Plant Usage and Prehistoric Diet: Paleoethnobotanical Investigations on Camp Pendleton, Southern California

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Abstract

Recent archaeological investigations on Camp Pendleton at coastal shell midden and inland highland sites ranging in age from the Archaic through the Late Prehistoric and into the Ethnohistoric periods have included rigorous paleoethnobotanical investigations. This paper presents the archaeobotanical database of Camp Pendleton, with discussion of plant resource utilization and diversity in temporal and spatial contexts. A working subsistence-settlement system model is presented which addresses resource exploitation, seasonality, settlement longevity, and inter-relationship of coastal settlements.

Introduction

Subsistence orientation of a population is of critical importance when elucidating prehistoric adaptations and resource emphasis. In particular, the relative importance of plants as compared to other resources and the changing emphasis on specific plants are important factors to consider when addressing diachronic trends in coastal adaptations. Recent archaeological investigations on Camp Pendleton at coastal shell midden and inland highland sites ranging in age from the Archaic through the Late Prehistoric and into the Ethnohistoric periods have included rigorous paleoethnobotanical investigations. The results of these studies now can be integrated with other lines of subsistence evidence from these sites and a much more comprehensive view of prehistoric adaptations can be obtained.

In this paper recent studies of plant resource utilization on Camp Pendleton are summarized (Klug and Popper 1995; Martin and Popper 1998, 1999; Reddy 1996, 1997a, 1997b, 1999a, 1999b, 2000a, 2000b, 2000c). First, the archaeobotanical database is discussed with particular focus on recovery rates and densities of carbonized plant remains from Camp Pendleton. Then, a working model of settlement subsistence system for Camp Pendleton is presented. Finally, patterns of plant utilization are summarized at shell middens on the coast and at inland sites.

The Archeaobotanical Database of Camp Pendleton

Until recently rigorous paleoethnobotanical investigations were typically not an integral aspect of archaeological research in northern San Diego County. Sampling for

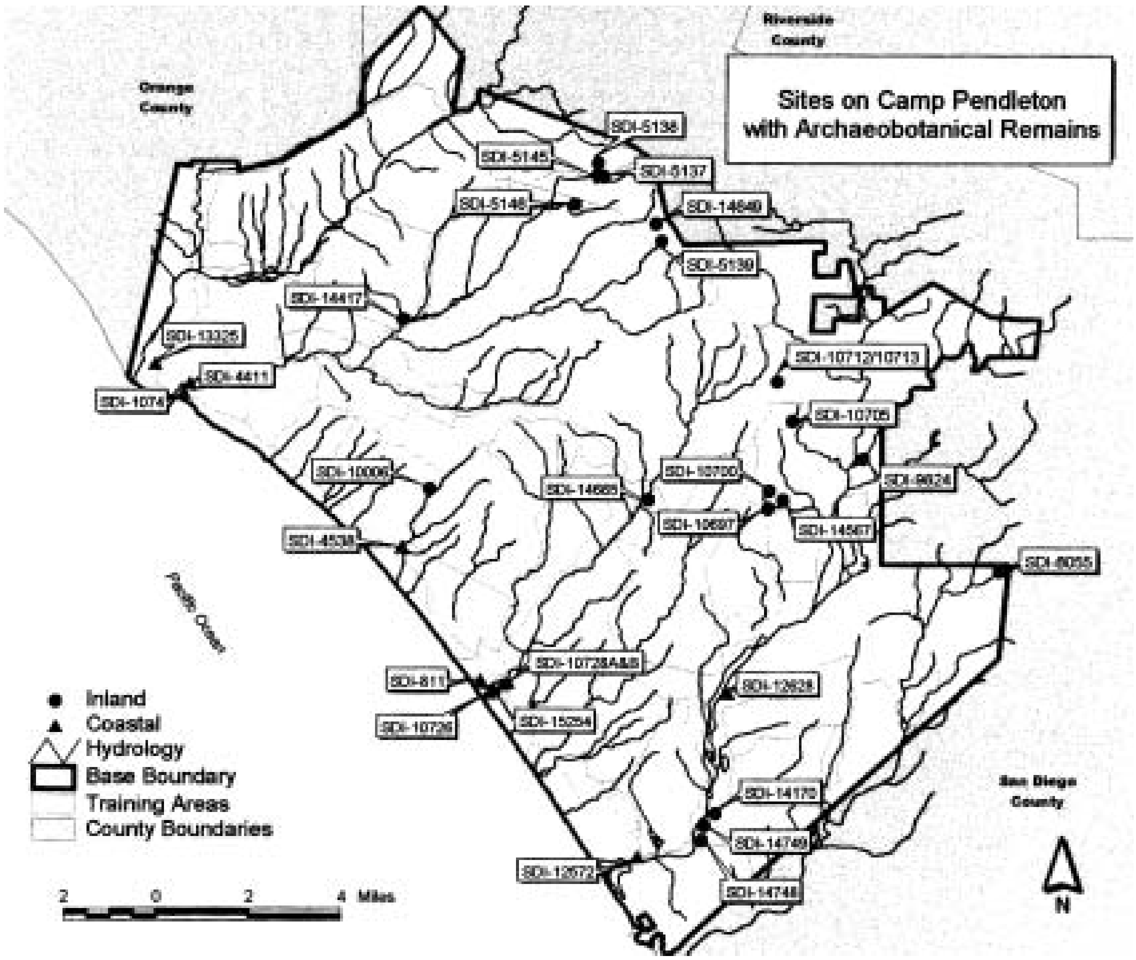

Fig. 1. Camp Pendleton showing sites with Archaeobotanical Remains.

archaeobotanical remains was either not attempted or restricted to very small sample sizes that had little interpretive utility. This is particularly the case for coastal shell middens since these were often considered to be use-specific sites with limited likelihood for plant usage or poor potential for plant preservation. As a result, the region's archaeobotanical database was limited, and it's use in defining the role of plants in human diet, and reconstructing the paleoenvironment is in its infancy. However, the results of the recent investigations on Camp Pendleton presented in this article reveal the tremendous potential such studies have for providing primary data on diachronic trends in prehistoric exploitation of plant resources.

Camp Pendleton, which accounts for almost 5 percent of San Diego County, has a database of archaeobotanical remains from 29 sites (Fig. 1). These 29 sites can be subdivided into those on the coast and those in inland highlands and valleys. The 9 sites on the coast are located on coastal marine terraces and coastal flood plains, while 20 sites are located in the inland highland and valley contexts.

