterize Loci C-E. Radiocarbon dates from these loci also indicate Late Prehistoric to Historic occupations. ASM tested Loci D and E of SDI-812/H for the Las Pulgas Corridor archaeological evaluation (Hale and Becker 2006: 59-116). Only the easternmost loci of the site, Locus D and Locus E, are therefore considered for this analysis. Results of the testing program conducted by ASM indicate that Loci D and E are actually connected by archaeological deposits, and that both loci continue further south than previously recorded. Deposits at Loci D and E of SDI-812/H are predominantly redeposited sediment and displaced cultural deposits associated with high velocity alluvial events from intermittent flooding of Las Flores Creek. Locus C, located in the same geophysical setting as Loci D and E, was probably subjected to the same depositional regime, while Loci A and B are at slightly higher elevations to the west and may contain deposits with greater integrity.

The testing program for Loci D and E consisted of the excavation of 46 STPs, 28 auger holes, 14 1 x 0.5 m units, 11 1 x 1 m units, 12 column samples, and 40 mechanical cores. All control units and column samples from the site were excavated to 100 cmbs, while STPs and auger probes were taken to depths of 80cm. Cultural materials recovered from SDI-812/H consisted of 442 artifacts and 10,643.2g of invertebrate and vertebrate remains. Two Cottonwood Triangular projectile points, one made of quartz and one of Piedra del Lumbre chert (PDL), were recovered from the site. The majority of all lithic artifacts recovered from the site were made of PDL. Ceramics from the site consisted entirely of body sherds, primarily Tizon Brown Ware. One Chestnut Cowry shell pendent and one shell bead were recovered from the site. A relatively large PDL cobble found at the site may represent lithic raw material culturally transported to the site. The shell assemblage from the site was made up almost entirely of *Donax*. Calibrated C^{14} dates obtained from the site indicate Late Prehistoric occupations, with calibrated ages ranging from A.D. 960 to1830. These dates are corroborated by the presence of: Cottonwood Triangular points, typically found in San Diego County by approximately A.D. 1200 (Jones 1993:32-33; Meighan 1954; Rogers 1939, 1945; True et al. 1974; 1991; Warren 1968); ceramics, thought to be introduced into the region by A.D. 1200-1300 at the earliest (Griset 1996; Schaefer 2003); and *Donax*, which was probably heavily exploited in the area between approximately A.D. 530 and 1515 (Byrd 1997). One calibrated C^{14} date from 90-100 cmbs in Unit 24 indicate date ranges of 1640-1950, extending into the modern period (see Table 2.3). However, historic metal debris was also recovered from this unit at depths ranging from 70-100 cmbs.

SDI-10723

SDI-10723 is a moderate sized shell midden site (60 x 35 m) located on a terrace directly above the beach. A large shell midden site, SDI-811, is recorded on the beach directly below SDI-10723. The site contains two dated components obtained from individual shell samples, one dating to between 8070-7800 BP, and a later component dated at 1310-1060 BP (see Table 2.3). The Late Holocene component, designated, SDI-10723 LH, consisted of shell deposits within a dark organic matrix, while the earlier component of the site (SDI-10723 EH) was identified within a lighter brown, more compact sediment. The dark organic matrix of SDI-10723 LH extended to 45 cm below the ground surface. The two components were excavated and collected separately in the field based on their differential stratigraphic profiles. A total of 11 STPs, 10 auger holes, five

1 x 0.5 m units, and three 1 x 1 m units were excavated at the site. Two of the 1 x 0.5 m units from the site were excavated to depths of 60 cm, and the others to 50, 70, and 80 cmbs, while the 1 x 1 m units were excavated to 40, 60, and 70 cm deep. Column samples were taken for all of the 1 x 0.5 m and 1 x 1 m units (Hale and Becker 2006:123-138).

SDI-10723 LH

Cultural material collected from this portion of the shell midden included 26913.9 g of invertebrate remains and 46.9 g of bone. *Donax* is the dominant marine invertebrate species at this component of site. Vertebrate remains from the site consisted primarily of cottontail rabbit, ground squirrel, and pocket gopher bone. Flaked stone artifacts from the component included two wedging tools and a drill. Metavolcanic sources were predominant in the lithic raw material from the site. Ground stone artifacts from the site were typically made of granite or metavolcanic material. Three *Olivella* shell beads and a bone tool were also found at the site. The invertebrate assemblage is overwhelming represented by *Donax*. However, the *Donax* recovered from the lower levels of the shell midden appeared intrusive. The lower midden levels also contained higher percentages of other shell species, including *Tivela stultorum* and *Ostrea lurida*. Additionally, two of the *Olivella* shell beads from the upper portion of the midden are of the “Disk” class, indicative of the Late Prehistoric to Protohistoric Periods (Bennyhoff and Hughes 1987:135-36).

SDI-10723 EH

Chione and *Argopectin* dominate the Early Holocene portion of the archaeological deposit. The lower midden levels also contained higher percentages of other shell species, including *Tivela stultorum* and *Ostrea lurida*. Flaked stone tools from the component were limited in number, consisting of one utilized flake and a modified cobble. The lower midden also included three ground stone artifacts.

INTERIOR SITES

Bedrock Milling Sites

Artifact scatters that also contained bedrock milling features were classified as Bedrock Milling Sites. Milling features from these sites typically consisted of milling slicks or mortars on large granite boulder outcrops. All three of the sites of this type were located within oak stands, and presumably were associated with acorn or grass seed collecting and processing.

SDI-10689: The site is located on the top of a granite knoll, with milling slicks present on four exposed granite boulder outcrops. It area is approximately 145 x 80 m. Archaeological excavation at the site consisted of 17 STPs and one 70 cm deep 1 x 0.5 m unit (Hale and Becker 2006: 143-150). A total of 85 artifacts was collected from the bedrock milling site. A Cottonwood Triangular projectile point made of quartz was among the artifacts recovered from the site. PDL and metavolcanics were relatively evenly represented with regards to lithic raw material comprising flaked stone artifacts collected from the site. It is interesting to note that the formed lithic artifacts made of metavolcanic material from the site, a multidirectional core and an early/middle stage biface, both displayed heavy patinas. This suggests they were situated on the site's surface for a relatively long period of time, and may indicate an early Late Holocene occupation of the site. Although no C^{14} dates were acquired for the site, the Cottonwood Triangular projectile point indicates a Late Holocene date for the site.

SDI-10714: The site is located on a low-lying alluvial ridge. Bedrock mortars, milling slicks, and rock art in the form of circular cupules characterize the milling features at the site. Excavation units consisted of 18 STPs, a 1 x 0.5 m unit excavated to 40 cmbs, a 1 x 1 m unit 50 cm deep, and a 20 cm deep 1 x 2 m unit (Hale and Becker 2006:151-162). The bedrock milling site contained the highest number of artifacts (n = 845) of all the Las Pulgas Corridor sites, and a dense midden deposit containing cultural material was identified adjacent to the bedrock milling features. The artifact assemblage included three Cottonwood Triangular projectile points. One of the points, and possibly a second, display evidence of fractures due to impact, while the third was probably broken during manufacture. The majority of debitage from the site consisted of metavolcanic raw material, while most of the formed stone tools from the site were made of PDL. Ceramics from the site include 3 rim sherds, 161 body sherds, and one modified sherd, all characterized as Tizon Brownware. Ceramics were probably introduced into northern San Diego County some time after A.D. 1200 (Griset 1996; Schaefer 2003). Two pieces of schist and 1 piece of sandstone with abraded edges were identified at the site, possibly representing pendants. An *Olivella* shell bead was recovered through flotation, and 3 bone tools were found within surface and subsurface contexts. A total of 18.9g of invertebrate remains, primarily *Donax*, and 29.7g of vertebrate remains was recovered from the site. The presence of ceramics, Cottonwood points, and *Donax* combine to make a strong case for a Late Prehistoric occupation of the site, reliably placing the site in the Late Holocene. The *Olivella* shell bead from the site also indicates a Late Prehistoric date. The bead is of the "Disk" classification assigned to the Late Prehistoric to Protohistoric Period by Bennyhoff and Hughes (1987:132, 135-36).

SDI-14571: The site, located on a colluvial ridge east of an intermittent drainage, is a bedrock milling site measuring 140 x 105 m in size. A total of 25 STPS, and two 1 x 0.5 m units was excavated at the site. The 1 x 0.5 m units were excavated to depths of 40 and 80 cmbs (Hale and Becker 2006:163-174). Artifacts from the site consist of bedrock mortars and slicks, ground stone, chipped stone, ceramics, and a small amount of vertebrate and invertebrate remains. A small hearth feature was also recorded during excavations. Radiocarbon dates from the site indicate a Late Prehistoric occupation (see Table 2.3). In addition to bedrock milling features, excavations at SDI-14571 yielded 455 artifacts, and 15.4g of ecofacts. Worked stone artifacts from the site were made primarily of metavolcanic material, while metavolcanic and PDL were equally represented in the debitage. Two pieces of ochre and a slate manuport were also identified at the bedrock milling site. Ceramics from the site consist of Tizon Brown Ware body sherds. Identified invertebrate remains from the site consist of *Donax*, while the vertebrate assemblage includes burned rabbit, deer, and naturally deposited bird and rodent bone. The occurrence of both ceramics and *Donax* suggest Late Prehistoric utilization of the site, corroborated by a calibrated C^{14} date of A.D. 1440-1640 from charcoal associated with the hearth feature. Hence, the artifact assemblage from SDI-14571 is considered as a Late Holocene site for the analysis.

Artifact Scatters

Artifact scatters and lithic scatters are defined differently because the assumption based on higher artifact diversity is that artifact scatters are typically occupied for longer durations. Artifact scatters were defined as those interior sites containing at least two artifact categories and without bedrock milling features. Artifact classes are defined here as general manifestations of material culture, such as flaked stone, ground stone, percussion tools, and ceramics, as well as ecofact classes identified as either vertebrate or invertebrate remains. Flaked stone artifacts are further subdivided into the six artifact classes of debitage, bifaces, cores, retouched flakes, utilized flakes, and modified cobbles. Seven artifact scatters were identified along the Las Pulgas Corridor. A total of 172 STPs, fourteen 1 x 0.5 m units, and three 1 x 1 m units were excavated at the artifact scatters (Hale and Becker 2006: 180-252). In addition to flaked stone artifacts these sites also produced small numbers ground stone artifacts, and may represent single or multi-component temporary campsites and activity areas. Unmodified quartz crystals were also recovered from two of these sites, SDI-12981 and SDI-14701. In addition to ground and flaked stone artifacts, SDI-14686 also contained percussion tools and a few invertebrate remains. Artifact scatters ranged in size from 4550 to 20,460 m^2 in size, and were located at elevations of 260-560 meters amsl. These sites were typically located on alluvial ridges in interior settings. Although no C^{14} dates were obtained for any of the artifact scatters, the presence of *Donax* at SDI-14686 suggests a Late Prehistoric component for this site. Therefore this site is the lone artifact scatter considered for this analysis, and is assigned to the Late Holocene Period.

Lithic Scatters

Lithic scatters consisted of those inland sites comprised of only flaked stone artifacts. Four lithic scatters from the Las Pulgas Corridor were utilized for this study (see Table 2.3). Archaeological work at these sites included the excavation of 84 STPs, eight 1 x 0.5 m units, and one 1 x 1 m unit (Hale and Becker 2006: 253-306). Lithic scatters contained only flaked stone artifacts, and probably represent temporary activity areas primarily utilized for lithic reduction, possibly associated with hunting activities. These sites were located on alluvial ridges and at confluences of Las Flores Creek tributaries at elevations of between 350-560 meters amsl. The sites ranged in size between 6000 to 32,000 m^2 in size. Only one C^{14} date was acquired from a lithic scatter site (see Table 2.3). Late Prehistoric dates of A.D. 1200-1300 were obtained from charcoal at SDI-12983. The Cottonwood point from the site corroborated these date ranges. Another Cottonwood point was recovered at SDI-14686, suggesting a Late Prehistoric utilization of this site as well. Both these sites are thus assigned to the Late Holocene Period for this analysis.

CHAPTER TRHEE

THEORETICAL BACKGROUND AND ANALYTICAL METHODS

COASTAL DECLINE AND COASTAL INTENSIFICATION MODELS

The Coastal Decline Model is a widely used theory of Southern California mobility patterns, with a history of support stretching back to the early 1960s (Christenson 1992; Gallegos 1987, 1992; Gallegos and Kyle 1988; Masters and Gallegos 1997; Rosenthal et al. 2001b; Warren et al. 1961; Warren and Pavesic 1963; Warren 1964, 1968). The model contends that hunter-gatherer use of interior resources increased during the Late Holocene, with limited and temporary use of littoral environments. The decline in the use of the coast is theorized to be due at least in part to the silting of much of the lagoon environments in Northern San Diego County around 4000 years ago. The subsequent sandy beaches resulted in a change in shellfish species availability, limiting the littoral resources available to hunter-gatherers (Gallegos 1987, 1992; Warren 1964, 1968; Warren et al. 1961; Warren and Pavesic 1963). Evidence for the decline in coastal use consisted mainly of a lack of coastal sites dated to the Late Holocene. Later research in the area documented a dearth of radiocarbon dates for archaeological sites between ca. 3500 BP to 1500 BP with a continuation of short-term coastal occupations after this time (Masters and Gallegos 1997).

Rosenthal et al. (2001b), present a recent synthesis of this model, divided into two major arguments. The first argument is that there are a relatively small number of documented

Late Holocene coastal sites in Northern San Diego County. The second is that the Late Holocene Period sites that are present on the coast do not display artifact and feature diversity typical of residential sites, such as structural remains, food processing areas, burials, and a full range of tools used for a variety of functions, all of which should be expected at longer term occupation sites. Rosenthal et al. (2001b) also state that seasonality indicators based on floral and faunal analysis suggests the majority of late period coastal sites represent primarily summer occupations rather than multiple seasonal use. Finally, Rosenthal et al. (2001b) contend that artifact assemblages from residential sites on the coast should include non-local resources, such as acorns and other plant and animal food from the interior, in addition to locally available resources.

Rosenthal et al. (2001b) argue that neither the Coastal Decline nor Coastal Intensification Models are completely satisfactory. Using assemblage richness and evenness of shellfish and fish from San Diego Coastal sites, they show a greater diversity of shellfish and fish taxa for Early to Middle Holocene sites as compared to Late Holocene sites. By the Late Holocene Period hunter-gatherers are thought to have primarily occupied the interior regions, moving between villages in the interior and coastal areas. Thus the coastal environments would have been exploited for temporary resource procurement activities such as fish runs or clam harvests (Rosenthal et al. 2001b). Rosenthal et al. (2001b:195) conclude that although "Warren (1968) and other researchers may have overstated the lack of evidence for late Holocene coastal occupation in San Diego County, their characterization of subsistence patterns as terrestrially oriented appears to be essentially correct."

The Coastal Intensification Model, conversely, states that coastal resources were more intensely utilized during the Late Holocene than the Early and Middle Holocene periods, and that some of the coastal sites represent residential locations (Byrd 1998; Byrd and Reddy 2002, 1999). The Intensification Model is based on four major points. The first is that many of the coastal sites on Camp Pendleton in Northern San Diego County have been ^{14}C dated to the Late Prehistoric Period (contradicting one basis for the Coastal Decline Model). Second, a number of these sites consist of large shell middens with dense deposits and diversified artifact and ecofact assemblages, including stone tools, ground stone implements, ceramics, modified bone and shell, marine and terrestrial vertebrate remains, marine shell, and macrobotanical remains. A third argument of the model is that some of these sites show multiple season utilization based on vertebrate remains and paleoethnobotanical studies. Fourth, an important observation for this model is the heavy reliance on *Donax* for the Late Prehistoric sites. *Donax* are a sandy beach species of clam, and would have been available to hunter-gatherers in coastal environments after the local estuaries silted in during the Late Holocene. The clams could be easily harvested in large amounts during different times of the year, and may have provided a low-cost reliable form of food (Byrd 1998; Byrd and Reddy 1999). Thus, although fewer marine invertebrate species may have been utilized in the Late Holocene, an intensified procurement of one shell species, *Donax*, may have occurred.

While some sites may have been temporarily abandoned, others may have been continually used. It is also possible that some lagoons did not silt in and rocky shore species were procured in these areas throughout the Holocene (Byrd 1998, Byrd and

Reddy 2002, 1999). Ethnographic documents suggest that the coast of Northern San Diego County was heavily utilized at the end of the Late Holocene, evidenced by early Spanish accounts of explorations in the region that note coastal villages (Byrd and Reddy 2002). Additionally, specialized, short-term occupation sites or "dinner camps" consisting of sparse shell remains (typically *Donax*) and artifact scatters are found in the coastal region during the Late Holocene. Collectors, as defined by Binford (1980) would occupy residential base camps for relatively long periods of time, with specialized groups making logistical forays to procure resources. Following Binford (1980) Byrd and Reddy (2002) interpret these "dinner camp" sites as temporary use areas repeatedly utilized by small foraging groups who would later return to residential base camps (i.e., large shell midden sites on the coast). The dense late period shell middens and associated limited activity sites, as well as environmental and ethnographic evidence, are all used to support the theory of an intensification of coastal adaptations. Taken together "these patterns are compelling evidence of a long-term trend toward greater resource intensification along the coast" (Byrd and Reddy 2002:51).