As of June 2000, approximately 3400 liters of sediment have been floated and over 8,400 carbonized seeds recovered from 29 sites on the base (Table 1– all tables are placed at the end of this article). The Camp Pendleton archaeobotanical database is comprised of seeds from over 26 families, and 65 genera including 59 native genera (91 per cent) and 6 (9 per cent) introduced genera (Table 2). Seeds belonging to the grass family dominate the total assemblage, and are represented by 20 genera (31 per cent of all genera) while acorns are rare. The 20 grass genera include only one introduced genus (*Digitaria* sp.). Among grasses, seeds belonging to *Bromus/Stipa* spp. and *Hordeum* sp. occur in the highest frequencies. Among legumes, seeds belonging to *Astralagus* sp., *Lotu*s sp. and *Trifolium* sp. occur in higher frequencies. Other genera represented in the assemblage in dominant frequencies include *Arctostaphylos* sp., *Chenopodium* sp.,*Cyperus* sp., *Euphorbia* sp., *Hemizonia* sp., *Heteromeles* sp., *Marah* sp., *Rhus laurina* and *Sambucus* sp.

The Camp Pendleton database presented here is comprised solely of carbonized seeds. The exclusion of non-carbonized seeds increases the probability that the study assemblage (including grass seeds) recovered from the 29 sites are from prehistoric cultural contexts and were incorporated into the archaeological deposits through use as food, fuel or other related activities. Furthermore, off-site control column samples were taken during several projects (for example Reddy 1997a, 1999a and 2000a), and no carbonized seeds were recovered from these non-cultural deposits. This further strengthens the inference that the carbonized seeds (including grasses) from these archaeological sites are the byproduct of prehistoric plant usage.

The Camp Pendleton macrobotanical database, although limited and based on test excavations, offers some stimulating insights into patterns of prehistoric plant usage. The volume of sediment processed for macro-remains at each site has varied considerably based on project goals, and capabilities. The results reveal intersite and inter-regional patterns in resource utilization. The seed densities vary significantly from site to site within the two areas (coastal versus inland), and also between areas. Notably, seed densities at sites along the coast are significantly lower than from sites in the inland highlands and valleys. The charcoal densities do not reflect this pattern; instead, the inland sites have the lowest densities.

Seed and charcoal densities are indicative of the intensity of activities involving particular plants and fire, and thus are useful in elucidating the intensity of plant use at each site. In other words, the higher the density, the more intense were activities involving particular plant resources. The higher seed densities at highland versus coastal sites may suggest greater plant usage since sample volume is not a significant contributing factor. In addition, variation in charcoal densities, which suggests differential preservation, reveals a higher density for the coastal sites, while the highland sites have a much lower charcoal density. This implies that poor preservation on the coast is not a causal factor in varying seed densities.

A Working Model

A working model for prehistoric subsistence and settlement systems was constructed which addresses seasonality, settlement longevity, and resource exploitation (Reddy 1997c). The reconstruction considers aspects of plant resource diversity in the southern California environment context, and is based on the premise that archaeological discovery is governed by survival and intensity of usage, two highly variable factors. For example, the resources exploited by the Camp Pendleton Late Prehistoric inland inhabitants included a diverse range of plants and animals which were locally available, but also included a few resources that were procured through long distance trade/exploitation. The intensity of resource usage, the diversity of plant usage, and the potential for archaeological survival and discovery is determined by several factors which act as filters. Intensity of usage filtering is temporally varied as macro and micro environmental changes altered the orientation of the system, and also as changes in socio-cultural systems occurred and determined adaptations.

The diagrammatic representation of the model presents the filtering agents and sequence of processes to illustrate the complexity of the ultimate archaeological picture (Fig. 2). An important aspect of the model is that it can be used to predict changes in diet and resource utilization through weighing the different factors according to the data set for a particular group of sites or a single site. Certainly, this is very preliminary in scope and needs further refinement through testing in other areas. Nonetheless, it addresses issues that are currently unexplained in this area, particularly with respect to the intensity of resource exploitation as determined by both human behavioral and environmental factors.

Plant Usage Through Time On The Coast And Inland Highlands

One of the issues to address when offering explanations for the geographic distinction is potential temporal patterning. Are the sites in this sample temporally distinct? If so, the patterning could indicate changing preference and exploitation of plants over time across space. Data from the 29 sites was compiled by time period to aid in refining potential distributions. Table 2 summarizes the carbonized remains recovered from Camp Pendleton by temporal period. The 29 sites include four Archaic settlements, one site with both Archaic and Late Prehistoric occupation, and 24 sites with only Late Prehistoric habitation. Comparing the Archaic and Late Prehistoric samples, seed densities of the latter are over 4 times greater. Although these patterns are significant, it is noted that the sample sizes of the two groups are not analogous, with only five data sets from Archaic sites as compared to 25 Late Prehistoric sites. Within the Late Prehistoric, the coastal sites have a significantly lower seed density than Late Prehistoric sites in the highlands. Unfortunately, database constraints do not allow comparison of coastal and inland Archaic sites.