RESEARCH QUESTION

This study aims to test the validity of the Coastal Decline Model as presented in its current form. The question of coastal adaptation in Southern California during the Holocene Period will be addressed through the analysis of formed chipped stone tools and lithic debitage from pre-historic coastal sites at San Elijo Lagoon, and from pre-historic inland and coastal sites in the Las Pulgas Corridor along Las Flores Creek. The

San Elijo sites consist of hunter-fisher-gatherer shell middens from a lagoon setting (see Figure 2.1). Uncalibrated ^{14}C dates from the San Elijo sites range from 8400 to 2400 BP, spanning the Early to Late Holocene. The Las Pulgas sites consist of coastal shell middens as well as lithic scatters, bedrock milling features, and temporary campsites in inland settings (see Figure 2.2). Calibrated ^{14}C dates were obtained from two of the Las Pulgas inland sites, ranging from approximately A.D. 1240-1620. Two of the Las Pulgas Sites, SDI-812/H and SDI-10723, are coastal shell midden sites, and will be used as a means of comparison to local Las Pulgas inland sites. SDI-812/H represents a Late Prehistoric Period coastal occupation (calibrated ^{14}C A.D. 1010-1820), while SDI-10723 is a multi-component site with both Archaic (calibrated ^{14}C B.C. 6410-6020) and Late Period occupations (calibrated ^{14}C A.D. 1260-1520). In addition to Las Pulgas and San Elijo sites, other previously recorded archaeological sites in San Diego County will also be utilized for comparisons in order to encompass full ranges of Holocene occupations for both inland and coastal sites. Thus, eight Early-Middle Holocene assemblages and two Late Holocene assemblages represent coastal environments. Six assemblages, all dated to the Late Holocene, represent inland environments.

A detailed analysis of finished tools and debitage will address functional, technological, and chronological questions. The results of the lithic analysis will test the Coastal Decline Model. The types, amounts, and variety of stone tools being used and produced on site may suggest types of resources used by hunter-fisher-gatherers, how these resources were procured, continuity or changes in subsistence strategies over time, and possibly even population densities. Comparison of coastal sites from both study areas to inland sites from Las Pulgas Corridor will attempt to discern differential hunter-gatherer land use of one drainage system in Northern San Diego County. Larger settlements that are occupied for relatively long periods of time should display a greater variety of tools as well as a relatively higher amount of artifacts. Thus, if the people of San Diego County shifted from a coastal to inland emphasis after the Middle Holocene, greater artifact diversity and density would be expected at interior sites than at coastal sites during the Late Holocene. Additionally, artifact diversity and density should be seen to decline at coastal sites between the Early and Late Holocene as these sites became less frequently utilized.

Temporally diagnostic artifacts will be compared to ^{14}C dates obtained from the sites. According to the Coastal Decline Model, lesser amount of tools would have been made at coastal sites during the Late Holocene, and a lower number of completed tools would have been imported and discarded at these sites, as they were occupied for lesser amounts of time. Conversely, we would expect to see more tools being produced at interior sites and more finished tools being brought in, used, and discarded at these interior sites if they were in fact occupied for longer periods of time during the Late Holocene. The overall number of artifacts per m^3 of excavated material, the number of artifact classes represented, and the ratio of cores to bifaces will be used to compare lithic technologies through time and across space. Changes and/or consistency in the types of tools used and produced at the San Elijo and Las Pulgas sites throughout the Holocene will be utilized to address questions concerning coastal versus inland adaptations.

Tool forms will be assessed, and used to imply function where possible. Debitage will be analyzed in an attempt to determine what type of tool technologies, such as core and bifacial technologies, were employed at the sites by hunter-fisher-gatherers. If changes in occupational strategies occurred across the Holocene, differences in tool types should be seen between Early to Late Holocene assemblages at coastal sites, as well as between coastal and inland sites. Comparative analysis, for example core to biface ratios, will also be utilized to determine site functions. Core-biface studies suggest that archaeological sites that are occupied for longer periods of time tend to display a greater number of cores as opposed to bifaces based on diverse lithic manufacture techniques, differential subsistence strategies, and possibly tool use-life (Bamforth and Becker 2000; Parry and Kelly 1987; Tomka 2001). Hence, if inland sites were used more intensively than coastal sites during the Late Holocene, these sites should have higher amounts of cores when compared to bifaces. Coastal sites would then be expected to contain more bifaces than cores in the Late Holocene, and a decrease in the core-biface ratio should be seen at coastal sites from the Early to the Late Holocene.

METHODS

Lithic analysis will attempt to address the research question through several methods previously utilized to determine site functions and residential mobility in other regions (Andrefsky 1998; Bamforth and Becker 2000; Barut 1994; Chatters 1987; Magne and Pokotylo 1981; Parry and Kelly 1987; Price 1978; Shott 1986; Sullivan III 2001; Tomka 2001, 1989; Whitaker 1994). Artifact diversity is examined to determine amount of site functions and residential mobility between coastal and interior sites. The number of artifact classes represented at a particular site is used to measure diversity. Decreased mobility is assumed to result in an increase in artifact density and diversity. Relative changes of the lithic tool types over time from the respective sites are used as evidence for change and continuity of site functions through time. Finally, differences in core-biface ratios are assumed to represent differences in site functions as well as occupation durations.

Although several of the SEL and Las Pulgas sites are characterized by multiple components (see Chapter 2), they typically represent either Early to Middle Holocene, or Late Holocene deposits. The research question attempts to address change and continuity throughout the Holocene, particularly the broad changes in residential and subsistence patterns between the larger time frames of the Early and Middle to Late Holocene periods, based on radiocarbon dates and diagnostic artifacts. All of the sites probably represent multiple occupations of an area over long periods of time, and may be the result of up to hundreds of separate occupation events. Additionally, only a relatively small sample of each site was tested to recover cultural materials. However, the data presented here are applicable for broad comparisons regarding the general time periods defined above in that they are generally dated to specific time periods within the Holocene. The basic question of coastal decline concerns cultural changes between broad time periods, specifically between the Middle Holocene and the Late Holocene. Sites are thus either assigned to an Early-Middle Holocene or Late Holocene component. The coastal Las Pulgas site SDI-10723 contains both Early (SDI-10723 EH) and Late Holocene (SDI-

10723 LH) dated deposits. However, the deposits are clearly defined by depth and by different shell species, specifically rocky-environment shell species deeper than 45 cmbs dated to the Early Holocene and sandy-environment shell species in the shallower levels dating to the Late Holocene.

A large date range for SEL –4 and SEL-5 cannot be separated out so easily. SEL-4 contains dates within all three divisions of the Holocene, with no discernable difference as to depth or locus. While SEL-5 produced radiocarbon dates within the Early and Middle Holocene, the occurrence of ceramics and the extensive amount of *Donax* complicate the accurate classification of this site as well. Therefore, while the sites will be considered for coastal versus inland comparisons across time, the results of the analyses comparing sites by time period will be examined without the results of SEL-4 and SEL-5. A total of eight Early-Middle Holocene and eight Late Holocene sites will be considered for the analysis (see Table 2.1).

ARTIFACT FUNCTION, DENSITY, AND DIVERSITY

Artifact functions from San Elijo Lagoon and Las Pulgas sites will be examined through artifact form. Individual artifacts are studied to determine if morphological shape can in some instances be used to infer function, which will in turn be used to determine the typical lithic tool kits of the coastal and interior sites. Different artifact types examined in the study include cores, bifaces, flake tools, and cobble tools.

Although several factors, including population densities and multiple site reoccupations, can contribute to the artifact density of a site, previous studies have demonstrated an inverse relationship between artifact diversity and residential mobility, and to a lesser degree between artifact density and mobility patterns (Andrefsky 1998; Barut 1994; Chatters 1987; Price 1978; Shott 1986). Diversity measures are important analytical tools in the interpretation of past human behavior through the archaeological record (Kintigh 1984; Meltzer et al. 1992; Plog and Hegmon 1993; Rhode 1988; Schott 1989; Sullivan III 1998). Diversity in archaeological contexts generally refers to the number and relative abundance of differing types of artifact types within a particular assemblage. Both richness and evenness must be taken into account when discussing diversity. Richness is defined as the number of artifact classes represented within a particular archaeological collection, while the relative abundances of these artifact classes within the collection define evenness (Rhode 1988:708). Diversity is in turn used to infer relative mobility of prehistoric populations in that archaeological sites containing higher artifact diversities tend to represent longer term occupations than sites with lower artifact diversities (Andrefsky 1998; Barut 1994; Chatters 1987; Price 1978; Shott 1986).

Sample size is also an important factor in determining the interpretive value of artifact diversity within a particular assemblage. It may be the case that the sample size of an assemblage plays a role in the interpretation of the artifact diversity of that assemblage. Hence, a measurement of the effect of sample size on artifact diversity, typically involving linear regression, can be applied to determine the relationship, if any, between the size of the sample and the number of artifact classes (McCartney and Glass 1990;

Meltzer et al. 1992; Plog and Hegmon 1993; Rhode 1988). However, this approach may overestimate the relationship between sample size and diversity unless the observed values are close to those expected, that is, unless the standard residuals produced are not too great and are distributed relatively evenly along the regression line (Rhode 1988:713).

Utilizing ethnographic accounts of hunter-gatherer land use and associated tool kits, Shott (1986) demonstrated that artifact diversity was inversely related to residential mobility. The tool diversity examined was defined as "the number of distinct tool types or classes" (Shott 1986:19). Artifact diversity was most closely related to mobility frequency, or the number of residential moves a group makes in a year. Thus, the fewer the residential moves a group makes in a year, the higher the artifact diversity (Shott 1986).

Two other studies (Barut 1994; Price 1978) provide an example of the association between artifact diversity and residential mobility within archaeological contexts. Using archaeological data from East Africa, Barut (1994:66-67) defined site types from different time periods (Late Stone Age and Middle Stone Age) as representing different mobility patterns, with Late Stone Age populations practicing a less mobile residential strategy. The lithic tool assemblage is slightly more diverse for the relatively more sedentary Late Stone Age sites (Andrefsky 1998:Table 8.5; Barut 1994). Price (1978) also demonstrates a general relationship between lithic artifact diversity and residential mobility with archaeological assemblages from Dutch Mesolithic sites. Price's data suggests an inverse relationship between artifact diversity and residential mobility, with short-term “extraction camps” containing slightly fewer artifact types than longer-term occupation “base camps” (Andrefsky 1998:Table 8.4; Price 1978:Table 1).

In addition to the relationship between artifact diversity and residential mobility, both Price (1978) and Barut (1994) also demonstrate a relationship between artifact densities and site occupation duration. According to Price (1978:94) “Differences in artifact density should be a good indicator of relative duration of occupation…The single assumption is made that the longer a site is occupied, the more artifacts will be deposited.” When comparing medium sized short-term occupation base camps to similar sized long-term occupation base camps, the long-term sites contain substantially higher counts of lithic artifacts per m^2 (Price 1978:Table 2). Price (1978) utilizes m^2 for his site comparisons without explanation, while m^3, such as that employed by Barut (1994) may actually be more suitable for quantifying site size. Barut’s data demonstrates that Late Stone Age sites, which are assumed to represent less mobile populations, typically contain larger numbers of lithic artifacts than Middle Stone Age sites per m^3 (Barut 1994:Table 2).

CORE-BIFACE RATIOS

Archaeological studies have utilized core-biface ratios as a means of investigating prehistoric mobility patterns and subsistence activities (Bamforth and Becker 2000; Parry and Kelly 1987; Tomka 2001). Parry and Kelly (1987) used core/biface ratios from various North American archaeological sites and theorized that mobile populations would produce more bifaces relative to cores than more sedentary populations. The theory is based on the assumption that more mobile peoples tend to make more tools conducive to transport with general usefulness, such as bifaces, while more sedentary groups typically produce expedient tools for use in the same general area as their manufacture and that they can more readily stockpile raw material. Parry and Kelly (1987) typically assign hunter-gatherers to the mobile group and horticulturists/farmers to the sedentary groups, envisioning a shift in technology from primarily biface utilization to more extensive core and flake tool use as people shift subsistence strategies for hunting and gathering to farming. The core to biface ratios provided by Parry and Kelly (1987) show that groups known to practice relatively intensive farming do in fact use more core technology relative to bifacial technology than hunter-gatherer groups that most likely spend less time at any one particular site.

Bamforth and Becker (2000) utilize core to biface ratios for the North American Plains to compare these ratios to infer relative mobility between groups of hunter-gatherers. They conclude that different ratios do suggest different site occupation durations, but may not indicate a change in technology, in that "increasing the duration of site occupation so that it is longer than the useful life of the cores that were flaked there would raise core/biface ratios, even if the site's inhabitants did not alter their technological habits" (Bamforth and Becker 2000:283). Therefore, according to Bamforth and Becker (2000), more sedentary groups of hunter-gatherers, as well as horticulturists/farmers, will produce higher core to biface ratios than will more mobile groups of hunter-gatherers.

Tomka (2001) on the other hand, suggests that core to biface ratios can be seen as a difference in activity rather than occupation duration. Using examples of hunter-gatherer groups from the Southern Plains, Tomka (2001:221) indicates that formal tools (i.e. bifaces) provide greater advantages over expedient tools (i.e. core tools) when performing “lengthy and strenuous tasks.” Site function is thus associated with core to biface ratios in that “the relative proportions of expedient versus formal and standardized tool forms, and in particular specialized cutting and scraping tools, in prehistoric assemblages should reflect the intensity of processing requirements associated with hunted resources” (Tomka 2001:221). Therefore, Tomka (2001) argues that tool morphology is not a reflection of mobility but of processing needs.

Following Bamforth and Becker (2000) and Parry and Kelley (1987), the number of cores in relation to bifaces from San Elijo Lagoon and Las Pulgas sites is utilized to determine relative site occupation duration for coastal and inland sites. If indeed population shifted to longer-term occupation of interior sites during the Late Holocene, then later period interior assemblages should have more cores relative to bifaces when compared to late period coastal sites. Additionally, Late Holocene coastal sites should have lower core-biface ratios than Early-Middle Holocene coastal sites. The actual ratio of cores and bifaces recovered from project sites, as well as from comparable sites in Northern San Diego County, will be examined to address these questions. Debitage analysis is also used to demonstrate the type of lithic technologies from project sites.

Both individual and aggregate debitage analysis can be examined to determine if the lithic technology at a particular site consisted primarily of core reduction or biface production (Andrefsky 1998; Magne and Pokotylo 1981; Sullivan III 2001; Tomka 1989; Whitaker 1994). Individual debitage analyses require the recording of characteristics on each piece of debitage from a given assemblage, while aggregate analyses are "conducted by stratifying the entire assemblage of debitage by some uniform criterion and then comparing the relative frequencies of debitage in each stratum" (Andrefsky 1998:126). The criteria typically used for aggregate debitage analyses are size and weight (Andrefsky 1998:126-135). This study utilizes both individual and aggregate analyses of debitage attributes in order to understand more about stone tool production and use at each site. The results of debitage analyses are utilized to demonstrate whether or not various tools were produced on-site or whether the finished tools were made elsewhere and brought to the site. Debitage can also help determine the kinds of stone tools produced on-site, even when none of the produced tools were recovered (Andrefsky 2001). Raw material must also be considered when examining core-biface ratios in that the quality, size, shape, and distant to the source of lithic raw materials all affect the types of tools made and deposited at a particular site (Andrefsky 1998:221-228).

LITHIC ANALYSIS

Flaked stone artifacts recovered from the SEL and Las Pulgas sites were classified following a typology illustrated by Andrefsky (1998:74). Chipped stone was first separated into tool and debitage categories. Tools were then categorized as either biface or non-biface. Non-bifaces were further broken down into flake tool and core tool categories. Flake tools include retouched flake, utilized flake, and modified cobble classes. Tools were thus divided into one of five artifact classes: Bifaces; Cores; Retouched Flakes; Utilized Flakes; and Modified Cobbles. Each artifact class was also divided into specific subclasses (see below).

Debitage was separated into flake and non-flake categories. Flakes were classified by dorsal cortex percentage as primary (50-100 percent cortex), secondary (1-49 percent cortex), and interior (no cortex). Flakes were also categorized as complete, incomplete with intact proximal end (that is bulb of force and striking platform), and incomplete with no identifiable proximal end. Any piece of debitage that did not display an identifiable ventral or dorsal side, a bulb of percussion, and/or a striking platform, was considered a non-flake. Non-flakes were all classified as shatter.

Recording Procedures and Definitions

All chipped stone artifacts were consistently classified by raw material. Material types are considered here because the availability and quality of lithic raw material can contribute to the types of tools made and used at a particular site (Andrefsky 2007; Larson and Kornfeld 1997). Material types were identified visually with no more than 10X magnification, using a hand lens. Materials recorded consist of metavolcanic, obsidian, petrified wood, quartzite, quartz, and chert. Metavolcanics encompasses a number of locally occurring igneous rocks used for chipped stone manufacture. The local rocks range in color from black, to gray, to several shades of green. The metavolcanics also represent a wide array of grain types, ranging from fine to coarse, with various amounts of inclusions, from porphyritic to aphanitic. Obsidian refers to all volcanic glass, typically black in color. Rocks with visible wood grain were classified as petrified wood. Quartzite included all metamorphic rocks with visible quartz crystals. Sedimentary rocks of cryptocrystalline structure (CCS) were classified as either quartz or chert, quartz being those rocks that were clear it milky white in color and fractured along angular plains, while all other CCS materials, ranging in color from dark brown to yellow, were labeled chert. One exception to this classification is PDL, a locally occurring chert with diagnostic phenocrysts in a CCS matrix. This distinctive chert is known to occur in only one outcrop on Camp Pendleton, where the material was quarried prehistorically (Becker 2004; Hale and Becker 2006).