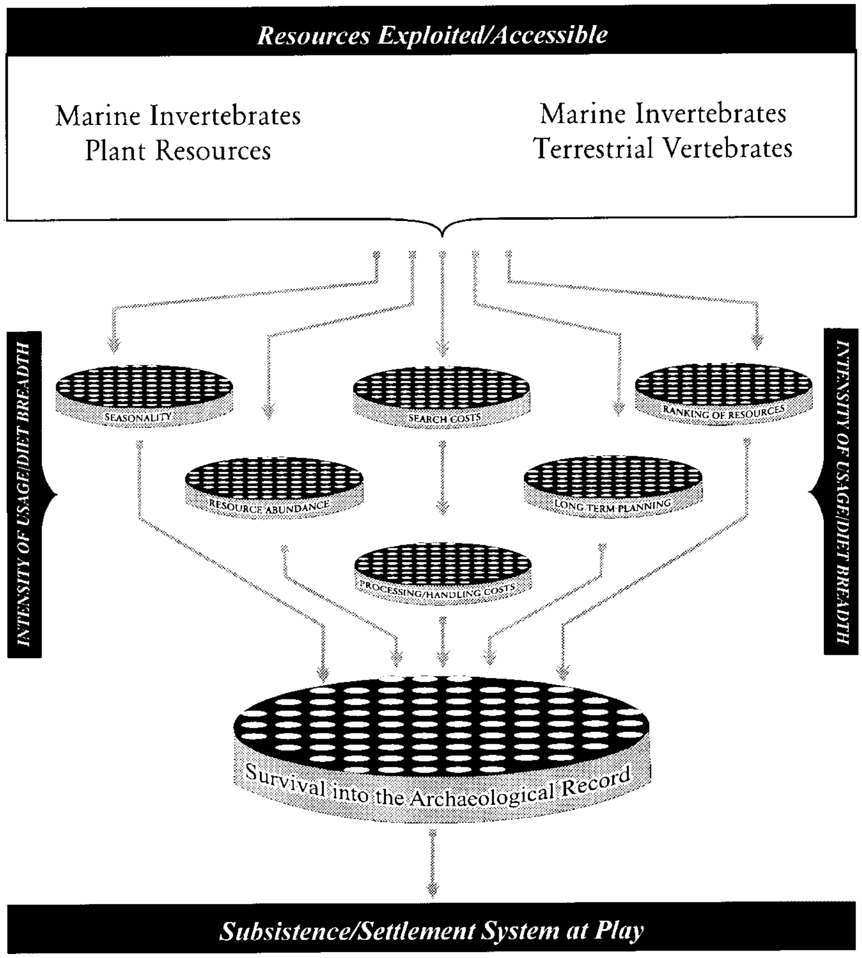

Fig. 2. Model for Settlement and Subsistence Systems on Camp Pendleton.

So, what does all this mean in terms of human behavior, subsistence practices and adaptations? Four main points can be articulated:

1. On Camp Pendleton, there is emerging evidence of broad scale changes in the intensity of plant usage over time.

2. The intensity of plant usage varies significantly between coast and inland sites during the Late Prehistoric period.

3. Due to the lack of paleoethnobotanical data from inland Archaic sites, any potential variation between coastal and inland Archaic plant usage is unknown.

4. Lastly, plant resource emphasis is focused on grass seeds at both Archaic and Late Prehistoric sites while evidence of acorn exploitation remains minimal throughout the sequence. Interestingly acorns appear in higher frequencies only toward the end of the sequence.

In other words, the archaeobotanical data from the 29 sites on Camp Pendleton indicate that prehistoric settlements in the area continued to exploit plants in varying and increasing intensities through time. The Late Prehistoric coastal settlements appeared to have exploited them less intensively as compared to the highland populations, while the Archaic sites, albeit a small sample, indicate a relatively diverse plant resource utilization. In addition, intensive plant usage appears to occur in highly localized catchments within the highlands. Thus, it is possible that with time there was divergence in plant utilization between the coast and the inland areas.

To elucidate potential divergence in plant utilization both over time and between the coast and inland, changes in plant usage over time were examined. Archaic period sites have fewer genera represented than Late Prehistoric period sites. However, it is noted that the inland highland valley Late Prehistoric sites that have the higher number of plant genera. Along the coast, seed densities remain similar from Archaic to Late Prehistoric. There is a decrease in total plant genera (including grass and legume genera), however, grass seed densities remain same. As such it is argued that the intensity of plant usage is similar through time on the coast, but the mode of usage changes from generalized to specialized with the focus of collection on fewer. A closer look at the data reveals that the genera belonging to the grass family increase significantly in the Late Prehistoric, particularly in the inland areas. I suggest that these patterns indicate that plant diversity decreased over time, and populations were focusing on particular plant groups in the Late Prehistoric period, most notably grasses, legumes, *Chenopodium* sp. and manzanita among others, in the inland areas. This trend is particularly clear when the densities of grass seeds are considered. Grass seed density increases significantly from the Archaic to the Late Prehistoric.

These results, although preliminary and limited in scope, need to be incorporated with data on other food resources to construct a comprehensive settlement subsistence model. In addition, more data from additional paleoethnobotanical research is needed to further test these hypotheses. In the following sections, plant utilization along the coast and in the inland areas are examined.

Plant Utilization in Coastal Settlements

Recent paleoethnobotanical investigations for several projects at shell middens on Camp Pendleton have demonstrated that adequate sample sizes and an appropriate sampling strategy will yield significant results (Klug and Popper 1995; Reddy 1996, 1997a, 1997b). The sites were interpreted as more than specialized shell middens where shellfish was the only subsistence resource being exploited and utilized. Instead, a wide range of plant resources, including seasonally distinct plant genera, were exploited on a moderately intense basis.

Preliminary results have revealed the potential for discerning differences in specific plant usage over time and space both within sites and between sites (Table 3). For example, comparison of the results between Archaic coastal settlements reveals considerable similarity in terms of genera diversity and seasonal representation at two sites (SDI-811 and SDI-15,254), significantly lower diversity at the two sites (SDI-12,628 and SDI-13,325) and high diversity at SDI-10,728 (A). It is noted that sample sizes vary and genera diversity could be directly related to small sample sizes, especially at SDI-13,325.

Note that seasonal representation is based on availability and use of the plant resources as summarized by Munz (1974) and Strike (1994). It is emphasized here that seasonality information gleaned from macrobotanical data is not necessarily conclusive and cannot be used in isolation. Even though the presence of certain plant remains could be indicative of certain seasonal occupation, it is important to note that plant remains may have been brought into one site from another site within an annual settlement system. This often creates a certain amount of confusion in resolving the issue of seasonality. In other words, the presence of an acorn nut at a site does not necessarily establish a fall occupation, since it is possible that acorns were harvested the previous year and brought into the site from elsewhere. Thus, any information regarding seasonality of plant remains reflects when the particular plant was available for collection and not necessarily when it was used or consumed by the site occupants, and therefore indirectly when a site was occupied. In the same light it is important to note that ethnohistorically many southern Californian Native Americans typically parched, or dried plant foods and then stored them for future use.

Plant usage at all the 10 shell midden sites in this sample was focused on local eco-zones, predominantly represented by the collection of grasses, and centered around spring and summer resources. A total of 21 families and 40 genera are represented at the sites, with grasses and legumes occurring in highest frequencies. Taxonomic richness and seed density of archaeobotanical assemblages from coastal sites vary considerably from very low to relatively high. SDI-4411, SDI-1074 and SDI-811 have a significantly higher seed density while the other sites have much lower densities (Table 2). This bimodal distribution could be a result of sampling and preservation, or related to diversity in human behavior at the different sites. Aspects of human behavior that could result in this pattern include resource focus, range of activities, and depositional context. It is important to note that SDI-1074, SDI-4411, and SDI-4538 are large Late Prehistoric habitation sites, while the other sites are more focused on shellfish procurement with lesser residential evidence.

Paleoethnobotanical studies at other coastal sites in southern California have indicated that preservation is better in some midden contexts than others (Klug and Popper 1995). Generally, shell middens that are densely packed with shell, artifacts, and ecofacts, and have little sediment, yield higher charcoal densities. Conversely, midden deposits such as those at Camp Pendleton that have more sediment, and undifferentiated midden yield lower charcoal densities. This difference has been attributed to varying preservation (Klug and Popper 1995). Densely packed midden represents refuse intentionally discarded in one location and left undisturbed, resulting in an anaerobic environment that preserves the plant remains well. Further sampling and intensive analysis is needed to elucidate possible distinctions in plant usage intensity among shell midden sites on Camp Pendleton.

The archaeobotanical data from these 10 sites reinforces several points in regards to sampling for archaeobotanical remains from coastal southern California sites, documentation of plant usage at coastal shell middens, and variation in plant usage between shell midden sites within a small region. High volume sampling at these sites has demonstrated the preservation of plant remains–an often ignored data set from coastal shell middens. Seed densities are typically moderate to low at these sites, but plant diversity is relatively high. Plant usage is documented at all of these shell middens, and these sites are not simply limited to shellfish processing but include other resources as well.

Table 4 presents a qualitative summary of food resources exploited at coastal sites, both Archaic and Late Prehistoric coastal sites. A considerable range of diversity in food resource utilization is observed. The coastal Archaic populations were typically utilizing a wide range of resources and not restricting their subsistence base to particular resources, plant or animal. The Late Prehistoric populations, however, typically appear to have been favoring invertebrate fauna, particularly *Donax gouldii*; with plant resource utilization varying from high to low utilization. Thus, archaeobotanical studies from shell middens have broadened our insights into the range of resources exploited, seasonal patterns of use, and aided reconstruction of coastal settlement adaptations. The sites are now interpreted as being more than specialized shell middens where shellfish was the only subsistence resource being exploited and utilized. Instead, a wide range of plant resources, including seasonally distinct genera, were exploited on a moderately intense basis.

Plant Usage In The Inland Highlands And Valleys

Recent paleoethnobotanical investigations at 19 sites in the inland areas of Camp Pendleton have employed paleoethnobotanical studies to elucidate prehistoric plant utilization in highland (SDI-5137, SDI-5138, SDI-5139 SDI-5145, SDI-5146, SDI-6055, SDI-10,697, SDI-10,700, SDI-10,712/713, SDI-10,705, SDI-14,417, SDI-14,649, and SDI-14,665) and river valley settings (SDI-9824, SDI-10,006, SDI-14,170, SDI-14,567, SDI-14,748 and SDI-14,749) (Martin and Popper 1999, Reddy 1997a,1999b, 2000a, 2000b). The sites ranged from bedrock milling stations to artifact scatters with rock art. Geomorphic reconstruction of the landscape has demonstrated an association of particular sites with groundwater seeps and tanks (Reddy 1997c). Chronological evidence (direct and indirect) at the sites revealed Late Prehistoric occupation. The presence of bedrock milling features at several sites reveals that this form of food processing was an important component of settlement systems. In addition to the bedrock milling features, some of the highland sites are characterized by the recovery of a significant number of ground stone which is further indicative of intensive processing of plant and possibly animal resources.

Paleoethnobotanical investigations from these inland sites resulted in the recovery of more than 7,900 carbonized seeds representing 23 different families and 47 genera (see Tables 1 and 5). Grass seeds are most frequent, representing over half the sample. Seasonality information gleaned from archaeobotanical remains suggests strong summer and spring collection, with limited fall collection. However, it is emphasized that this seasonality information suggests site occupation during the represented months, but does not negate occupation during unrepresented seasons.

Seed densities vary significantly between the 19 sites with SDI-5139 having a significantly higher seed density than all the other sites (Table 5). Three other sites have high seed densities including SDI-6055, SDI-9824 and SDI-14,649. Of these four sites, SDI-5139 and SDI-14,649 are located in a similar and unique ecological niche (the Case Spring Highlands in Northeastern Camp Pendleton). At both the sites, the seed densities are high throughout all the levels, thus suggesting that this area was a locale for intensive plant utilization (particularly of grasses), and this included processing, possible consumption and disposal (Reddy 1997a, 2000b). Difference in the intensity of plant usage between the inland sites indicates that subsistence activities varied significantly. While SDI-5139, SDI-6055, SDI-9824 and SDI-14,640 were locales for intensive plant food utilization, other sites were more generalized locales where plant utilization was only one of several important activities related to food procurement. The only underlying similarity in terms of floral abundance and utilization at the inland sites is that grasses dominate most of the assemblages; therefore, it is hypothesized that grasses were the most important plant utilized at most inland sites during the Late Prehistoric Period.

True (1993) in his extensive research in the nearby San Luis Rey drainage argued that the distribution and association of five types of bedrock milling elements indicated differences in settlement-subsistence patterns, differentiation between acorn focused and generalized food processing, and intensification of acorn based subsistence in a very Late Prehistoric to Protohistoric times. Direct evidence, in the form of archaeobotanical remains, were not recovered during True's studies. Six of the Camp Pendleton inland sites in the study (all in the Case Spring area; SDI-5137, SDI-5138, SDI-5139, SDI-5145, SDI-5146, and SDI-14,649) yielded both carbonized plant remains and bedrock milling features (see Table 5). Thus, these sites provided an opportunity to test True's (1993) bedrock milling-based plant subsistence inferences with direct evidence from plant remains (Reddy 1997c, 2000b). Application of True's (1993) bedrock milling element categorization to milling features at these six sites indicated strong differences in subsistence emphasis. Heavy acorn focused processing could be inferred only at one site, while more generalized processing (seeds, fiber, small animals etc.) with acorns being of secondary importance were inferred for four sites. Generalized processing with minimal acorn processing was indicated at two sites.

When archaeobotanical results from these six Case Spring sites with bedrock milling features are integrated with the milling categorical data developed by True (1993), more complex patterns emerge, and a simple correlation between bedrock milling elements and food processing is not strongly supported. For example, one site (SDI-5139) has a high frequency of deep mortars (67 percent of all bedrock features) with few other associated milling features, which based on True's (1993) classification suggests heavy emphasis on acorn processing. In contrast, the archaeobotanical data is characterized by a high carbonized seed density (109 seeds per liter of sediment) in which grasses predominate and acorns are infrequent. Of course, the frequencies of these two plant groups could also be a product of specific processing methods and the likelihood of being carbonized. Nonetheless, these results demonstrate that multiple lines of evidence with emphasis on primary data are needed to better address issues related to subsistence activities. The relationship between bedrock milling, element morphology and grass seed densities is an intriguing research issue that needs further clarification, specially elucidating the correlation between specific grass seed processing methods (such as pounding) and milling elements. Among the six Case Spring sites, it is evident that plant exploitation varies significantly with some sites (SDI-5139 and SDI-14,649) focusing on grasses, while others (SDI-5137, SDI-5138, SDI-5145, and SDI-5146) having more generalized assemblages.