Standard measurements were also taken for all chipped stone artifacts. Each individual tool and debitage artifact was weighed to .1 of a gram. Length, width, and thickness of all tools and cores were measured to .1 of a millimeter (mm), while the maximum dimensions of pieces of debitage was recorded in 5 mm intervals. The condition of formed tools was also recorded as complete, 50-99 percent complete, or less than 50 percent complete. Tools were also recorded as length missing, width missing, length and width missing, complete, or indeterminate fragments. Size and weight of artifacts are also utilized in combination to acquire standardized measurements for comparative purposes between sites. Specific definitions, subdivisions, and recording techniques for each artifact class are given below.

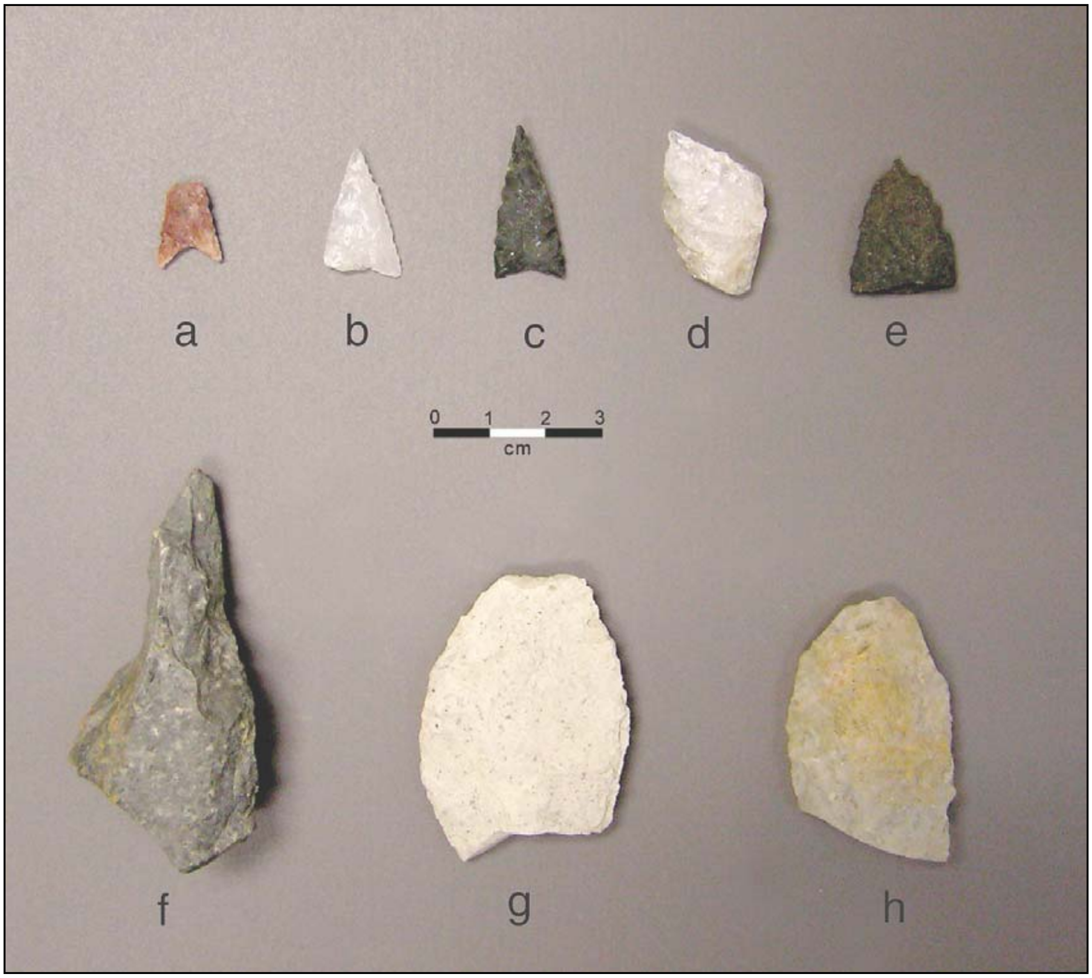

Figure 3.1: Representative bifaces from Las Pulgas Corridor sites; a, b, and c) PDL, quartz, and metavolcanic Cottonwood Triangular points, respectively; d) early/middle stage quartz biface; e) late stage metavolcanic biface; f) early/middle stage metavolcanic biface; g) late stage quartz biface; h) early/middle stage PDL biface

Bifaces: A chipped stone artifact that is flaked on two faces to form an edge along its entire margin is considered a biface. Figure 3.1 shows a representative sample of bifaces from the Las Pulgas sites. Bifaces typically display invasive flake scars across at least half of the tool's face. Three characteristics were documented for all bifaces: completeness, size, and stage of production. Completeness was recorded as nominal states of length missing, width missing, length/width missing, complete, or indeterminate fragment. Size was recorded by four ratio scale variables, weight, maximum length, maximum width, and maximum thickness. Bifacial staging entails a more complicated classification scheme, and can be divided into as many as nine stages. Stages can be defined by measurements such as width to thickness ratios and degree of edge angle, as well as by visual attributes (Andrefsky 1998; Callahan 1974, 1979; Whitaker 1994). Bifaces were classified by stage of production in this analysis with only three variables, early/middle stage, late stage, or indeterminate. Early/middle stage encompasses Callahan's stage 1-3 while late stage is equivalent to Stages 4 and 5 in Callahan's scheme. Early/middle stage bifaces are defined as those with relatively non-invasive flake scars, irregular edges, and thick cross sections. Late stage bifaces, on the other hand, are defined as having invasive flake scars, well-formed straight edges, and thin cross sections. Ambiguous bifaces or those too fragmented to accurately stage were classified as indeterminate.

Projectile points were recorded as a subclass of bifaces. All identifiable projectile points were Cottonwood Triangular types. These points lack identifiable hafting elements, as compared to projectile points with stemmed or eared hafts. Therefore, typical projectile point measurements, such as neck/base width and haft/neck length were not taken.

Cores: A core is defined as a stone that displays evidence of flake removal in the form of negative flake scars (Andrefsky 1998; Cotterell and Kamminga 1987). Flakes are

Figure 3.2: Representative metavolcanic cores from San Elijo Lagoon Sites; core in lower left corner is classified as unidirectional, while all others pictured are multidirectional

removed from a "flat surface or striking platform" on the stone (Andrefsky 1998:137). While cores are typically utilized to acquire flakes for the purpose of manufacturing tools, they may also be used as tools themselves (Andrefsky 1998). This study classified cores into one of four categories: unidirectional cores, multidirectional cores, bifacial cores, or tested cobbles (Figures 3.2 and 3.3). Unidirectional cores include those stones with flakes removed in one direction from a single platform. Multidirectional cores are those with flakes removed in more than one direction from more than one striking

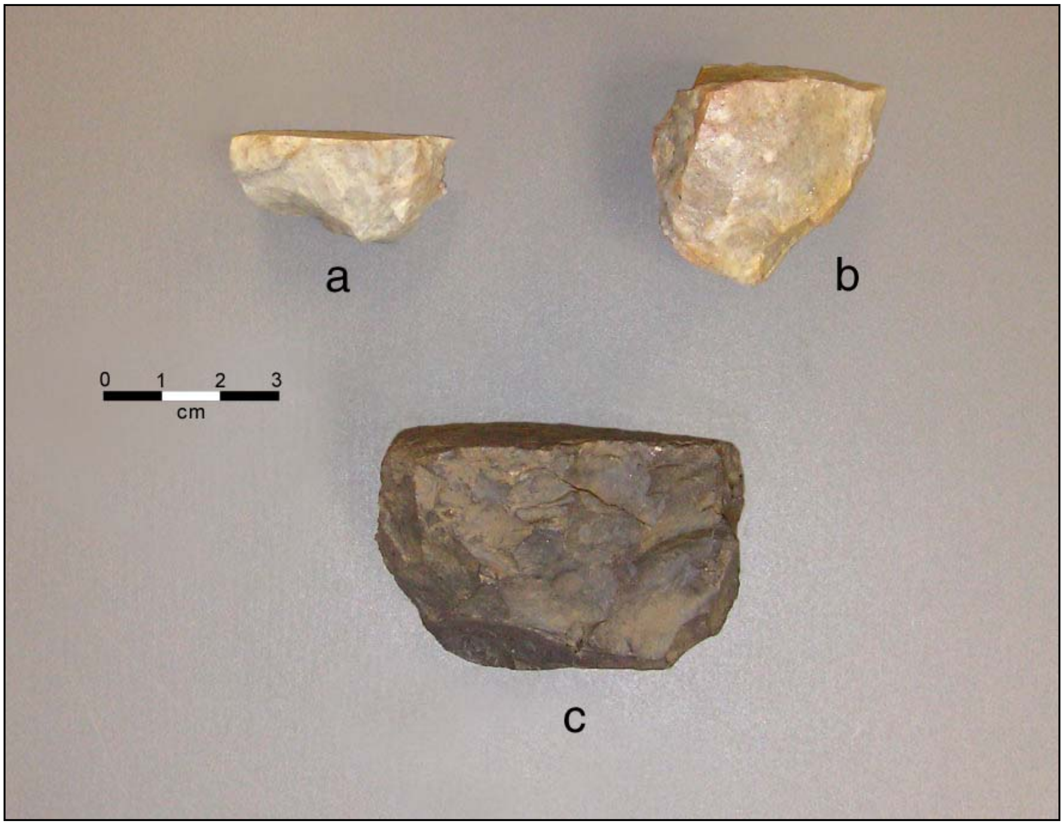

Figure 3.3: Representative cores from Las Pulgas Corridor Sites; a) bi-directional PDL core; b) unidirectional PDL core; c) bi-directional metavolcanic core

platform, where the relationship between the platforms is not patterned. Bifacial cores also have more than one striking platform, but flakes are removed directly opposite each other, forming a bifacial edge on the stone. Finally, tested cobbles are cores displaying the removal of no more than two primary flakes, presumably for evaluating the suitability of the raw material for tool manufacture.

In addition to weight, the size of cores was recorded by measuring maximum length, width, and thickness. The maximum length of each core was multiplied by its weight to obtain the maximum linear dimension (MLD). While a uniform length for unidirectional cores may be taken perpendicular to the platform, such standardized measurements are not as simple for cores with multiple platforms. The MLD was thus utilized as a means of comparing core size within and across sites regardless of platform orientation (Andrefsky 1998). The angles and orientations of striking platforms are often intentionally prepared in order to better remove a desired size and shape flake. Platform preparation can occur in the numerous forms, such as small flake scars on the face of the core from "trimming" of the platform or ground platform edges on the face of the core and the surface of the platform (Whittaker 1994). Platform preparation was recorded as present or absent for this study.

Retouched Flakes: Flakes that displayed intentional modification to one or more of the flake margins were classified as retouched flakes (Andrefsky 1998:77-80; Keeley 1980; Whittaker 1994:19-20). Retouched flake tools were classified as scrapers, graver/perforators, and denticulates. Scrapers are unifacially retouched flakes with relatively steep and invasive retouch that forms a continuous working edge. A denticulated flake consists of a series of saw-like notches, or concavities, along the edge of the tool (Figures 3.4 and 3.5). Graver/perforators have distinct spurs formed by notches or other retouch. Retouched flakes that did not fit traditional tool types were classified as non-patterned or indeterminate fragments. Non-patterned retouch includes unifacial and bifacial retouch on flakes with uneven edges and is typically non-continuous. Retouched flakes that were too small or incomplete to accurately determine retouch characteristics were classified as indeterminate fragments. Six attributes were

Figure 3.4: Representative denticulated retouched flakes from San Elijo Lagoon Sites

documented for retouched flakes: blank type, completeness, size, retouch orientation, modification type, and flake type. Blank type attempted to identify if the tool was made on a primary, secondary, or interior flake. For the purpose of this study, primary and secondary flakes were combined for retouched flakes and blank type was simply recorded as cortical or non-cortical. Completeness encompasses the same variables as bifaces, recording tools as length missing, width missing, length and width missing, complete, or indeterminate fragment. Size was measured with length, width, and thickness, as well as

Figure 3.5: Representative denticulated retouched flakes from Las Pulgas Corridor Sites

tools where the flake orientation could not be determined, the maximum length was measured.

Retouch orientation describes where on the flake retouch is present, the distal or proximal ends, lateral sides, or a combination of two or more locations. Modification type describes how the flake edge was retouched, including obverse, inverse, alternating, and bifacial retouch. Obverse retouch is located on the dorsal side of a flake, while inverse retouch consists of retouch on a flake's ventral side. Alternating retouch includes both obverse and inverse retouch on the edge of a flake, but not directly opposite each other. When a flake is retouched on direct opposite sides obversely and inversely it is classified as bifacially retouched. Bifacially retouched flakes differ from traditional bifaces in that they are not worked along the entire edge of the flake and the retouch is relatively non-invasive. If possible, retouched flakes were recorded as made on either core or bifacial thinning flakes. Definitions for these flake types conform to that for the overall debitage analysis (see below).

Utilized Flakes: Flakes with edges that were modified through use were classified as utilized flakes (Andrefsky 1998:77-80; Keeley 1980; Whittaker 1994:19-20). Utilization was characterized as either scalar or denticulated edge damage. Scalar edge damage consisted of small utilization scars on the edge of a flake shaped like scales, while denticulated edge damage consists of notched edge damage similar to that of retouched denticulates but on a smaller scale. All utilization was macroscopically identified through the use of a magnifying glass. Completeness, size, and flake type were recorded for utilized flakes in the same manner as retouched flakes.

Modified Cobbles: Several flaked stone artifacts did not fit into standard tool types. These artifacts were classified as modified cobbles, and include wedges, drills/perforators, and indeterminate flaked cobbles (Figure 3.6). Wedges are defined by both a morphological shape and macroscopic use-wear. These are cobbles that are flaked slightly to form a relatively thin edge on one side that is typically wider than on the opposite side. Battering in the form of stepped edge damage and grinding occurs on one or both sides of the tool (Hale and Becker 2006). Drills/perforators are relatively long and narrow cobbles with a diamond-shaped or near circular cross-section. These tools

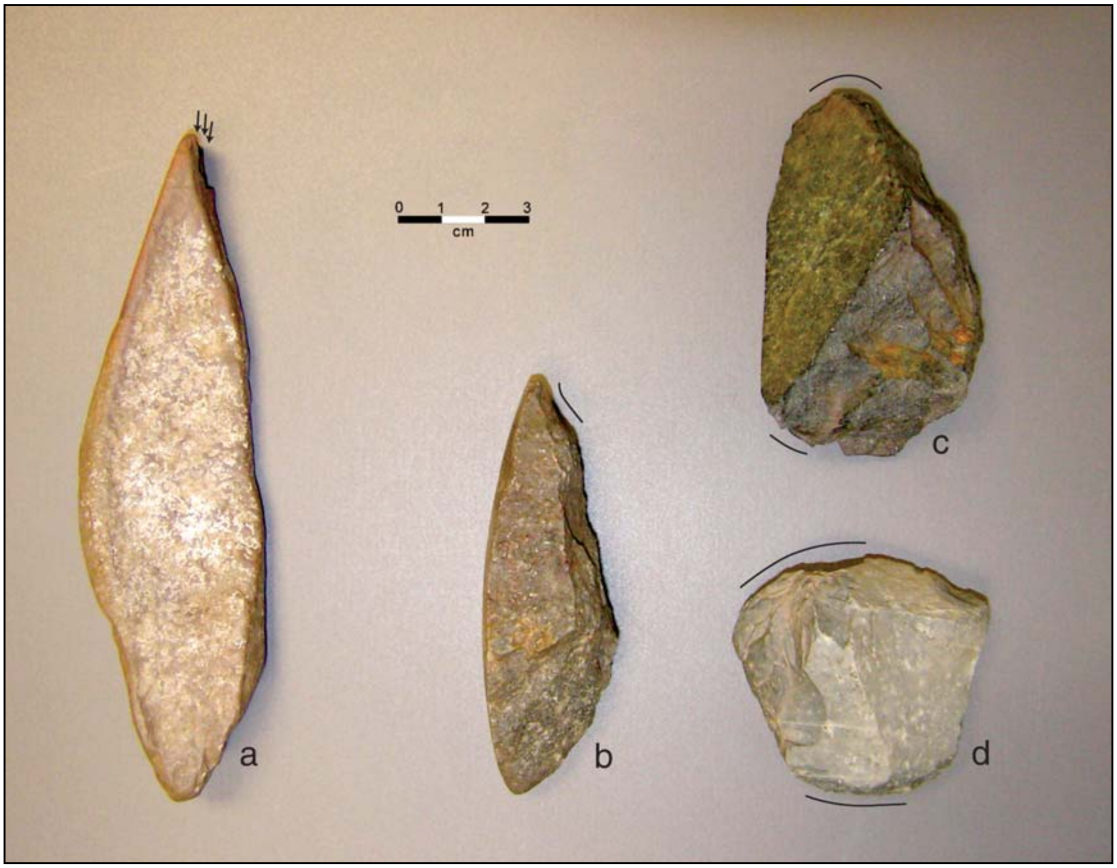

Figure 3.6: Representative modified metavolcanic cobbles from project sites; a) drill/perforator from SEL-4; b) drill/perforator from SDI-10723LH; c) wedge from SEL-3; d) wedge from SDI-10723LH; black lines and arrows denote location of use-wear traces used to classify tool

may be used to pierce materials utilizing either circular boring or puncturing motions (Becker 2004; Hale and Becker 2006). Other cobbles have flakes removed in non-patterned fashions, but do not conform to the definition of a core. Weight, length, width, and thickness were documented for modified cobbles, with maximum length defined in the same manner as that for cores. A description of the type of modification was recorded for the cobbles.

Debitage: Debitage consists of unmodified flaked stone produced during core reduction and tool production. Flakes are defined as pieces of debitage that display ventral and dorsal sides. Previous flake scars or cortex typically characterize the dorsal side of a flake. The ventral side is a smooth surface from the interior of a core or tool with no previous flake removals. Partial rings of percussion may be visible on the ventral side of a flake. Complete flakes also contain intact proximal and distal ends. The proximal end of a flake contains the bulb of force and striking platform from whence the flake was removed from the core or tool, and the distal end is directly opposite the proximal end. A flake may be broken distally but still exhibit a bulb or platform, and would thus be considered a proximal flake. Debitage artifacts with no identifiable ventral or dorsal sides are classified as shatter.

Analysis of debitage artifacts attempts to explain, among other things, modes of production and manufacturing technologies. Debitage size and cortex amount can be especially useful in estimating reduction sequences for a lithic assemblage. Flakes with relatively greater amounts of dorsal cortex are typically made during earlier stages of production (Andrefsky 1998; Johnson 1989; Magne and Pokotylo 1981; Morrow 1984), as are relatively large flakes (Amick et al. 1988; Carr and Bradbury 2001:134; Shott 1994). Additionally, core reduction techniques can be expected to produce larger and more intact flakes as compared to tool production (Prentiss 2001). Flakes with a maximum dimension of less than 25 mm are considered to represent later stages of reduction. This is an arbitrary size division based on studies showing that flakes smaller than 25 mm are typically not suitable for flake tools or flake blanks for tool production

(Becker 2003). Finally, it has been demonstrated experimentally that higher percentages of shatter in debitage assemblages are typically associated with core reduction (Carr and Bradbury 2001:129).

Several attributes were examined for the debitage analysis, including size, weight, completeness, cortex amount, raw material, platform type, curvature, and thickness. Each flake was weighed to the tenth of a gram, regardless of completeness. Flake size was recorded by placing each flake in a square template measuring from 10mm and up at 5mm intervals. Flakes were oriented within the template along the artifact's length axis, that is the distance from proximal to distal end. If no proximal to distal axis was identifiable on a flake, the maximum length was measured for the artifact. Debitage thickness was not measured for this study. Flakes with intact proximal, distal and lateral edges were classified as complete. If only a small portion of one of these edges was broken and the size of the flake could be accurately determined, the flake was also considered complete. The amount of dorsal cortex was based on an ordinal scale. Primary flakes are those with 50 percent of more dorsal cortex, while secondary flakes have 49 percent or less. Flakes with no dorsal cortex were classified as interior. However, because of the problems inherent in assigning reliable and replicable cortex percentages to each flake, primary and secondary flakes are typically combined as cortical elements in a nominal scale (presence or absence of cortex) for this analysis. Raw material was assigned to each flake following the same criteria as that applied to chipped stone tools. Only size, weight, and raw material type were recorded for non-flake debitage.

In an attempt to determine manufacturing techniques, specifically core-flake production versus bifacial reduction, a visual inspection of all complete flakes was undertaken. Bifacial thinning flakes typically are relatively thin with good curvature and complex platforms, while core flakes are relatively thick with little or no curvature and single faceted or cortical platforms. In addition, characteristics typical of bifacial thinning flakes include: relatively complex dorsal sides (i.e., large amount of previous flake scars taken from multiple directions); little or no cortex; steep platform angles; feathered edge terminations; thin uneven edges; non-symmetrical shapes; diffuse flat bulbs of force; and occasionally a lip at the interface of the platform and ventral side (Andrefsky 1998; Magne and Pokotylo 1981; Tomka 1989; Whitaker 1994). Flakes were then classified as either core or bifacial thinning based on their ability to fit these criteria, while flakes that did not fit either criterion were defined as indeterminate.

While it would be possible to code for all the traits mentioned above and associated with bifacial thinning flakes, only the three attributes of platform, curvature, and thickness were recorded in an attempt to standardize the distinction of flake type (Appendix A). Platform type was recorded for all proximal flakes, while curvature and thickness were documented only for complete flakes. Platforms were classified as complex, flat, cortical, or indeterminate. A facet is defined as a flat surface or plane on the striking platform (Andrefsky 1998:92). Rather than attempt to count the number of facets on a flake's platform, platforms were distinguished as flat or complex. Flat platforms are basically single faceted, while complex platforms encompass those that are rounded, abraded, and multiple faceted. Cortical platforms have cortex on all or part of the striking platform. Platforms that could not be accurately defined because they were too small or damaged were classified as indeterminate. Flakes were classified as thick, moderately thick, or thin. Flake thickness was taken as an arbitrary classification based on the relative thickness of the flake as compared to its overall size. Therefore the recorder subjectively chose the attribute based on each individual flake's apparent overall thickness as opposed to its length and width. Curvature was measured as significant, slight, or none. Flakes with an angle of 16 degrees or more were considered to have significant curvature, while those with angles between 0-15 degrees were classified as slight curvature. Flake angle was measured by placing each flake on a plastic template with an angle measuring 15 degrees. If the curvature of the flake was greater than the template, the flake was recorded as containing significant curvature, while the curvature of flakes with angles less acute than the template, though not flat, were classified as slight. Flakes that were flat or nearly flat were recorded as having no curvature.

CHAPTER FOUR

TECHNO-TYPOLOGY OF THE FLAKED STONE ARTIFACTS

The following chapter gives a report of the flaked stone artifacts from each site analyzed for this study. The resulting descriptions will be used in the succeeding chapters to assess changes in lithic artifact types and manufacturing techniques over time, and between coastal and inland settings. Debitage analyses will attempt to address questions concerning lithic production methods through attributes including flake size, cortex percentages, platform types, flake completeness, and flake curvature. A technological and typological summary is presented for each site assemblage in an attempt to coordinate the results of the analyses.

The primary comparisons addressed through the research question concern changes from the Middle Holocene to the Late Holocene, and differences between coastal and interior sites. This chapter is therefore organized by site dates of Early to Middle Holocene Period and Late Holocene Period, as well as by coastal and interior locales. Sites are also organized by location on either the San Elijo Lagoon or within the Las Pulgas Corridor.

EARLY TO MIDDLE HOLOCENE PERIOD SITES

The results of a lithic analysis for sites with radiocarbon dates prior to 3600 BP are presented here for comparative purposes in following chapters examining changes in lithic technology from the Early to Middle Holocene to the Late Holocene (Table 4.1).

Table 4.1. Lithic Artifacts for Early-Middle Holocene Sites

Class	Subclass	SDI-10,723 EH (C)	SEL-1A (C)	SEL-1B (C)	SEL-1C (C)	SEL-2 (C)	SEL-3 (C)	SEL-6 (C)	SEL-9 (C)	Total
Biface	Early/Middle stage			1						1
	Late stage								1	1
Subtotal				**1**					**1**	**2**
Core	Bifacial						4			4
	Multidirectional		7	1	1	1	3			13
	Tested Cobble						1			1
	Unidirectional		6			1				7
Subtotal			**13**	**1**	**1**	**2**	**8**			**25**
Debitage		82	642	232	22	53	178	100	405	1714
Modified Cobble	Graver/perforator	1								1
Retouched Flake	Denticulated/notched		2	1		1			1	5
	Retouched Flake		3	1		1	3			8
	Scraper		1				1			2
Subtotal			**6**	**2**		**2**	**4**		**1**	**15**
Utilized Flake	Denticulated/notched			1						1
	Scalar edge damage	1								1
Subtotal		**1**		**1**						**2**
Wedge	Wedge						2			2
Total		**84**	**661**	**237**	**23**	**57**	**192**	**100**	**407**	**1761**

(C) = Coastal Site

Early to Middle Holocene dates were only obtained for sites from coastal environments. The Early to Middle Holocene Period sites are organized by location as either San Elijo Lagoon or Las Pulgas Corridor.

SAN ELIJO LAGOON SITES (COASTAL)

SEL-1A

Excavations at SEL-1A unearthed a total of 661 flaked stone artifacts. The flaked stone recovered includes of 642 pieces of debitage, 13 cores, and 6 retouched flakes, three of which display denticulated retouch and one classified as a scraper (see Table 4.1). With the exception of six quartzite flakes, metavolcanic materials account for all off the flaked stone recovered from the site.

Debitage

A total of 642 pieces of debitage were analyzed for SEL-1A. The majority of the debitage from the site, 75.5 percent (n = 485) consisted of interior flakes, with cortical elements comprising 12.6 percent (n = 81) of the assemblage. Angular shatter and blocky debris account for 11.8 percent (n = 76) of the debitage collection (see Appendix A). Flake size indicates that smaller flakes dominate the assemblage, with 71.8 percent (n = 409) ranging between 10-25 mm and the rest from 25-65 mm. A technological analysis revealed primarily core flakes at the site. The three attributes of platform type, curvature, and thickness indicate 4 core flakes and no bifacial thinning flakes. However, a visual inspection of multiple flake characteristics identified 36 core flakes and 2 bifacial thinning flakes. Therefore while some bifacial production probably occurred at the site, core reduction was much more common.

Techno-Typology

In summation, lithic production at SEL-1A is characterized primarily by later stage core reduction of locally occurring lithic material. The predominance of interior flakes suggest that primarily later stages of reduction occurred at the site in that more interior flakes are typically produced during lithic production as a core is reduced further and contains less of its original cortex (Andrefsky 1998; Johnson 1989; Magne and Pokotylo 1981; Morrow 1984). The relative abundance of small flakes may suggest, as with cortex percentages, that later stages of reduction typically occurred at the site (Amick et al. 1988; Carr and Bradbury 2001:134; Shott 1994). The debitage analysis also indicates that core technology was much more common at the site than biface manufacture based on the identification of 36 core flakes as opposed to only 2 bifacial thinning flakes. Finished tools and cores recovered from the site mirror the debitage analysis. Numerous cores (n = 13) demonstrating various states and methods of reduction were recovered. The tool assemblage consists entirely of retouched flakes, i.e., large flakes removed from cores, while no bifaces were found. This, in conjunction with the evidence from debitage analysis indicating late stage core reduction, suggests that prepared cores were brought to the site, and then further reduced on site to produce flake tools. It is also likely that a limited amount of bifacial production and/or repair also took place at the site, but in a subordinate role to that of flake tool manufacture.

SEL-1B

Archaeologists recovered a total of 237 flaked stone artifacts from SEL-1B. Flaked stone from the site consists of 1 core, 1 biface, 1 denticulate, 1 indeterminate retouched flake, a utilized flake, and 232 pieces of debitage (see Table 4.1).

Debitage

The debitage assemblage from SEL-1B consists of 72.4 percent (n = 168) interior flakes and 18.1 percent (n = 42) cortical flakes (see Appendix A). Shatter comprises 14.8 percent (n = 22) of the collection. Recordation of flake size identified 59.5 percent (n = 125) of the collection ranges from 10-25 mm, while 40.5 percent of the flakes are between 25-75 mm. The technological analysis of the debitage revealed only core reduction at the site. The three-attribute analysis identified one core flake, and the visual typology of flakes recognized 5 flakes associated with core reduction.

Techno-Typology

As with SEL-1A, this site demonstrates primarily late stages of core reduction. However, the early to middle stage biface recovered from the site indicates that either bifaces were in fact produced at the site to some degree, or that they were imported to the site. The lack of bifacial thinning flakes recovered from the site may suggest the latter, although it is also possible that bifacial thinning flakes exist at the site and were not recovered. In any case, based on the debitage analyses, indicating relatively small, interior flakes as well as core flakes, and the tool assemblage, with cores and flake tools outnumbering bifaces, it is evident that later stages of core reduction occurred more frequently at the site.

SEL-1C

SEL-1C has the lowest artifact frequency of the SEL-1 sites. Flaked stone artifacts from the site consist of a core and 22 pieces of debitage (see Table 4.1).

Debitage

Interior flakes account for 59.1 percent (n = 13) of this small sample (n = 22). Cortical elements comprise the remaining 40.9 percent (n = 9) of the sample (see Appendix A). No shatter was identified at the site. Flake size indicates a relatively even split between small and large flakes, with 45.5 percent (n = 10) ranging from 10-25 mm and the rest falling between 25-75 mm in size. A technological analysis of the debitage identified three core flakes through both the visual typology and the three-attributes of platform type, curvature, and thickness.

Techno-Typology

While the core and core flakes recovered from the site suggest core technology, and the flake size and cortical elements indicate multiple stages of reduction, the sample is much too small to make reliable interpretations concerning stone tool use or manufacture at SEL-1C. However, the site was included in the study because it is a locus of SEL-1, and both SEL-1A and SEL-1B contain substantial artifact assemblages.

SEL-2

A total of 57 flaked stone artifacts were recovered from SEL-2, including 53 pieces of debitage and 4 worked stones (see Table 4.1). Worked stone from the site consist of 2 cores and two retouched flakes, all from subsurface contexts. One of the retouched flakes is denticulated, while the other displays non-patterned retouch.

Debitage

Testing at SEL-2 recovered 53 pieces of debitage. Interior flakes represent 83.0 percent (n = 44) of the site's debitage, with cortical elements comprising the remaining 17.0 percent (see Appendix A). The site contained no angular debris or blocky shatter. Flake size suggests that smaller flakes are more common at the site. Flakes ranging between 10-25 mm in size account for 69.8 percent (n= 37) of the debitage, while the remaining flakes are range between 25-60mm. Technological analyses of the debitage reveal only core reduction at the site. The three-attribute analysis of platform type, curvature, and thickness identified 1 core flake, and the visual inspection of multiple flake characteristics identified 4 core flakes.

Techno-Typology

As with SEL-1C, this assemblage is too limited to reliably extrapolate stone tool use from the site. However, initial indications would suggest core reduction at the site, based on the core and flaked tools recovered from the site as well as core flakes identified through lithic analysis. Additionally, the higher percentages of small and interior flakes tentatively indicate late stages of reduction.

SEL-3

Test excavations at SEL-3 identified 192 flaked stone artifacts. Flaked stone from the site includes 178 debitage and 14 worked stone artifacts. The worked stone artifacts consist of 8 cores, 4 retouched flakes (including 1 scraper), and two wedges (see Table 4.1).

Debitage

Interior flakes account for 66.9 percent (n = 119) of the debitage from SEL-3. Cortical elements make up 27.0 percent of the assemblage (n = 48), with shatter comprising the remainder of the debitage collection (see Appendix A). Large flakes are slightly more common at the site, with flakes ranging from 25-90 mm in size comprising 52.1 percent (n = 87) of the sample, as compared to 47.9 percent (n = 80) flakes measuring between 10-25 mm. A technological debitage analysis indicates both bifacial production and core reduction at the site. The three-attribute analysis of platform, curvature, and thickness identified 7 core flakes and one bifacial thinning flake, while the visual typology picked out 4 core flakes and no bifacial thinning flakes. The visual inspection also identified one possible bipolar flake.

Techno-Typology

As is typically seen for SEL sites, stone tool manufacture at SEL-3 consisted primarily of core reduction. However, relatively even percentages of large and small flakes, as well as only a slightly larger amount of interior flakes as compared to cortical elements and shatter, suggests that multiple stages of reduction occurred at the site.

SEL-6

Flaked stone artifacts from SEL-6 consist entirely of 100 pieces of debitage (see Table 4.1).

Debitage

The debitage collected at SEL-6 consists of 81.0 percent (n = 81) interior flakes, with cortical elements and shatter comprising 19 percent (n = 19) of the collection (see Appendix A). Smaller flakes, ranging between 10-25 mm, comprise 67.7 percent (n = 67) of the assemblage, with the remainder of the flakes falling between 25-65 mm in size. A technological analysis of the relatively small sample identified only core technology at the site. The three-attribute analysis associated 4 flakes with core reduction, while the visual typology identified only 1 core flake.

Techno-Typology

The debitage from SEL-6 indicates primarily late stage core production occurred at the site. This is based on the overall occurrence of relatively small and interior flakes, as well as the identification of core flakes.

SEL-9

Excavations at SEL-9 identified 407 flaked stone artifacts. The artifacts include 405 pieces of debitage and 2 worked stones. The worked stones from the site are a biface and a denicultated retouched flake (see Table 4.1).

Debitage

The artifact assemblage from SEL-9 includes 69.1 percent (n = 280) interior flakes, 20.7 percent (n = 84) cortical flakes, and 10.1 percent (n = 41) shatter (see Appendix A). Small flakes outnumber larger flakes at the site. Flakes ranging between 10-25 mm comprise 70.9 percent (n = 258) of the assemblage, while those ranging between 25-95 account for 29.1 percent (n = 106). Technological analyses suggest that core reduction occurred at the site and that bifacial production did not. The three-attribute analysis of platform type, curvature, and thickness indicated 8 flakes associated with core-flake technology, while the visual inspection of multiple flake attributes identified 6 core flakes. Two of the core flakes consist of quartzite material.

Techno-Typology

Overall, later stages of core reduction accounted for lithic technology at the site. The abundance of relatively small and interior flakes suggests later stages of reduction, while core flakes only were identified through the analyses. The tool assemblage from SEL-9 includes one flake tool that may have been manufactured on site, as well as an obsidian biface that was probably imported to the site. This is based on the fact that the flake tool is made of quartzite and quartzite debitage is present at the site as well as locally occurring, while no obsidian debitage was recovered from the site, and obsidian does not occur locally.