Reconstruction of overall prehistoric subsistence systems at the inland highland and valley sites indicates that vertebrates, including large and small mammals, rodents, birds, and reptiles were exploited to varying degrees by the Late Prehistoric occupants (Table 6). The vertebrate faunal remains indicate that the occupants of these sites focused heavily on local upland terrestrial mammal resources, especially large mammals such as mule deer, while rabbits played a secondary role. Marine vertebrate and invertebrate exploitation occurred in limited quantity at seven sites and in high quantities at one site located in the Santa Margarita River drainage system within close proximity of the associated lagoonal resources. Overall, the inland highland and valley sites on Camp Pendleton are characterized by a resource emphasis on plant processing which included more specialized sites (possibly grasses) and more generalized food processing sites (which included seeds, fibers, and small animals).

Conclusion

In conclusion, paleoethnobotanical investigations on Camp Pendleton are in their infancy and considerably more research needs to be done in order to address some of the more compelling issues related to diachronic trends in coastal adaptations. Five preliminary patterns are discernible from the extant archaeobotanical database. First, there is clear evidence of broad scale changes in the intensity of plant usage over time on Camp Pendleton. Second, the intensity of plant usage varies significantly between coastal and inland sites during the Late

Prehistoric. Third, due to the lack of paleoethnobotanical data from Inland Archaic sites, any potential variation between coastal and inland Archaic plant usage remains unknown. Fourth, plant resource emphasis is focused on grass seeds in both Archaic and Late Prehistoric sites while evidence of acorn exploitation remains minimal throughout the sequence. Lastly, based on the patterns emerging from the paleoethnobotanical data, I suggest that plant diversity decreased over time and populations were focusing on particular plants in the Late Prehistoric period, most notably grasses, legumes, *Chenopodium* sp., and manzanita (among others) in the inland.

Future studies on Camp Pendleton and in neighboring areas need to continue to incorporate rigorous paleoethnobotanical studies into their research designs (Archer and Hastorf 2000). Plant remains from archaeological contexts have a wealth of information that can be used to aid in our understanding of prehistoric adaptations and subsistence systems.

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Table 1. Plant Families and Genera Represented at sites on Camp Pendleton

Plant Family	Genera	Origin *	Sites (SDI-)	N	Reference
Aiozonaceae	Indeterminate	?	9824	13	Reddy 2000a
			10712/713	53	Reddy 2000a
			14,417	12	Reddy 2000a
	Mollugo sp.	I	10,728(A)	9	Reddy 1997b
	Sesuvium sp.	N	10,728(A)	2	Reddy 1997b
Amaranthaceae	*Amaranthus* sp.	N	10,728 (A)	4	Reddy 1997b
			10,728(B)	2	Reddy 1997b
Anacardiaceae	*Rhus laurina*	N	1074	1	Klug & Popper 1995
			4411	1	Klug & Popper 1995
			4538	3	Reddy 1996
			5139	7	Reddy 1997a
			6055	6	Reddy 2000a
			10,700	2	Reddy 1999b
			10712/713	9	Reddy 2000a
			10,705	1	Reddy 1999b
			10,726	6	Reddy 1996 & 1999a
			10,728(A)	5	Reddy 1997b
			12,572	1	Reddy 2000c
			14,665	8	Reddy 2000a
			15,254	4	Reddy 1996 & 1999a
Asteraceae	Indeterminate	?	6055	9	Reddy 2000a
			13,325	1	Klug & Popper 1995
			15,254	1	Reddy 1996 & 1999a
	Aster sp.	N	10,728(B)	1	Reddy 1997b
	Hemizonia sp	N	811	4	Martin and Popper 1998
			1074	5	Klug & Popper 1995
			4411	5	Klug & Popper 1995
			5137	9	Reddy 1997a
			5138	6	Reddy 1997a
			5139	29	Reddy 1997a
			5146	1	Reddy 1997a
			6055	9	Reddy 2000a
			9824	1	Reddy 2000a
			10,006	13	Reddy 2000a
			10,700	2	Reddy 1999b
			10712/713	13	Reddy 2000a
			10,705	2	Reddy 1999b
			10,726	1	Reddy 1996 & 1999a
			12,572	1	Reddy 2000c
			13,325	1	Klug & Popper 1995
			14,417	2	Reddy 2000a
			14,649	22	Reddy 2000b
			14,665	1	Reddy 2000a
			15,254	6	Reddy 1996 & 1999a
	Hemizonia sp cf.	N	811	1	Martin & Popper 1998
	Madia sp.	N	5139	1	Reddy 1997a
			6055	3	Reddy 2000a
			9824	1	Reddy 2000a
			10,728 (A)	1	Reddy 1997b
Brassicaceae	*Brassica* sp.	I	5139	1	Reddy 1997a
	Lepidium sp.	N	1074	1	Klug & Popper 1995
			4411	3	Klug & Popper 1995
			4538	8	Reddy 1996
			5139	3	Reddy 1997a
			6055	8	Reddy 2000a
			10,726	6	Reddy 1996 & 1999a
			10,728 (A)	1	Reddy 1997b
			15,254	1	Reddy 1996 & 1999a
	Lepidium sp. cf	N	1074	1	Klug & Popper 1995
	Sisymbrium sp.	I	5145	4	Reddy 1997a
			5146	2	Reddy 1997a
Caprifoliaceae	*Sambucus* sp.	N	4538	1	Reddy 1996
			5137	4	Reddy 1997a
			5138	6	Reddy 1997a
			5139	7	Reddy 1997a
			5146	1	Reddy 1997a
			9824	4	Reddy 2000a
			10,006	10	Reddy 2000a
			10712/713	6	Reddy 2000a
			10,705	1	Reddy 1999b
			10,726	1	Reddy 1996 & 1999a
			10,728 (A)	4	Reddy 1997b
			10,728(B)	1	Reddy 1997b
			12,572	6	Reddy 2000c
			14,649	2	Reddy 2000b
			14,665	2	Reddy 2000a
			15,254	6	Reddy 1996 & 1999a
Chenopodiaceae	Indeterminate	?	1074	3	Klug & Popper 1995

Table 1. Plant Families and Genera Represented at sites on Camp Pendleton, continued