LAS PULGAS CORRIDOR SITE (COASTAL)

Only a portion of one site from the Las Pulgas Corridor predates 3600 BP. The lower deposits at SDI-10723 (deeper than 45 cmbs) are dated to the Early Holocene Period. This is contiguous with a notable change in shell species deposit within the shell midden. Therefore the lithic artifacts from below 45 cm at SDI-10723 are described in this section while the upper levels are treated as a different component and described in the following section.

SDI-10723 EH

From the Early Holocene deposit at SDI-10723, a total of 84 flaked stone artifacts were recovered from surface and subsurface contexts. Artifacts recovered include 82 pieces of debitage and 2 worked stone artifacts, a utilized flake and a modified cobble (see Table 4.2).

Debitage

Only 82 pieces of debitage were recovered from the Early Holocene component of the site. The majority of the debitage from this component consisted of interior flakes (54.9 percent), with angular shatter and cortical flakes comprising 45.1 percent of the collection (see Appendix A). This suggests that some degree of early stage production, as well as later stages of reduction, occurred at the site during this time period.

Only flakes removed from platformed cores were identified in the component. The three-attribute analysis of platform, curvature, and thickness identified 1 flake associated with core production, while a visual inspection of multiple flake attributes identified 2 core flakes. Flake size indicates that larger flakes and smaller flakes are represented evenly from the site's early component.

Techno-Typology

Flaked stone use for SDI-10723 EH included multiple stages of production, representing primarily core reduction. Debitage analyses indicate core technology dominated at the site, while relatively even percentages occur for interior flakes versus cortical elements and shatter, as well as for relatively small versus large flakes. The limited tool assemblage is composed entirely of flake and cobble based tools.

LATE HOLOCENE PERIOD SITES

Only Las Pulgas Corridor Sites could be dated to firmly within the Late Holocene Period. Radiocarbon dates were obtained from four of the sites, while another four are classified

Table 4.2. Lithic Artifacts for Late Holocene Sites

Class	Subclass	SDI-10,723 LH (C)	SDI-10689 (I)	SDI-10714 (I)	SDI-12983 (I)	SDI-14571 (I)	SDI-14659 (I)	SDI-14686 (I)	SDI-812/H (C)
Biface	Early/Middle stage	1	2	2		3			
	Late stage	1							
	Projectile point		1	3	1		1		2
Subtotal		**2**	**3**	**5**	**1**	**3**	**1**		**2**
Core	Bidirectional						1	1	
	Bifacial			1					
	Multidirectional	3	1			2		1	1
	Tested Cobble	1			1				
	Unidirectional	2				1			
Subtotal		**6**	**1**	**1**	**1**	**3**	**1**	**2**	**1**
Debitage		418	73	650	113	412	40	140	350
Modified Cobble	Drill/perforator	1							
Retouched Flake	Denticulated/notched	3							
	Flaked cobble			2					
	Graver/perforator	1	1						
	Retouched Flake	1		3	1	3			1
	Scraper	5				3			
Subtotal		**10**	**1**	**5**	**1**	**6**			**1**
Utilized Flake	Scalar edge damage	3							
Wedge	Wedge	2				2		1	
Total		**442**	**78**	**661**	**116**	**426**	**42**	**143**	**354**

(C) = Coastal Site
(I) = Interior Site

as Late Holocene based on temporally diagnostic artifacts and/or ecofacts recovered from the sites. The sites are discussed by coastal and interior settings. Table 4.2 presents a summary of lithic artifacts recovered from these sites.

COASTAL SITES

SDI-812/H

A total of 403 flaked stone artifacts was collected from surface and subsurface contexts at SDI-812/H. The collection consists of 399 pieces of debitage and 4 worked stone artifacts. Modified stone artifacts from the site include 1 core, 2 projectile points, and 1 retouched flake (see Table 4.2). One PDL manuport was also recorded at the site.

Debitage

A total of 399 pieces of debitage were analyzed from SDI-812/H. The majority of the debitage consisted of interior flakes (52.9 percent) and shatter (46.1 percent), with only three secondary flakes and one primary flake collected from the site (see Appendix A).

These percentages suggest that earlier stages of production took place at the site to some degree. Although a lack of cortical flakes often indicates later stages of production, this may not entirely be the case at SDI-812/H. Most of the debitage raw material from the site consists of PDL, which occurs in tabular form, possibly making cortical elements less typical. Earlier stage production is also suggested by the relatively large amount of shatter, which is tentatively indicative of early to middle stages of production (Becker 2004:14-15). However, later stages of production may also have occurred at the site. A technological analysis of the debitage revealed primarily core flakes, based on the identification of three flake attributes and a visual examination of multiple flake characteristics. The three attributes of platform type, curvature, and thickness indicate that two flakes are associated with core production, and the visual inspection of various flake attributes places all but one of the identifiable flake types (n = 8) as core flakes, four of which are made on PDL material. Although metavolcanics are rare in the debitage assemblage from the site, the remaining identified core flakes consist of this material. One PDL bifacial thinning flake was identified through the visual inspection, and the three-attribute analysis revealed an additional bifacial thinning flake made of quartz. The majority of the flakes from the site are relatively small, falling between 10-25 mm in size, with only 21.9 percent (n = 47) larger than 25 mm.

Techno-Typology

SDI-812/H does not fit the expected pattern for large coastal sites in San Diego County based on the lithic analysis. In summary, flaked stone at the site appears to represent mainly PDL use for both core and biface-flake production, from early to late stages of reduction. The dominant use of PDL is atypical for coastal sites along this drainage. Relatively large amounts of metavolcanic tools are common at coastal sites, yet tools recovered from this site consisted of only two projectile points and one retouched flake, none of which were made on metavolcanic. While only one core was recovered from the site, debitage analysis indicates that core reduction did take place at the site, probably utilizing both PDL and metavolcanic materials. The high percentage of small PDL interior flakes suggests that bifacial technology, probably in the form of maintenance as opposed to production, also occurred at the site. Based on debitage type and flake size, as well as worked stone, all stages of lithic reduction appear to be represented at the site although the earlier stages of production are uncommon. However, size sorting of debitage from fluvial processes may account for the overall small size of flakes recovered from the site, partly obscuring patterning related to reduction stage and production techniques.

SDI-10723 LH

From the Late Holocene component of SDI-10723, a total of 442 flaked stone artifacts were recovered from surface and subsurface contexts. Artifacts recovered include 418 debitage and 24 worked stone artifacts. Flaked stone artifacts include 6 cores, 1 early /middle stage biface, 1 late stage biface, 5 scrapers, 3 denticulates, 1 graver/perforator, 1 indeterminate retouched flake, 2 modified cobbles (1 classified as a drill), a wedge, and 3 utilized flakes (see Table 4.2).

Debitage

A total of 500 pieces of debitage were recovered at the site from surface and sub-surface contexts. Interior flakes comprise 61 percent of the assemblage, with angular shatter and cortical flakes accounting for the remaining 39 percent of the collection (see Appendix A). This suggests that some degree of early stage production, as well as later stages of reduction, occurred at the site.

The results of the technological analysis indicate a combination of core flakes and bifacial thinning flakes, with core flakes dominating the assemblage. The three-attribute analysis of platform, curvature, and thickness suggest 9 flakes are associated with core production and 2 flakes are from bifacial thinning. A visual inspection of multiple flake attributes, on the other hand, identified 38 core flakes and no bifacial thinning flakes. Therefore, while some biface production probably occurred at the site, core reduction was much more prevalent. Flake size indicates that larger flakes are slightly more common at the site, with 56 percent of the flakes ranging between 25-90 mm, and the rest ranging from 10-25mm.

Techno-Typology

Flaked stone use at SDI-10723 LH relied principally on metavolcanic material for making core and flaked based tools, representing all stages of reduction, with similar results concerning debitage size and cortex percentage as seen in the Early Holocene component of the site. Flaked stone tools from the site include a variety of retouched and utilized flakes, most of which probably exemplify finished or late stage tools. The tool assemblage also includes two bifaces, one of which was probably discarded or lost during the early stages of production. Both the worked stone artifact assemblage and the debitage analysis suggest that multiple stages of reduction occurred at the site, and that while some bifacial production did take place, technology related to core production on metavolcanic materials dominated the flaked stone activity. Most of the metavolcanic debitage from the site consisted of medium-grained material, while the majority of metavolcanic tools were manufactured with aphanitic rocks, suggesting that some of the fine-grained material tools were brought into the site in the later to finished stages of production.

INTERIOR SITES

SDI-10689

The lithic assemblage from SDI-10689 included 78 flaked stone artifacts. Flaked stone from the site consisted of 73 debitage and 5 worked stone artifacts. One core, 2 bifaces, 1 projectile point, and 1 graver/perforator comprised the worked stone assemblage (see Table 4.2).

Debitage

A total of 73 debitage artifacts were recovered from surface and subsurface contexts at the site, with 91.8 percent (n = 67) recovered from the site surface. Interior debitage dominated this artifact class, comprising 78.1 percent (n = 57) of the assemblage. Shatter comprised 15.1 percent (n = 11) of the collection, with the remaining 6.8 percent (n = 5) consisting of cortical elements (see Appendix A). This would indicate that later stages of lithic reduction predominated at the site.

Debitage analyses identified only core flakes from the debitage assemblage. The three-attribute analysis produced 3 core flakes and no bifacial thinning flakes, while 4 core flakes and no bifacial thinning flakes were recognized through the visual inspection. All of the core flakes identified were made of metavolcanic material. Flake size indicates that smaller flakes were more common at the site, with 51.6 percent (n = 32) of the assemblage measuring less than 25 mm, and the remaining 48.4 percent (n = 30) ranging from 25-75 mm. However, 64 percent (n = 16) of the PDL flakes were smaller than 25 mm, while 69.6 percent (n = 16) of the metavolcanic flakes were larger than 25 mm. This may indicate later stage reduction of PDL, with earlier stages of reduction for metavolcanic materials.

Techno-Typology

In summation, flaked stone utilization at the SDI-10689 included both bifacial reduction and core production, representing multiple stage of reduction. Both core flakes and one core of this material evidence core reduction of metavolcanic material. Although only core flakes were recovered from the site, the presence of early/middle stage bifaces at the site, coupled with the small flake size for PDL material, suggest that at least some bifacial reduction did occur at the site. The lack of evidence for bifacial manufacture may also be a product of the relatively small sample size from the site.

SDI-10714

The artifact assemblage from SDI-10714 included 660 flaked stone artifacts. Flaked stone recovered from the site consisted of 649 debitage and 11 worked stone artifacts. The worked stone artifacts included 1 core, 2 bifaces, 3 projectile points, 2 modified cobbles, and 3 retouched flakes.

Debitage

A total of 649 debitage artifacts were recovered at the site. The majority of the debitage (82 percent) was recovered from subsurface contexts. Interior flakes comprised 76.7 percent (n = 498) of the assemblage, followed by shatter at 18.3 percent (n = 119), while cortical flakes accounted for 4.9 percent (n = 32) of the collection (see Appendix A). These percentages are indicative of primarily late stage reduction occurring at the site.

The technological analysis indicated a combination of core flakes and bifacial thinning flakes, with core flakes dominating the assemblage. The three-attribute analysis of platform, curvature, and thickness suggest 21 flakes are associated with core production and 2 flakes are from bifacial thinning. A visual inspection of multiple flake attributes identified 10 core flakes and no bifacial thinning flakes. Both bifacial thinning flakes identified were made of PDL, while all but one of the core flakes were metavolcanic, the exception being a quartz core flake. Flake size indicates that small flakes are slightly more common at the site, with 51.6 percent of the flakes ranging between 0-25 mm, and the rest larger than 25 mm.

Techno-Typology

Flaked stone use at SDI-10714 apparently consisted of the exploitation of metavolcanic material for producing core and flake based tools, and the utilization of PDL for both core reduction and biface manufacture. Flaked stone tools from the site included five bifaces, all made of PDL. The only core recovered from the site was a bifacial core, also made of PDL, while all of the retouched flakes from the site were made of metavolcanic material. Debitage analysis also suggests that PDL was used primarily for biface production, and metavolcanic material was heavily used for core reduction. It is interesting to note that although metavolcanic core tools and core flakes were identified, no metavolcanic cores were recovered at the site. This could indicate that metavolcanic cores were worked and then transported from the site prior to exhaustion. The large amount of relatively small interior flakes from the site suggests late stage reduction occurred at the site. However, the non-cortical nature of PDL, coupled with the recovery of both early stage and finished PDL bifaces, may indicate early and late stage reduction of PDL, while tool and debitage analysis indicates late stage reduction predominated metavolcanic use at the site. The small flake size at the site may indicate later stages of biface production occurred along with core production at the site, while the shatter may suggest at least some earlier stage reduction of either cores or bifaces. It is also the possibility that at least some of the shatter recorded at the site is due to natural forces acting on the PDL material deposited at the site through alluvial processes.

SDI-12983

Flaked stone artifacts from SDI-12983 are represented by 113 debitage and 3 worked stone tools. Worked stone artifacts from the site consist of 1 core, 1 projectile point, and 1 retouched flake (see Table 4.2).

Debitage

The debitage analysis included 113 pieces, 95.6 percent of which were interior flakes. Cortical flakes and shatter comprised only 4.5 percent of the assemblage, indicating later stage reduction took place at the site for the most part (see Appendix A). The technological analysis of debitage from the site demonstrates both core and bifacial reduction. The three-attribute analysis indicates one core flake and one bifacial thinning flake, while the visual inspection of multiple flake characteristics identified only one core flake of quartz material. The flake size shows that large flakes are rare at the site with only 11.5 percent (n = 13) ranging from 25-60 mm, with the rest of the flakes falling between 10-25 mm in size. The higher percentage of smaller flakes suggests later stages of biface reduction happened at the site.

Techno-Typology

Flaked stone activity at SDI-12983 relied on PDL for the purpose of biface and core production, typically in later stages of reduction. Worked stone from the site included a quartz projectile point and a retouched metavolcanic flake. Debitage analysis suggests that these tools may have been brought into the site complete or nearly complete, modified slightly, and then lost or abandoned. The debitage analysis also indicates that PDL tools were probably flaked at the site and then possibly transported away.

SDI-14571

A total of 426 flaked stone artifacts were recovered from the site surface and from subsurface excavations at SDI-14571. Debitage comprised 412 pieces of the assemblage, with 14 worked stone artifacts rounding out the collection. Flaked stone at the site consists of 3 cores, 3 bifaces, 3 scrapers, 3 retouched flakes, and two wedges (see Table 4.2).

Debitage

The debitage analysis examined all 412 pieces, of which 77.5 percent are interior flakes. Shatter from the assemblage follows with 18.4 percent of the collection, while cortical elements comprise only 4.1 percent. The low percentage of shatter and cortical flakes indicates little early stage production occurred at the site.

The results from the technological analysis indicate a combination of core and bifacial thinning flakes, with core flakes dominating the assemblage. The three flake attributes of platform, curvature, and thickness suggest 85.7 percent (n = 12) of the technologically identifiable flakes are core flakes, while 14.3 percent (n = 2) are bifacial thinning flakes (see Appendix A). The visual inspection of multiple flake characteristics that were not coded for individually identified even more core reduction at the site, indicating 96 percent (n = 24) of the flakes were associated with core production, and only 14 percent (n = 1) with biface production. However, one of the flakes identified as a core flake was made of granitic material, and may represent ground stone shaping rather than core reduction. Large flakes from the site are less common than relatively small flakes, with 34.9 percent of the assemblage ranging from 25 to 85 mm. By contrast, flakes ranging between 10-25 mm comprise 65.1 percent of the collection. Thus flake size from the site tends to match the interpretation of cortex percentage in that while both early and late stages of reduction occurred at the site, later stages of biface production were prevalent.

Techno-Typology

The use of flaked stone at SDI-14571 relied on a variety of materials for the purpose of biface and core-flake production, from early to late stages of reduction. Worked stone artifacts from the site include 3 bifaces and 6 retouched flakes, consisting mainly of tools in the early to middle stages of production. Of the tools, only the 3 scrapers could be reliably considered finished tools. This contradicts the results of the debitage analysis, which suggest that later stages of reduction occurred more frequently at the site. There is also a contrast of raw material use as reflected by tools, which are predominantly metavolcanics, and debitage, which is represented by a variety of materials, with PDL comprising the majority of the artifact class. Also, the majority of metavolcanic tools from the site are made of medium-grained materials, while relatively equal amounts of fine and medium-grained material occurred with the metavolcanic debitage. These contradictions may indicate that late stage biface reduction of PDL and fine-grained metavolcanics occurred at the site, but that the majority of those artifacts were transported from the site.

SDI-14659

The artifact assemblage from SDI-14659 includes a total of 42 flaked stone artifacts. The flaked stone artifacts consist of 40 pieces of debitage and 2 worked stone artifacts. One core and one projectile point represent the worked stone artifacts recovered from the site (see Table 4.2).

Debitage

A total of 40 pieces of debitage were recovered from the site, the majority of which are interior flakes. Cortical elements and shatter compose a total of 17.5 percent (n = 7) of the assemblage, while 82.5 (n = 33) percent of this artifact class consists of interior flakes (see Appendix A). While these percentages may suggest primarily later stage reduction took place at the site, the sample size is probably too small to reliably make this determination.