Plant Family	Genera	Origin *	Sites (SDI-)	N	Reference
			13,325	1	Klug & Popper 1995
	Atriplex sp.	N	811	2	Reddy 1996; Martin & Popper 1998
			1074	1	Klug & Popper 1995
			5139	4	Reddy 1997a
			6055	1	Reddy 2000a
			12,572	17	Reddy 2000c
			14,170	1	Martin & Popper 1999
			14,649	1	Reddy 2000b
			14,749	1	Martin & Popper 1999
			15,254	1	Reddy 1996 & 1999a
	Atriplex sp. cf.	N	811	1	Martin & Popper 1998
	Chenopodium sp.	N	811	8	Reddy 1996; Martin & Popper 1998
			1074	12	Klug & Popper 1995
			4411	9	Klug & Popper 1995
			4538	8	Reddy 1996
			5137	15	Reddy 1997a
			5138	4	Reddy 1997a
			5139	15	Reddy 1997a
			5145	4	Reddy 1997a
			6055	34	Reddy 2000a
			9824	64	Reddy 2000a
			10,006	11	Reddy 2000a
			10,700	2	Reddy 1999b
			10712/713	83	Reddy 2000a
			10,705	4	Reddy 1999b
			10,726	7	Reddy 1996 & 1999a
			10,728 (A)	48	Reddy 1997b
			12,572	13	Reddy 2000c
			14,417	7	Reddy 2000a
			14,567	2	Reddy 1999b
			14,665	22	Reddy 2000a
			15,254	72	Reddy 1996 & 1999a
	Chenopodium sp. cf.	N	1074	3	Klug & Popper 1995
Cucurbitaceae	Indeterminate	?	9824	2	Reddy 2000a
			15,254	1	Reddy 1996 & 1999a
	Marah sp.	N	811	6	Martin & Popper 1998
			1074	5	Klug & Popper 1995
			4411	14 F	Klug & Popper 1995
			4538	2	Reddy 1996
			5138	2	Reddy 1997a
			5146	3	Reddy 1997a
			10,700	3	Reddy 1999b
			10,705	3	Reddy 1999b
			10,726	1	Reddy 1996 & 1999a
			10,728 (A)	8	Reddy 1997b
			12,572	1	Reddy 2000c
			14,567	4	Reddy 1999b
	Marah sp. cf (frags)	N	4411	1	Klug & Popper 1995
Cyperaceae	Indeterminate	?	12,572	6	Reddy 2000c
	Carex sp.	N	5139	1	Reddy 1997a
	Cyperus sp.	N	5139	9	Reddy 1997a
			5146	1	Reddy 1997a
			6055	40	Reddy 2000a
			9824	5	Reddy 2000a
			10,006	2	Reddy 2000a
			10,697	5	Reddy 2000a
			10712/713	22	Reddy 2000a
			10,705	19	Reddy 1999b
			10,728 (A)	12	Reddy 1997b
			14,649	28	Reddy 2000b
			15,254	1	Reddy 1996 & 1999a
	Eleocharis sp.	N	10,728 (A)	3	Reddy 1997b
			15,254	1	Reddy 1996 & 1999a
	Eleocharis macrastachya	N	4538	2	Reddy 1996
	Scirpus sp.	N	1074	1	Klug & Popper 1995
			15,254	2	Reddy 1996 & 1999a
Ericaceae	*Arctostaphylos* sp.	N	5139	53	Reddy 1997a
			5146	7	Reddy 1997a
			14,170	13	York et al 1999
			14,649	2	Reddy 2000b
			14,748	8	Martin & Popper 1999
	Vaccinium sp. cf	N	4411	3	Klug & Popper 1995
			4538	3	Reddy 1996
			5139	2	Reddy 1997a
Euphorbiaceae	*Euphorbia* sp.	N	10,006	38	Reddy 2000a
			10,728 (A)	14	Reddy 1997b

Table 1. Plant Families and Genera Represented at sites on Camp Pendleton, continued

Plant Family	Genera	Origin *	Sites (SDI-)	N	Reference
Fabaceae	Indeterminate	?	811	2	Reddy 1996
			1074	13	Klug & popper 1995
			4411	1	Klug & Popper 1995
			4538	15	Reddy 1996
			6055	386	Reddy 2000a
			9824	55	Reddy 2000a
			10,006	29	Reddy 2000a
			10,697	11	Reddy 2000a
			10,700	23	Reddy 1999b
			10712/713	58	Reddy 2000a
			10,705	12	Reddy 1999b
			10,726	117	Reddy 1996 & 1999a
			12,572	9	Reddy 2000c
			13,325	1	Klug & Popper 1995
			14,417	3	Reddy 2000a
			14,567	3	Reddy 1999b
			14,649	106	Reddy 2000b
			14,665	69	Reddy 2000a
			15,254	22	Reddy 1996 & 1999a
	Astragalus sp.	N	4538	2	Reddy 1996
			5138	4	Reddy 1997a
			5139	7	Reddy 1997a
			10,728 (A)	66	Reddy 1997b
	Lens sp. ?	I	6055	2	Reddy 2000a
			10,006	7	Reddy 2000a
			10,697	6	Reddy 2000a
			10712/713	3	Reddy 2000a
	Lotus sp.	N	5146	12	Reddy 1997a
			10,728 (A)	1	Reddy 1997b
			10,728(B)	7	Reddy 1997b
	Trifolium sp.	N	5137	2	Reddy 1997a
			5138	2	Reddy 1997a
			5139	8	Reddy 1997a
			5145	1	Reddy 1997a
			10,728 (A)	2	Reddy 1997b
			13,325	1	Klug & Popper 1995
	Vicia sp.	N	10,728 (A)	4	Reddy 1997b
Fagaceae	*Quercus* sp.	N	811	6	Reddy 1996; Martin & Popper 1998
			5139	6	Reddy 1997a
			9824	1	Reddy 2000a
			10,700	4	Reddy 1999b
			10,705	2	Reddy 1999b
			10,728 (A)	1	Reddy 1997b
			14,417	2	Reddy 2000a
			14,649	1	Reddy 2000b
			15,254	1	Reddy 1996 & 1999a
	Quercus sp. attachment	N	5137	1	Reddy 1997a
			5138	2	Reddy 1997a
			5139	9	Reddy 1997a
			5145	3	Reddy 1997a
			6055	1	Reddy 2000a
			9824	1	Reddy 2000a
Juglandaceae	*Juglans* sp.	I	14,170	1	York et al 1999
Lamiaceae	*Salvia* sp.	N	6055	32	Reddy 2000a
			9824	10	Reddy 2000a
			10,700	2	Reddy 1999b
			10,705	24	Reddy 1999b
Malvaceae	Indeterminate	?	4411	1	Klug & Popper 1995
			6055	10	Reddy 2000a
			14,567	1	Reddy 1999b
			15,254	1	Reddy 1996 & 1999a
Papaveraceae	*Eschscholtzia* sp.	N	14,567	3	Reddy 1999b
			15,254	1	Reddy 1996 & 1999a
Poaceae	Indeterminate	?	811	6	Reddy 1996; Martin & Popper 1998
			1074	20	Klug & Popper 1995
			4411	6	Klug & Popper 1995
			4538	11	Reddy 1996
			5137	2	Reddy 1997a
			5139	8	Reddy 1997a
			5146	23	Reddy 1997a
			6055	204	Reddy 2000a
			9824	50	Reddy 2000a
			10,006	227	Reddy 2000a
			10,697	48	Reddy 2000a
			10,700	881	Reddy 1999b
			10712/713	360	Reddy 2000a
			10,705	177	Reddy 1999b

Table 1. Plant Families and Genera Represented at sites on Camp Pendleton, continued

Plant Family	Genera	Origin *	Sites (SDI-)	N	Reference
			10,726	34	Reddy 1996 & 1999a
			10,728 (A)	18	Reddy 1997b
			10,728(B)	7	Reddy 1997b
			12,572	7	Reddy 2000c
			14,170	2	Martin & Popper 1999
			14,417	17	Reddy 2000a
			14,567	8	Reddy 1999b
			14,649	675	Reddy 2000b
			14,665	245	Reddy 2000a
			15,254	95	Reddy 1996 & 1999a
	Agrostis sp.	N	5137	5	Reddy 1997a
			5139	3	Reddy 1997a
	Agropyron sp.	N	5146	7	Reddy 1997a
	Aristida sp.	N	5137	2	Reddy 1997a
			5138	2	Reddy 1997a
			5139	19	Reddy 1997a
			5146	10	Reddy 1997a
	Bouteloua sp.	N	5139	6	Reddy 1997a
	Digitaria sp.	I	5137	1	Reddy 1997a
			5139	18	Reddy 1997a
			10,728 (A)	37	Reddy 1997b
	Bromus/Stipa/ Avena/ spp.	N	4538	13	Reddy 1996
			5139	192	Reddy 1997a
			5146	5	Reddy 1997a
			9824	290	Reddy 2000a
			10,006	400	Reddy 2000a
			10712/713	46	Reddy 2000a
			10,728 (A)	10	Reddy 1997b
			14,649	42	Reddy 2000b
	Eragrostis sp.	N	811	25	Reddy 1996
			4538	29	Reddy 1996
			5137	21	Reddy 1997a
			5138	10	Reddy 1997a
			5139	14	Reddy 1997a
			5146	2	Reddy 1997a
			10,728 (A)	2	Reddy 1997b
	Festuca sp.	N	5139	1	Reddy 1997a
			5146	11	Reddy 1997a
	Hordeum sp.	N	1074	1	Klug & Popper
			4411	1	Klug & Popper 1995
			5139	38	Reddy 1997a
			5145	2	Reddy 1997a
			6055	24	Reddy 2000a
			9824	1	Reddy 2000a
			10,006	7	Reddy 2000a
			10,697	3	Reddy 2000a
			10,728 (A)	23	Reddy 1997b
			10,728(B)	4	Reddy 1997b
			14,170	41	York et al 1999
			14,649	8	Reddy 2000b
			14,665	2	Reddy 2000a
	Hordeum sp. cf	N	13,325	1	Klug & Popper 1995
	Leptochloa sp.	N	5139	3	Reddy 1997a
			10,728(A)	1	Reddy 1997b
	Paspalum sp.	N?	811	1	Reddy 1996
			4538	2	Reddy 1996
			10,728(A)	9	Reddy 1997b
	Phalaris sp.	N	811	1	Martin & Popper 1998
			1074	1	Klug & Popper 1995
			10,728(A)	1	Reddy 1997b
			14,649	1	Reddy 2000b
	Phalaris sp. cf	N	1074	1	Klug & Popper 1995
	Panicum sp.	N	5139	3	Reddy 1997a
			5145	1	Reddy 1997a
			5146	2	Reddy 1997a
			10,728(A)	1	Reddy 1997b
	Sporobolus sp	N	811	3	Reddy 1996
			5146	3	Reddy 1997a
			10,728(A)	3	Reddy 1997b
	Type 5	?	1074	1	Klug & Popper 1995
	Grass A	?	5137	3	Reddy 1997a
			5138	2	Reddy 1997a
			5139	16	Reddy 1997a
			5146	5	Reddy 1997a
	Grass B	?	5139	3	Reddy 1997a
	Grass C	?	5139	2	Reddy 1997a
	Grass Rachis	?	5138	2	Reddy 1997a
			5139	7	Reddy 1997a
			5146	1	Reddy 1997a

Table 1. Plant Families and Genera Represented at sites on Camp Pendleton, continued

Plant Family	Genera	Origin *	Sites (SDI-)	N	Reference
	Grass Node	?	5146	2	Reddy 1997a
Polygonaceae	*Polygonum* sp.	N	10,728(A)	2	Reddy 1997b
	Rumex sp.	N	6055	1	Reddy 2000a
			9824	4	Reddy 2000a
			10,728(A)	1	Reddy 1997b
Portulacaceae	*Calandrinia* sp.	N	1074	2	Klug & Popper 1995
	Portulaca sp.	N	5137	1	Reddy 1997a
			5138	8	Reddy 1997a
			5139	1	Reddy 1997a
			5146	1	Reddy 1997a
			10,728(A)	1	Reddy 1997b
Rosaceae	*Heteromeles* sp.	N	811	1	Reddy 1996
			5138	21	Reddy 1997a
			5139	18	Reddy 1997a
			10,705	1	Reddy 1999b
			10,726	3	Reddy 1996 & 1999a
			14,417	1	Reddy 2000a
			14,567	1	Reddy 1999b
			14,665	3	Reddy 2000a
			15,254	3	Reddy 1996 & 1999a
	Heteromeles sp. cf	N	1074	3	Klug & Popper 1995
	Prunus sp.	N	5139	11	Reddy 1997a
			5146	4	Reddy 1997a
			10,728(A)	8	Reddy 1997b
			10,728(B)	1	Reddy 1997b
Rubiaceae	*Galium* sp.	N	5137	1	Reddy 1997a
			5139	7	Reddy 1997a
			9824	18	Reddy 2000a
			10,705	1	Reddy 1999b

Table 1. Plant Families and Genera Represented at sites on Camp Pendleton, continued