A technological analysis of the debitage revealed only one PDL bifacial thinning flake. The three-attribute analysis identified no technologically determinate flakes, while the visual inspection of multiple flake attributes identified the one flake associated with bifacial reduction. Finally, flake size suggests that large flakes are almost as common as smaller flakes at the site, with 45 percent (n = 18) of the flakes ranging from 25-45 mm and 55 percent (n = 22) of the flakes between 10 and 25 mm in size.

Techno-Typology

Flaked stone use at SDI-14659 probably relied primarily on PDL for biface and core-flake production, encompassing early to late stages of reduction. Worked stone from the site consisted of one finished projectile point made on metavolcanic material and one PDL core. Based on the limited occurrence of metavolcanic debitage at the site, it is probable that the point was brought from another location. The small sample size of the collection makes further interpretation or conclusions concerning the lithic assemblage unreliable.

SDI-14686

A total of 143 flaked stone artifacts were recovered from the site. These artifacts include 140 debitage and 3 modified stone artifacts. Worked stone from the site consist of 2 cores and one modified cobble (see Table 4.2).

Debitage

The debitage analysis consisted of 144 flakes and pieces of debris. Interior flakes comprised 71.4 percent of the assemblage (n = 100), followed by shatter at 24.3 percent (n = 34), and cortical elements at 4.2 percent (n = 6) (see Appendix A). These percentages suggest that some degree of early stage production occurred at the site, but that later stage reduction dominated the production sequence.

A technological analysis of the assemblage revealed two core flakes and one bifacial thinning flake, both in the three-attribute analysis and through the visual typology. All of the technologically determinate flakes were made of metavolcanic material. The majority of the flakes from the site (60 percent) were between 10-25 mm in size, while the remaining 40 percent (n = 56) ranged from 25-65 mm.

Techno-Typology

Overall, flaked stone utilization at SDI-14686 employed a variety of materials for both biface and core-flake production, primarily comprising later stages of reduction. Results of the debitage analysis match the worked stone from the site in that metavolcanic core-flake production and late stage reduction occurred at the site, but contrast with regards to the bifacial production reflected in the debitage assemblage but not the tools. This may simply indicate that bifaces produced or repaired at the site were later transported to different locations. A contrast also occurs with raw material use as seen in debitage, which is mainly quartz, and worked stone which consists of metavolcanics and PDL. However, these contradictions are not surprising considering the small number of worked stone artifacts recovered from the site.

SUMMATION

SAN ELIJO LAGOON

Seven coastal sites dating to the Early-Middle Holocene period comprised the San Elijo Lagoon site assemblages for this study. Flaked stone technology from the San Elijo Lagoon sites consisted primarily of core reduction of locally occurring metavolcanic materials. Flake size from these sites indicates all stages of reduction occurred, with differing emphasis on stages at different sites. Interior flakes are also more common at the sites overall, also suggesting later stages of reduction (see Appendix A). However, because both core reduction and biface production technologies are present at the San Elijo Lagoon sites, reduction stages may be obscured (see Stahle and Dunn 1982).

Although it is likely that all stages of reduction occurred at the sites, a difficulty arises in attempting to demonstrate a preference of one over the other at sites with mixed technologies (c.f. Andrefsky 2007).

Core-flaked based technologies dominated the lithic production at all of the sites. Debitage analysis identified a dominance of core flakes at the sites. Bifacial thinning flakes were identified, but account for less than 2 percent of the identified flake types (see Appendix A). The analysis of the debitage matches that of the tools in that the majority of tools from the San Elijo Lagoon sites are flake based. One of the bifaces recovered from the sites was in the early to middle stages of production, and this was made of a locally occurring metavolcanic material, while the other was a late stage obsidian biface, which does not occur locally (Table 4.3). This along with the debitage analysis suggests that only a small amount of biface production did occur at the San Elijo Lagoon sites.

LAS PULGAS CORRIDOR

Las Pulgas Corridor site assemblages included in this study consisted of two coastal sites and six interior sites dating to the Late Holocene period, as well as one small component of a coastal site dating to the Early-Middle Holocene. Debitage analyses recorded higher percentages of bifacial thinning flakes for the inland sites and more core reduction flakes for the coastal sites (see Appendix A). Coastal sites from the Las Pulgas Corridor, as with the SEL sites, typically display core reduction of locally occurring metavolcanic material. This pattern is seen in both the early and late components of the sites. Interior

Table 4.3. Biface stages by raw material type for Late and Early/Middle Holocene sites

Site	Biface Stage	Chert	Metavolcanic	Obsidian	PDL	Quartz	Total
Late Holocene							
Coastal Sites							
SDI-812/H	Projectile point				1	1	**2**
SDI-10,723 LH	Early/Middle stage	1					**1**
	Late stage		1				**1**
Subtotal		**1**	**1**		**1**	**1**	**4**
Interior Sites							
SDI-10689	Early/Middle stage		1		1		**2**
	Projectile point					1	**1**
SDI-10714	Early/Middle stage				2		**2**
	Projectile point				3		**3**
SDI-12983	Projectile point					1	**1**
SDI-14571	Early/Middle stage		1		1	1	**3**
SDI-14659	Projectile point		1				**1**
Subtotal		**1**	**4**		**8**	**4**	**17**
Early-Mid Holocene							
Coastal Sites							
SEL-1B	Early/Middle stage		1				**1**
SEL-9	Late stage			1			**1**
Subtotal							
Total		**1**	**5**	**1**	**8**	**4**	**19**

sites from the Las Pulgas Corridor, on the other hand, demonstrate primarily biface technology of PDL chert and metavolcanic material. Tools from the two environments conform to the expectations of the debitage analysis in that the coastal sites contain primarily cores and flake tools, while the lithic assemblages from interior sites include more bifaces. Additionally, unfinished biface from the Late Holocene coastal sites represents an exotic chert material, while late stage bifaces and projectile points are made from locally occurring metavolcanic and quartz materials as well as PDL from a quarry less than five kilometers northeast of the coast (see Table 4.3). The lack of bifacial thinning flakes and the raw material correlating to the various stages of bifaces suggest that biface production was even less common at coastal Las Pulgas sites during the Late Holocene than at the SEL sites. Conversely, bifacial thinning flakes are more common at inland sites (see Appendix A), and early/middle stage bifaces are represented by locally occurring materials for the inland sites (see Table 4.3), indicating relatively more bifacial production at these sites.

The basic tool kit for the Las Pulgas sites is similar between coastal and interior sites, and to the SEL sites. The tools typically include bifaces, cores, retouched and utilized flakes, denticulates, scrapers, drills, gravers, wedges, and projectile points. The primary differences are seen in the amount of bifacial tools at interior sites as compared to coastal sites, with more cores and flake tools recovered from coastal environments in general.

CHAPTER FIVE

DISSCUSSION OF THE RESULTS OF LITHIC ANALYSIS

The following chapter examines the results of the lithic analyses and attempts to place them in the context of the competing models. Lithic artifact densities and diversities are utilized to examine site occupation duration as suggested by previous research (Andrefsky 1998; Barut 1994; Price 1978; Shott 1986). Artifact densities are calculated by dividing the number of lithic artifacts for a site by the m^3 of excavated sediment from the site. The numbers of different lithic artifact classes present at each site are used to measure artifact diversity. Linear regression is in turned utilized to determine if sample size is responsible for any differences in artifact richness at each site.

Core-biface ratios are calculated for project sites using systems defined by Parry and Kelly (1987) and Bamforth and Becker (2000). The results of the core-biface analyses are also presented to understand how long people used particular sites during specific time periods in addition to differential site function and raw material availability. The results of these analyses are then tied together and examined with additional lines of evidence in the final chapter to test the validity of the Coastal Decline Model.

ARTIFACT DENSITY AND ARTIFACT DIVERSITY

The density data suggest that indeed Late Holocene interior sites follow the Coastal Decline model in that they do have higher overall artifact densities than coastal sites from

Table 5.1. Lithic Artifact Densities for San Elijo Lagoon and Las Pulgas Sites

Site #	Excavated (m3)	Lithic Artifacts (n)	Lithic Artifacts/m3	Lithic Tools	Lithic Tools/m3
Late Holocene					
Coastal Sites					
SDI-812/H	25.3	354	14.0	4	0.2
SDI-10723 LH	3.76	442	117.6	24	6.4
Subtotal	**29.06**	**796**	**27.4**	**28**	**1.0**
Interior Sites					
SDI-10689	1.63	78	47.9	5	3.1
SDI-10714	2.18	661	303.2	11	5.0
SDI-12983	5.56	116	20.9	3	0.5
SDI-14571	2.48	426	171.8	14	5.7
SDI-14659	2.55	42	16.5	2	0.8
SDI-14686	2.05	143	69.8	3	1.5
Subtotal	**16.45**	**1466**	**89.1**	**38**	**2.3**
Total/Site	**45.5**	**2262**	**49.7**	**66**	**1.5**
Early-Mid Holocene					
Coastal Sites					
SEL-1A	8.12	661	81.4	19	2.3
SEL-1B	4.64	237	51.1	5	1.1
SEL-1C	1.16	23	19.8	1	0.9
SEL-2	2.32	57	24.6	4	6.0
SEL-3	10.44	192	143.3	14	1.3
SEL-6	2.32	100	43.1	0	0.0
SEL-9	10.44	407	39.0	2	0.2
SDI-10723 EH	2.33	84	36.1	2	0.9
Total/Site	**41.77**	**1761**	**42.2**	**47**	**1.1**

both time periods (Table 5.1). Interior sites have greater artifact density with regards to lithic artifacts (89.1) and lithic tools (2.3) than either Early/Middle Holocene or Late Holocene coastal sites. So over time coastal locations show a decline in occupation relative to interior locations based upon artifact density. Additionally, the Early/Middle Holocene coastal sites have greater artifact densities for both lithic artifacts (42.2) and lithic tools (1.1) than Late Holocene coastal sites (27.4 and 1.0). So even when looking at only coastal sites there appears to be a decline in coastal use during the Late Holocene. However, the Las Pulgas coastal site SDI-10723LH contains the highest artifact density per m^3 of all the project sites for lithic tools (6.4), and in particular a much higher density than the earlier component of the same site, SDI-10723EH, for both tools and all lithic artifacts. When the data are viewed as an aggregate and the mean or average volume is

Table 5.2. Lithic Tool Types for San Elijo Lagoon and Las Pulgas Sites

Site #	Biface	Core	Denticulate	Drill	Graver	Projectile point	Retouched Flake	Scraper	Utilized Flake	Wedge	Total
Late Holocene											
Coastal Sites											
SDI-812/H		1				2	1				**4**
SDI-10,723 LH	2	6	3	1	1		1	5	3	2	**24**
Subtotal	**2**	**7**	**3**	**1**	**1**	**2**	**2**	**5**	**3**	**2**	**28**
Interior Sites											
SDI-10689	2	1			1	1					**5**
SDI-10714	2	1				3	5				**11**
SDI-12983		1				1	1				**3**
SDI-14571	3	3					3	3		2	**14**
SDI-14659		1				1					**2**
SDI-14686		2								1	**3**
Subtotal	**7**	**9**			**1**	**6**	**9**	**3**		**3**	**38**
Total	**9**	**16**	**3**	**1**	**2**	**8**	**11**	**8**	**3**	**5**	**66**
Early-Mid Holocene											
Coastal Sites											
SDI-10,723 EH					1				1		**2**
SEL-1A		13	2				3	1			**19**
SEL-1B	1	1	1				1		1		**5**
SEL-1C		1									**1**
SEL-2		2	1				1				**4**
SEL-3		8					3	1		2	**14**
SEL-9	1		1								**2**
Subtotal	**2**	**25**	**5**		**1**		**8**	**2**	**2**	**2**	**47**
Total	**11**	**41**	**8**	**1**	**3**	**8**	**19**	**10**	**5**	**7**	**113**

assessed, the coastal sites tend to decline. However, this trend is not neccessarily true for all sites, as atested by SDI-10723LH. This site is in direct opposition to the expectation of the Coastal Decline Model, which would predict a higher artifact density at the earlier coastal sites, as the coast would have been utilized less frequently in later time periods. The late period interior bedrock milling sites SDI-10714 and SDI-14571 have lower artifact densities than the coastal site SDI-10723LH when only lithic tools are considered, but do contain significantly higher artifact densities than coastal sites from both time periods when debitage is included. Therefore artifact density supports the Coastal Decline Model, indicating generally longer term occupations for Late Holocene interior sites, with shorter periods of occupation at Early/Middle Holocene coastal sites, and even less duration of occupation at Late Holocene coastal sites.

Artifact richness is utilized here to help infer the relative mobility pattern of the project

Table 5.3. Number of Artifacts and Artifact Classes Represented at Project Sites

Site #	Artifacts (n)	Artifacts (ln)	Artifact Classes (n)	Artifact Classes (ln)	Class/Site
Late Holocene					
Coastal Sites					
SDI-812/H	354	5.869296913	4	1.386294361	
SDI-10723 LH	442	6.091309882	9	2.197224577	
Subtotal	**796**		**13**		**6.5**
Interior Sites					
SDI-10689	78	4.356708827	5	1.609437912	
SDI-10714	661	6.49375384	5	1.609437912	
SDI-12983	116	4.753590191	4	1.386294361	
SDI-14571	426	6.054439346	6	1.791759469	
SDI-14659	42	3.737669618	3	1.098612289	
SDI-14686	143	4.96284463	3	1.098612289	
Subtotal	**1466**		**26**		**4.333**
Total	**2262**		**39**		**4.875**
Early-Mid Holocene					
Coastal Sites					
SEL-1A	661	6.49375384	5	1.609437912	
SEL-1B	237	5.468060141	6	1.791759469	
SEL-1C	23	3.135494216	2	0.693147181	
SEL-2	57	4.043051268	4	1.386294361	
SEL-3	192	5.257495372	5	1.609437912	
SEL-6	100	4.605170186	1	0	
SEL-9	407	6.008813185	3	1.098612289	
SDI-10723 EH	84	4.430816799	5	1.609437912	
Total	**1761**		**31**		**3.875**

n = number
ln = natural log of number

sites. Lithic tools from the project sites were divided into ten distinct tool classes, as presented in Table 5.2 by the number of each particular class represented for each site. The analysis suggests higher artifact richness in Late Holocene coastal sites (6.5) than in interior Late Prehistoric sites (4.33), in that they typically contain a greater number of lithic artifact classes. Lower diversity values are also noted for Early/Middle Holocene sites on the coast (3.875) when compared to all Late Holocene sites (Table 5.3). While this tends to suggest a longer-term occupation for late period coastal sites, with shorter occupations for late period interior sites, the relationship between artifact diversity and sample size of the assemblage must be addressed. Debitage was added to the number of

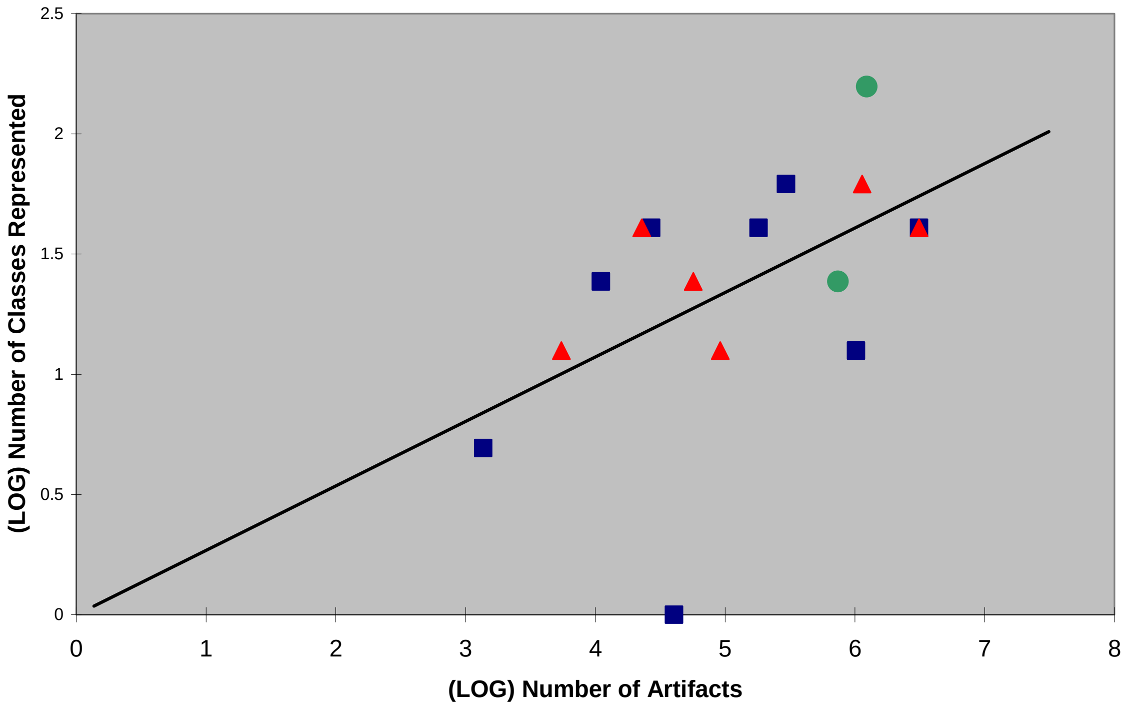

Figure 5.1: Relation between richness and sample size for project sites. Circles represent LH coastal sites, triangles LH interior sites, and squares EH-MH coastal sites.

artifacts and the number of classes represented for each site (a minimum value of 1 and maximum value of 11) was tabulated in raw counts and with natural logarithms (see Table 5.3). A regression equation was performed on the data employing Microsoft Excel software (Figure 5.1), utilizing the natural logarithms of the numbers of artifacts and artifact classes (after Rhode 1988). The results suggest that assemblage size is responsible for only slightly more than one quarter of the assemblage richness (r^2=. 252), while the relationship drops to only 19.8 percent when adjusted r^2 is considered. Hence, other variables, such as occupation duration, must also play a role in the observed artifact diversity of the project sites (although admittedly other factors, such as sample bias, sample error, and the potential misclassification of artifacts, could also account for these

Table 5.4. Regression Results Displaying Standard Residuals

Site #	Expected	Observed	Standard Residuals
Lat Holocene			
Coastal Sites			
SDI-812/H	1.563709962	-0.177415601	-0.40310403
SDI-10723 LH	1.619340027	0.57788455	1.313005116
Interior Sites			
SDI-10689	1.184698885	0.424739027	0.965044862
SDI-10714	1.72018091	-0.110742997	-0.251617944
SDI-12983	1.284145942	0.102148419	0.232090298
SDI-14571	1.610101331	0.181658138	0.412743453
SDI-14659	1.029585461	0.069026827	0.156835094
SDI-14686	1.336579087	-0.237966798	-0.540681739
Early-Mid Holocene			
Coastal Sites			
SEL-1A	1.72018091	-0.110742997	-0.251617944
SEL-1B	1.463171565	0.328587904	0.746580955
SEL-1C	0.878697622	-0.185550442	-0.421587113
SEL-2	1.106105321	0.28018904	0.63661443
SEL-3	1.410410089	0.199027823	0.452208923
SEL-6	1.246956157	-1.246956157	-2.833195338
SEL-9	1.598668727	-0.500056439	-1.136172722
SDI-10723 EH	1.203268212	0.406169701	0.9228537

variables). It also must be stated that the regression approach used here is sensitive to overestimation of relationship based on the number of artifact classes. Figure 5.1 does demonstrate a relatively normal distribution of the observed versus expected results along the regression line as do the standard residuals obtained (Table 5.4). Observations lie more than one standard deviation from the regression line in only three cases. Therefore it could be assumed that the overestimation of this relationship is not too great, and other factors, such as duration of occupation, may also play a role in the differences in artifact richness between site types. Hence, the diversity (richness) of artifacts also tends to support the Coastal Decline Model in that Late Holocene interior sites have higher diversity and as such appear to have been occupied for longer duration than coastal sites from the Early/Middle Holocene. However, this pattern again does not hold for the Late Period coastal sites at Las Pulgas, which have greater artifact diversities than either of the other suites of sites (see Table 5.3).

Overall, Late Holocene interior sites tend to exhibit greater artifact density with regards to stone tools than do coastal sites from either time period. Late Period sites from the interior settings have a relatively higher richness of lithic artifacts than coastal sites from the Early/Middle Holocene Period, but Late Holocene coastal sites have greater richness in the stone tool assemblage than either late interior or early coastal sites. As shown in previous studies the higher artifact density and diversity at a particular site tends to indicate a longer-term occupation of that site. Thus, in general, interior sites appear to represent relatively greater lengths of occupation in the Late Holocene for the project sites based on stone tool assemblages, with the Late Period coastal sites at Las Pulgas expressing an anomaly in this pattern.

CORE-BIFACE RATIOS

Core to biface ratios were recorded for the project sites in order to examine both site occupation duration and differential site functions (Table 5.5). The core-biface ratio for the San Elijo Lagoon coastal sites is 12.5, while the two Late Holocene coastal sites from Las Pulgas contain a combined core biface ratio of 3.5. Conversely, Late Holocene interior sites from the Las Pulgas Corridor display a core-biface ration of 1.3, considerably lower.

Table 5.5. Core to Biface Ratios for San Elijo Lagoon and Las Pulgas Sites

Site #	Date BP	Core	Biface	Ratio
Late Holocene				
Coastal Sites				
SDI-812/H	580-1580	1	0	1
SDI-10723	1310-1060	6	2	3
Subtotal		**7**	**2**	**3.5**
Interior Sites				
SDI-10689	No date	1	2	0.5
SDI-10714	No date	1	2	0.5
SDI-12983	750	1	0	1
SDI-14571	380	3	3	1
SDI-14659	No date	1	0	
SDI-14686	No date	2	0	
Subtotal		**9**	**7**	**1.3**
Total		**16**	**9**	**1.8**
Early-Mid Holocene				
Coastal Sites				
SEL-1A	8324-8396	13	0	13
SEL-1B	4944-7498	1	1	1
SEL-1C	4264	1	0	1
SEL-2	4281-7437	2	0	2
SEL-3	7180-7724	8	0	8
SEL-9	5235-5256	0	1	0
Total		**25**	**2**	**12.5**

According to similar patterns acquired by Parry and Kelly (1987) and Bamforth and Becker (2000), this suggests that people were probably using these coastal sites for greater periods of time than they were the interior sites, and that coastal sites were used for longer durations in the Early/Middle Holocene than in the Late Holocene. This also suggests a difference in site function between not only interior and coastal sites, but also between coastal sites of different time periods. The debitage analysis from the project sites supports this assumption and shows that coastal sites appear to have been used for

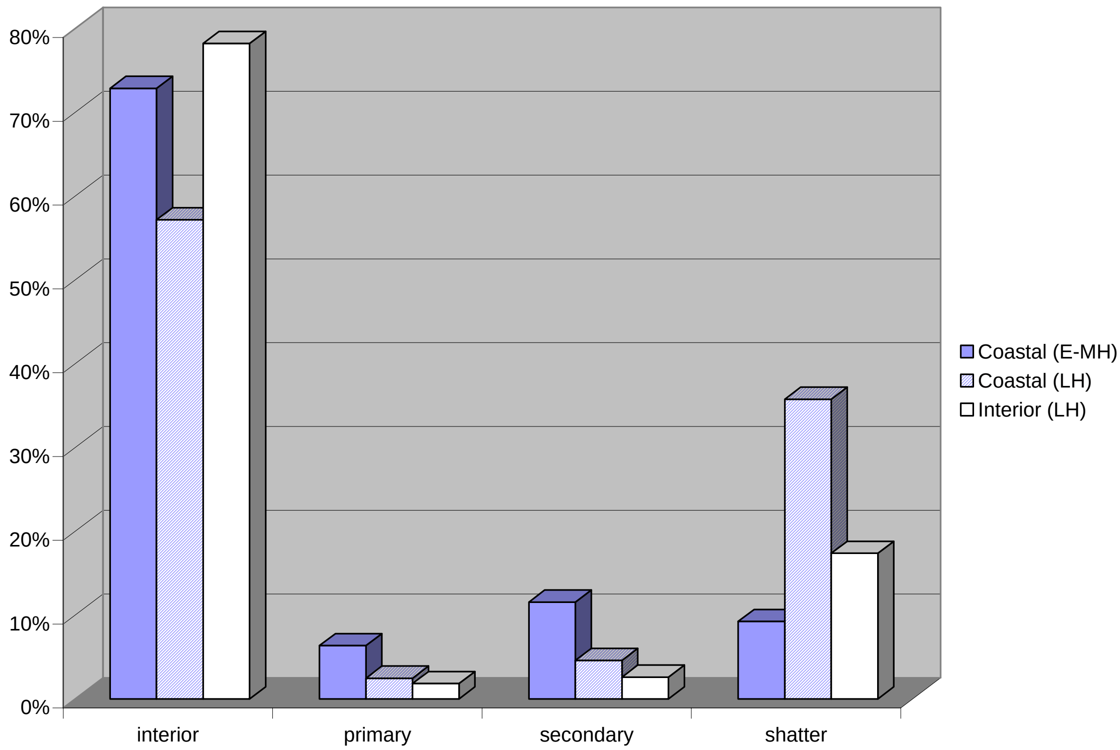

Figure 5.2: Debitage type for coastal and interior sites

core-flake production, while biface reduction typically dominated interior site technological activities. The analysis shows that flakes from coastal sites represent less than 2 percent bifacial thinning flakes, whereas over 20 percent of the identifiable flakes from interior sites represent biface production (see Appendix A). Both coastal and interior sites display evidence of late stage reduction, but the percentage of non-cortical flakes at coastal sites is slightly lower than at interior sites (Figure 5.2). This suggests that later stage reduction may be more common at interior sites, but as mentioned above reduction stage is often obscured in mixed assemblages, where more than one stage of lithic reduction is represented. Conversely, coastal sites exhibit more cortical elements, indicating more early stage reduction. Percentages of complete flakes are slightly higher for Early Holocene coastal sites than interior sites and lower in Late Holocene coastal

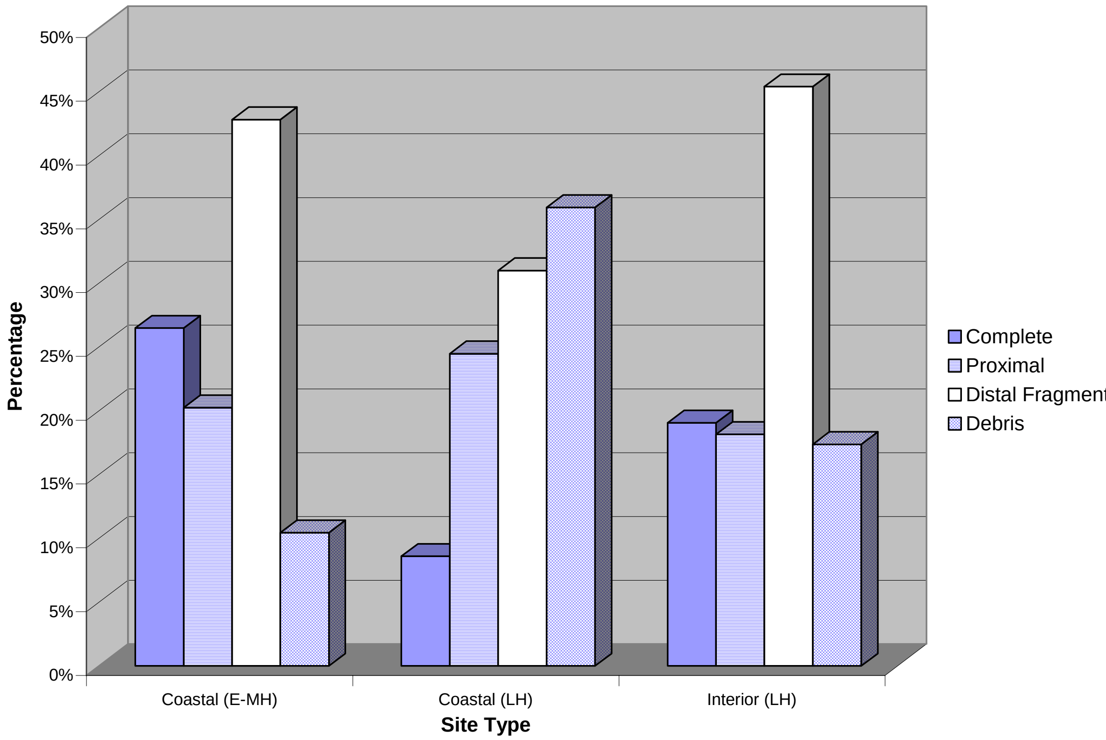

Figure 5.3: Debitage completeness for coastal and interior sites

sites, while distal fragments are slightly more common at interior sites (Figure 5.3). This suggests more formal tool production at the interior sites than coastal sites, but less formal tool production in Late Holocene coastal sites as compared to Early Holocene sites on the coast (after Sullivan III 2001:Figure 11.1). In fact, the smaller flake size and relative frequency of non-cortical flakes at interior sites might also be a product of biface production as opposed to core-flake tool would suggest differential activities between the two areas; with interior sites representing more hunting activities or those activities requiring consistent use, such as butchering or scraping hides. This is probably the case in that the two environments provide different resources that require different procurement strategies. Hunting may be more predominant inland, but could also occur on the coast. However, activities such as acorn procurement (and possibly though not necessarily processing) would have to occur inland where the oaks grew, just as collection of marine invertebrates must occur at the coastal environment. Therefore the different procurement strategies can be seen in the lithic assemblage, and do not appear to change dramatically through time. The core to biface differential, along with core size and tool type, may be indicative of material availability as well as different reduction strategies. Relatively high quality PDL is readily accessible and abundant in interior contexts, thus both formal and informal tool production could be expected (Andrefsky 1994). Given the abundance of relatively low quality metavolcanic material at coastal sites, informal tool types, such as retouched flakes and utilized flakes, should be the norm (see Andrefsky 1998:Figure 7.13). Although no utilized flakes were found at interior sites, as with coastal sites this tool class may be underrepresented due to identification restraints. However, material from the interior sites contains locally occurring PDL, which is more conducive to use identification than are the metavolcanics, yet no utilized flakes were found. It is also possible that due to the tabular structure of PDL, the material was typically selected for biface manufacture (Becker 2004). Coastal sites contained extremely low amounts of exotic raw material, but no non-local material was recovered from interior sites, rather locally occurring metavolcanic, PDL, quartz, and quartzite were utilized. Overall, the core to biface ratios for the sites suggest that not only was there a difference in occupation duration between time periods and coastal versus inland sites (as indicated by artifact density and diversity), but also a difference in site functions, not only between coastal and inland sites, but potentially also between coastal sites in the Early-Middle Holocene and coastal sites in the Late Holocene.

CHAPTER SIX

CONCLUSIONS

The results of the lithic analysis from the San Elijo Lagoon and Las Pulgas Corridor sites gives some support the Coastal Decline Model. If the use of coastal sites did in fact decline over time, it would be expected that the lithic artifacts should indicate lower occupation duration at coastal sites during the Late Holocene, which is the case based on artifact densities and artifact diversities observed at the sites. Late Holocene interior sites contain greater densities of artifacts than coastal sites from either time period, and higher artifact diversities than Early/Middle Holocene sites, indicating longer term or more intensive interior occupations during later periods. However, the greater artifact diversities seen for later period coastal sites indicate a continued use of the coast throughout the Holocene. Finally, the difference in core versus bifacial technology indicates longer duration occupation at Early/Middle Holocene coastal sites, and that all three suites of sites were probably exploited differently.

Additional lines of evidence also indicate a decline in the utilization of coastal resources through time, as well as differences in the ways these sites were utilized. This is observed when all artifact types are examined (Figure 6.1). Ceramics occur considerably more at Late Prehistoric assemblages, although this is not surprising considering the assumed late introduction of pottery into the region. However, interior sites in the Late Holocene also contain greater amounts of ceramic artifacts than contemporary sites on

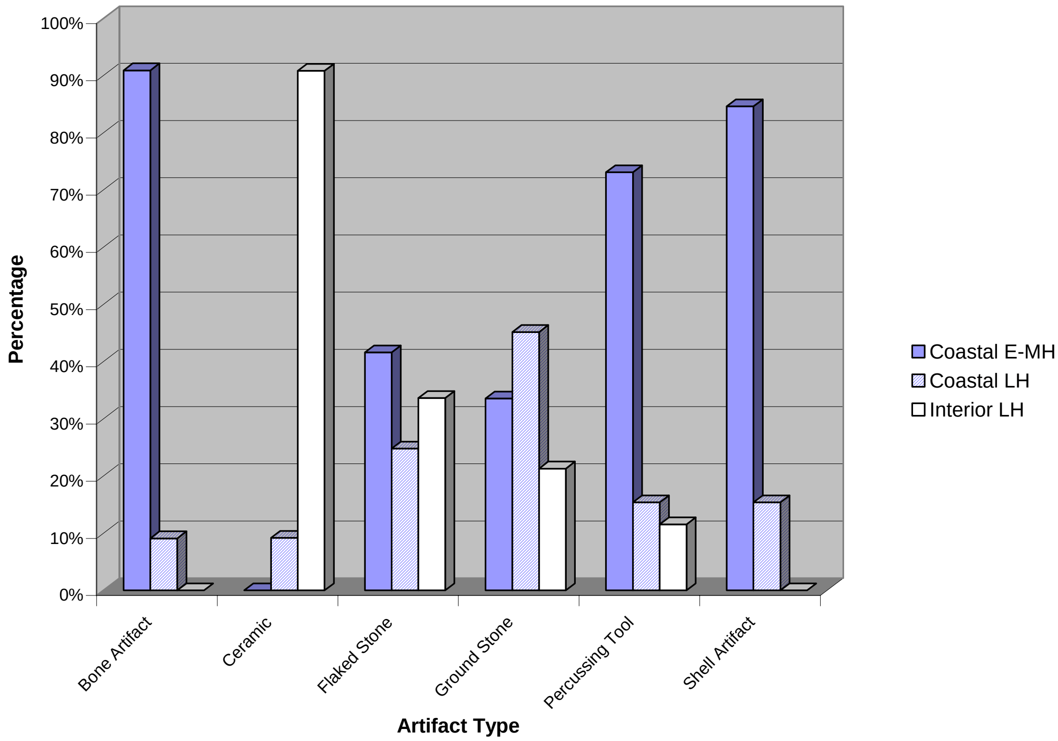

Figure 6.1: Artifact density for coastal and interior sites

percentages of most other artifact classes than all Late Prehistoric sites. Ground stone provides one exception to this, in that Late Prehistoric coastal assemblage contains higher frequencies of ground stone implements than either of the other site groups. This may suggest a differential utilization of coastal sites during the Late Prehistoric. The exploitation of floral resources and the ground stone implements used to process them appear to increase in the coastal environments during the Late Holocene. Plant food remains in the form of seeds, including sedges, sage, grasses, berries, and legumes, were recovered from project sites. Reddy (2004:Figure 9-6) indicates a "logistical exploitation" of grass seeds for inland sites, with a more "opportunistic" and "focused" approach to plant utilization along the coast in Southern California during the Late Holocene. Reddy (2004) also notes an apparent increase in the overall use of plant

Table 6.1. Ecofact Densities for San Elijo and Las Pulgas Sites

Site #	Shell wt.(g)/m3	Bone (g)/m3	Total
Late Holocene			
Coastal Sites			
SDI-10723	7157.95	12.47	7170.42
SDI-812/H	364.08	1.96	366.04
Subtotal	**7522.03**	**14.43**	**7536.46**
Interior Sites			
SDI-10714	8.67	13.62	22.29
SDI-12983	0.13		0.13
SDI-14571	0.93	5.28	6.21
SDI-14686	8.29		8.29
Subtotal	**18.02**	**18.90**	**36.92**
Total	**7540.05**	**33.33**	**7573.38**
Early-Mid Holocene			
Coastal Sites			
SDI-10723	1697.77	7.94	1705.71
SEL-1A	2321.56	45.75	2367.31
SEL-1B	1515.06	44.68	1559.74
SEL-1C	729.89	8.36	738.25
SEL-2	969.63	12.16	981.79
SEL-3	14414.66	54.76	14469.42
SEL-6	2211.19	25.97	2237.16
SEL-9	1752.67	17.49	1770.16
Subtotal	**25612.43**	**217.11**	**25829.54**
Total	**33152.48**	**250.44**	**33402.92**

resources along the coast over time. This is also borne out by an increase over time of ground stone implements used to process the plant foods on the coast as well as an increase in the intensity of use of these implements (Hale 2004).

Vertebrate and invertebrate faunal remains from the SEL and Las Pulgas sites also indicate a decline in coastal utilization over time. Excavations at the SEL and Las Pulgas sites produced various vertebrate faunal remains, including rabbit, deer, squirrel, fish, and sea mammal, as well as invertebrate faunal remains. When the weight of shell and bone remains from project sites are standardized, early period sites do have a greater degree of ecofact density, as would be predicted in the Coastal Decline Model (Table 6.1). As would be expected as a simple result of their abundant local availability, coastal sites contain more shell than interior sites, but Early/Middle Holocene coastal sites contain considerably greater amounts of shellfish remains than interior sites from the Late Prehistoric. The earlier period coastal sites also contain a relatively greater amount of vertebrate remains than late period coastal sites, but also more than the Late Holocene interior sites.

While it is apparent that a shift away from coastal exploitation and towards utilization of the inland occurred during the Late Holocene, the evidence also indicates a continued use of the coast in the Las Pulgas Corridor. SDI-10723 LH appears to have been utilized more frequently and intensively than the Early/Middle Holocene site at the same location. Differences in procurement strategies between the two components of the site are observable in the shift to exploitation of rocky shore species of shellfish to sandy species *Donax* shell after the silting of the lagoon environment, but the later site component displays a more diverse lithic artifact assemblage and greater densities of artifacts and faunal remains. If the silting of the lagoons were a primary cause for the coastal decline, it would be expected that the occupation of the Late Prehistoric component of SDI-10723 would be less extensive. A similar pattern of extensive use of the coast during the Late Holocene with less extensive coastal utilization during the Early/Middle Holocene is also recorded for sites on comparable landforms (SDI-10726 and SDI-15254) at the mouth of Las Flores Creek, approximately 0.8 kilometers south of SDI-10723.

Numerous sites are recorded along the San Diego County coast from Camp Pendleton to Mexico, including suites of sites at Agua Hedionda (Gallegos 1991) Batiquitos (Gallegos 1985; Smith and Moriarty III 1985) and San Elijo Lagoons (Byrd et al. 2004; Scientific Resource Surveys, Incorporated), on the San Diego Bay (Gallegos and Kyle 1988), and near the Tijuana Estuary (Becker et al. 2006). All of theses sites contain shell middens with dates spanning the Archaic period. While the structure of these sites is similar to that of the Early Archaic component at SDI-10723, they all have considerably higher density and diversity of artifacts than any of the Camp Pendleton coastal sites, including those dated to the Late Prehistoric period. These Archaic period sites south of Camp Pendleton also tend to have higher core-biface ratios than those recorded on Camp Pendleton from any time period. Conversely, while Late Prehistoric deposits are recorded at some of these sites (including some *Donax* middens), they are all very sparse in nature when compared to the Late Prehistoric occupations at Camp Pendleton. One explanation for this discrepancy is that the coast was exploited differently in northern San Diego County than to the south. Thus the northern area may have been heavily utilized in the Late Prehistoric period as compared to the southern area, while the converse would be true in the earlier periods. This could be due to differential environmental conditions resultant in the siltation of the lagoon habitats at this time, but may also reflect a different cultural adaptation of the ancestors of the two distinct ethnographic populations occupying these areas. It could also be the case that Late Prehistoric deposits in the southern area are virtually obliterated through extensive development spared the northern sites by the creation of Camp Pendleton.

The results of this analysis suggest that a decline in coastal use occurred during the Late Holocene in San Diego County. On the other hand, the San Diego County interior, while it may have been utilized more frequently in the later periods, does not appear to have replaced the coast as the predominant procurement environment, at least in the Las Pulgas Corridor. An alternative explanation may be a shift in settlement patterns during the Late Holocene. A large number of relatively extensive Early-Middle Holocene occupations tended to occur on the coast, with people potentially spending the majority of the year at these coastal sites, exploiting coastal resources. During the Late Holocene an increased exploitation of interior resources may have occurred, with people moving out from a smaller number of coastal sites to numerous interior areas to procure these resources, and then later returning to the coast. Additionally, the silting of the lagoon environments, while undoubtedly playing a role, may not have been directly responsible for this decline. Multiple lines of evidence from overall artifact assemblages, floral and faunal data, and ground stone analysis tend to support the results of the lithic study. These results can be examined in a broader archaeological context. San Diego County can be seen as unique along the Pacific Coast in that the Northwest Coast and Coastal California as far south as the ethnographic Chumash developed complex cultural systems based primarily on the procurement of coastal resources (Ames 1991; Arnold 2001; Cassidy et al. 2004; Erlandson and Moss 1996; Hayden 1990; Jones 1991, 1992; King 1990; Lightfoot 1993; Lyman 1991; Wessen 1990) while no such complex system developed in extreme Southern California. It is possible that additional research into the use of the San Diego County coast may shed light on the changes that occurred in other coastal environments during the Holocene.

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APPENDIX A

DEBITAGE ATTRIBUTES

Three Attribute Analysis of Debitage Characteristics for Late Holocene Sites

Platform Type	Flake Curvature	Flake Thickness	SDI-812/H	SDI-10,723 LH	SDI-10689	SDI-10714	SDI-12983	SDI-14571	SDI-14659	SDI-14686	Total
Cortical	Incomplete	Incomplete	10	74	1	33		7		3	**128**
	Good	Moderate						1			**1**
	Good	Thin				1					**1**
	Moderate	Moderate		2	1	8		2			**13**
	Moderate	Thick		2		2		1			**5**
	Moderate	Thin				1					**1**
	None	Moderate		11	1	5					**17**
	None	Thick	1	5		2		2			**10**
	None	Thin				1					**1**
Crushed	Incomplete	Incomplete	13	9	3	45	6	26	5	5	**112**
	Good	Moderate						1			**1**
	Good	Thick				1					**1**
	Moderate	Moderate			1	4					**5**
	Moderate	Thick		2				1			**3**
	Moderate	Thin		1				1		1	**3**
	None	Moderate				4	1				**5**
	None	Thick						2			**2**
Indeterminate	Incomplete	Incomplete	281	227	53	350	79	273	27	110	**1400**
	Moderate	Moderate	1	1		1		1			**4**
	Moderate	Thick						2			**2**
	Moderate	Thin				1					**1**
	None	Moderate		4		1					**5**
	None	Thick	1	4		1	1	3			**10**
Multiple Faceted	Incomplete	Incomplete	7	6	1	38	4	19	3	9	**87**
	Good	Thin				1					**1**
	Moderate	Moderate		2		4	1				**7**
	Moderate	Thin		1		1	1				**3**
	None	Moderate		3		2			1		**6**
	None	Thick	1								**1**
Single Faceted	Incomplete	Incomplete	33	54	7	103	20	55	3	9	**284**
	Good	Moderate				2					**2**
	Moderate	Moderate	1	4	2	14		4	1	1	**27**
	Moderate	Thick	1	2		5		4			**12**
	Moderate	Thin				1		1			**2**
	None	Moderate		2		11		2			**15**
	None	Thick		2	3	5		3		2	**15**
Total			**350**	**418**	**73**	**648**	**113**	**411**	**40**	**140**	**2193**

Three Attribute Analysis of Debitage Characteristics for Early-Mid Holocene Sites

Platform Type	Flake Curvature	Flake Thickness	SDI-10,723 EH	SEL-1A	SEL-1B	SEL-1C	SEL-2	SEL-3	SEL-6	SEL-9	Total
cortical	Incomplete	Incomplete	10	43	25	4	6	17	1	17	**123**
	Good	Moderate		2	1			2		1	**6**
	Good	Thick			1						**1**
	Moderate	Moderate		2	4	1	2	5	1		**15**
	Moderate	Thick		4	1		3	3		1	**12**
	Moderate	thin			1			2		1	**4**
	None	Moderate		1							**1**
	None	Thick	1	2			1				**4**
crushed	Incomplete	Incomplete	3	33	17			4	1	9	**67**
	Good	Thin						1			**1**
	Moderate	Moderate		1	2						**3**
	Moderate	Thick						1			**1**
	None	Moderate						1			**1**
	None	Thick		1							**1**
	None	Thin			1						**1**
indeterminate	Incomplete	Incomplete	54	378	125	10	28	80	65	268	**1008**
	Moderate	Thick	1								**1**
	None	Moderate	1								**1**
	None	Thick			1						**1**
multiple faceted	Incomplete	Incomplete	2	5				3		4	**14**
	Good	Thick		1	1						**2**
	Moderate	Moderate			2		1			2	**5**
	Moderate	Thick		1							**1**
	None	Moderate		1	1					1	**3**
single faceted	Incomplete	Incomplete	10	144	41	3	9	38	25	86	**356**
	Good	Moderate		2	1			2	2		**7**
	Good	Thick		2				1		1	**4**
	Good	Thin				1		1			**2**
	Moderate	Moderate		6	3		1	10	3	4	**27**
	Moderate	Thick		8	2	2		4	2	4	**22**
	Moderate	Thin		2	1		1			2	**6**
	None	Moderate		1	1	1		3		3	**9**
	None	Thick		2			1			1	**4**
Total			**82**	**642**	**232**	**22**	**53**	**178**	**100**	**405**	**1714**

Debitage Completeness

Late Holocene Sites

Site	Complete	Debris	Distal Fragment	Proximal	Total
SDI-812/H	18	163	118	51	**350**
SDI-10,723 LH	48	113	120	137	**418**
SDI-10689	11	11	42	9	**73**
SDI-10714	160	119	230	140	**649**
SDI-12983	16	3	77	17	**113**
SDI-14571	66	76	201	69	**412**
SDI-14659	6	5	22	7	**40**
SDI-14686	13	34	76	17	**140**
Total	**338**	**524**	**886**	**447**	**2195**

Early-Mid Holocene Sites

Site	Complete	Debris	Distal Fragment	Proximal	Total
SDI-10,723 EH	7	28	26	21	**82**
SEL-1A	189	76	234	143	**642**
SEL-1B	61	22	98	51	**232**
SEL-1C	11		8	3	**22**
SEL-2	24		13	16	**53**
SEL-3	61	11	68	38	**178**
SEL-6	24	1	63	12	**100**
SEL-9	77	41	224	63	**405**
Total	**454**	**179**	**734**	**347**	**1714**

Flake Type Based Visual Inspection of Multiple Debitage Characteristics

Late Holocene Sites

Flake Type	Site	Granite	Metavolcanic	Piedra del Lumbre	Quartz	Total
Core Reduction	SDI-812/H		3	4		**7**
	SDI-10,723 LH		35		3	**38**
	SDI-10689		4			**4**
	SDI-10714		10			**10**
	SDI-12983				1	**1**
	SDI-14571	1	20	1	2	**24**
	SDI-14686		2			**2**
Subtotal		**1**	**74**	**5**	**6**	**86**
Bifacial Thinning	SDI-14571		1			**1**
	SDI-14659			1		**1**
	SDI-14686		1			**1**
Subtotal			**2**	**1**		**3**
Total		**1**	**76**	**6**	**6**	**89**

Early-Mid Holocene Sites

Flake Type	Site	Metavolcanic	Quartzite	Total
Core Reduction	SDI-10,723 EH	2		**2**
	SEL-1A	36		**36**
	SEL-1B	5		**5**
	SEL-1C	3		**3**
	SEL-2	4		**4**
	SEL-3	4		**4**
	SEL-6	1		**1**
	SEL-9	4	2	**6**
Subtotal		**59**	**2**	**61**
Bifacial Thinning	SEL-1A	2		**2**
Total		**61**	**2**	**63**

Cortical Percentage

Late Holocene Sites

	Primary		Secondary		Interior		Shatter		Total	
Site	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
SDI-812/H		0.00%	1	1.43%	186	11.95%	163	31.11%	**350**	**15.95%**
SDI-10,723 LH	18	40.91%	32	45.71%	255	16.38%	113	21.56%	**418**	**19.04%**
SDI-10689	3	6.82%	2	2.86%	57	3.66%	11	2.10%	**73**	**3.33%**
SDI-10714	17	38.64%	15	21.43%	498	31.98%	119	22.71%	**649**	**29.57%**
SDI-12983		0.00%	2	2.86%	108	6.94%	3	0.57%	**113**	**5.15%**
SDI-14571	3	6.82%	13	18.57%	320	20.55%	76	14.50%	**412**	**18.77%**
SDI-14659		0.00%	2	2.86%	33	2.12%	5	0.95%	**40**	**1.82%**
SDI-14686	3	6.82%	3	4.29%	100	6.42%	34	6.49%	**140**	**6.38%**
Total	**44**	**100.00%**	**70**	**100.00%**	**1557**	**100.00%**	**524**	**100.00%**	**2195**	**100.00%**

Early-Mid Holocene Sites

	Primary		Secondary		Interior		Shatter		Total	
Site	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
SDI-10,723 EH	45	3.64%	3	2.80%	6	3.11%	28	15.64%	82	4.78%
SEL-1A	485	39.27%	36	33.64%	45	23.32%	76	42.46%	642	37.46%
SEL-1B	168	13.60%	12	11.21%	30	15.54%	22	12.29%	232	13.54%
SEL-1C	13	1.05%	1	0.93%	8	4.15%		0.00%	22	1.28%
SEL-2	44	3.56%	3	2.80%	6	3.11%		0.00%	53	3.09%
SEL-3	119	9.64%	19	17.76%	29	15.03%	11	6.15%	178	10.39%
SEL-6	81	6.56%	5	4.67%	13	6.74%	1	0.56%	100	5.83%
SEL-9	280	22.67%	28	26.17%	56	29.02%	41	22.91%	405	23.63%
Total	**1235**	**100.00%**	**107**	**100.00%**	**193**	**100.00%**	**179**	**100.00%**	**1714**	**100.00%**

Flake Size

Late Holocene Sites

Flake Size (mm)	SDI-812/H	SDI-10,723 LH	SDI-10689	SDI-10714	SDI-12983	SDI-14571	SDI-14659	SDI-14686	Total
0-10	171	27	3	87	54	95	7	22	**466**
10-15	96	77	17	125	27	87	7	32	**468**
15-20	31	80	18	116	19	86	8	30	**388**
20-25	14	77	9	97	5	54	9	20	**285**
25-30	18	58	10	70	1	23	4	14	**198**
30-35	10	32	4	55	4	24	3	12	**144**
35-40	3	34	3	42	1	18	2	3	**106**
40-45	4	11	4	28	1	14		4	**66**
45-50	3	4		14		1		1	**23**
50-55		7	1	6	1	5		1	**21**
55-60		5	1	5		2		1	**14**
60-65		3		1					**4**
65-70		1	2			1			**4**
70-75			1	3		1			**5**
75-80		1				1			**2**
80-85		1							**1**
Total	**350**	**418**	**73**	**649**	**113**	**412**	**40**	**140**	**2195**

Early-Mid Holocene Sites

Flake Size (mm)	SDI-10,723 EH	SEL-1A	SEL-1B	SEL-1C	SEL-2	SEL-3	SEL-6	SEL-9	Total
0-10	8	216	30		17	34	22	166	**493**
10-15	20	158	57	5	13	29	30	78	**390**
15-20	13	94	51	5	7	21	16	53	**260**
20-25	14	54	33	1	4	21	12	37	**176**
25-30	13	37	16	2	4	18	7	22	**119**
30-35	7	36	16	3	4	7	3	16	**92**
35-40	1	12	11	1	2	12	3	7	**49**
40-45	1	15	6	2	1	12	2	9	**48**
45-50	3	11	4	1		6	1	6	**32**
50-55	1	1	4			6		4	**16**
55-60		5	3		1	4	3	3	**19**
60-65		3		1		3	1	2	**10**
65-70						2			**2**
70-75	1		1	1		2			**5**
75-80								1	**1**
80-85									**0**
85-90						1			**1**
90-95								1	**1**
Total	**82**	**642**	**232**	**22**	**53**	**178**	**100**	**405**	**1714**