Plant Family	Genera	Origin *	Sites (SDI-)	N	Reference
			14,649	11	Reddy 2000b
			15,254	2	Reddy 1996 & 1999a
Solanaceae	Indeterminate	?	1074	1	Klug & Popper 1995
			4538	3	Reddy 1996
			10,726	3	Reddy 1996 & 1999a
			15,254	7	Reddy 1996 & 1999a
	Solanum sp.	N	5137	2	Reddy 1997a
			5139	32	Reddy 1997a
			10,697	1	Reddy 2000a
			10712/713	34	Reddy 2000a
			10,705	17	Reddy 1999b
			14,417	13	Reddy 2000a
			14,665	3	Reddy 2000a
Verbenaceae	*Verbena* sp.	N	5137	1	Reddy 1997a
			5139	31	Reddy 1997a
			10,728(A)	1	Reddy 1997b
			15,254	1	Reddy 1996 & 1999a
Violaceae	*Viola* sp.	N	5137	2	Reddy 1997a
			6055	38	Reddy 2000a
			10,705	77	Reddy 1999b
			10,728(A)	1	Reddy 1997b
Vitaceae	*Vitis* sp.	N	5139	1	Reddy 1997a
	Unident. Nut	?	10,726	3	Reddy 1996 & 1999a
			14,567	1	Reddy 1999b
			14,748	4	Martin & Popper 1999
	Seed A	?	811	58	Martin & Popper 1998
			10,705	14	Reddy 1999b
	Seed B	?	10,700	34	Reddy 1999b
	Type I	?	4411	1	Klug & Popper 1995
	Type II	?	4411	2	Klug & Popper 1995

* N= Native; I- Introduced; F = Fragments

Table 2. Temporal Distribution of Plant remains on Camp Pendleton

Time Period	Site (SDI-)	Reference	Sample Volume (L)	Carbonized Seeds (N)	Seed Density (N/L)	Genera (N)
Coastal Archaic	15,254	Reddy 1996, 1999a	691	293	0.42	14
	10,728(A)	Reddy 1997b	242	379	1.57	33
	13,325	Klug and Popper 1995	24.7	14	0.6	4
	811	Reddy 1996; Martin & Popper 1998	127.5	137	1.35	12
	Total		1085.2	823	0.77	40
Inland Archaic	12,628	Popper & Martin 1999	1.8	8	4.44	0
Total Archaic			1087	831	0.76	
Coastal Late Prehistoric	4538	Reddy 1996	61	95	1.36	13
	10,726	Reddy 1996, 1999a	806.3	224	0.28	10
	1074	Klug and Popper 1995	63.4	136	2.1	13
	4411	Klug and Popper 1995	28	140	5	9
	10,728(B)	Reddy 1997b	71	33	0.46	6
	12,572	Reddy 2000c	190.35	72	0.38	6
	Total		1220.05	700	0.57	
Inland Late Prehistoric	5137	Reddy 1997a	120	74	0.62	16
	5138	Reddy 1997a	84	92	1.1	12
	5139	Reddy 1997a	6	648	108	37
	5145	Reddy 1997a	85.5	14	0.16	4
	5146	Reddy 1997a	67	128	3.56	19
	6055	Reddy 2000a	67.5	1041	15.42	16
	9824	Reddy 2000a	30.5	616	20.4	15
	10,006	Reddy 2000a	76	811	10.67	9
	10,697	Reddy 2000a	21	113	5.38	5
	10,700	Reddy 1999b	94.2	1068	11.34	7
	10,712/713	Reddy 2000a	87	988	11.36	10
	10,705	Reddy 1999b	55.35	413	7.46	13
	14,170	Popper & Martin 1999	3.6	192*	2.22	4
	14,417	Reddy 2000a	117	81	0.69	7
	14,567	Reddy 1999b	83	58	0.71	5
	14,649	Reddy 2000b	30.5	1148	38.2	11
	14,665	Reddy 2000a	130.5	409	3.35	8
	14,748	Popper & Martin 1999	4.5	20	4.44	1
	14,749	Popper & Martin 1999	2.2	12	5.45	1
	Total		1165.35	7734	6.6	
Total Late Prehistoric			2385.4	8434	3.5	

* includes 184 seeds from dry screen and 8 from flotation; seed density is based on flotation only

Table 3. Patterns in Macrobotanical Remains From Shell Middens on Camp Pendleton.

Site	Seed Density (per liter)	Genera	Seasons represented	Time of Occupation
Archaic				
SDI-811	1.35	12	Spring, Summer, Fall	Late Archaic
SDI-10,728 Locus A	1.57	33	Spring, Summer, Fall	Early archaic Occupation
SDI-12,628	4.44	0	?	Early - Late Archaic
SDI-13,325	0.6	4	Spring, Summer	Late Archaic
SDI-15,254	0.42	14	Spring, Summer, Fall	Early Archaic
Late Prehistoric				
SDI-1074	2.1	13	Spring, Summer, Fall	Late Prehistoric
SDI-4411	5	9	Summer, Fall	Late Prehistoric
SDI-4538	1.36	13	Spring, Summer	Late Prehistoric
SDI-10,726	0.28	10	Spring, Summer	Late Prehistoric, Donax dominated
SDI-10,728 Locus B	0.46	6	Spring, Summer, Fall	Late Prehistoric, Donax dominated
SDI-12,572	0.38	6	Spring, Summer	Late Archaic - Late Prehistoric

Table 4. Food Resources Utilized by Archaic and Late Prehistoric Coastal Populations.

Site	Marine Fauna	Vertebrate Terrestrial Fauna	Invertebrate Fauna	Plant Resources
Coastal Archaic				
SDI-811 *	Moderate-High	High	High -predom *Donax*	Moderate
SDI-10,728 Locus A	Moderate-High	High	High - Diverse	High
SDI-12,628	Moderate-High	High	Moderate to High-Diverse	Moderate-Low
SDI-13,325 *	Moderate	High	High - Diverse	Moderate-Low
SDI-15,254	Low	Med-Low	High - Diverse	Moderate
Coastal Late Prehistoric				
SDI-1074 *	High	Low	High - predom *Donax*	High
SDI-4411 *	Low	Low	High - predom *Donax*	High
SDI-4538 *	Low	High	High - predom *Donax*	High
SDI-10,726	Low	Moderate-Low	High - predom *Donax*	Low
SDI-10728 Locus B	Low	Low	High - predom *Donax*	Low
SDI-12,572	Low	Low	Moderate- Diverse	Low

*Coastal Floodplain

Table 5. Macrobotanical Remains Recovered From Inland HIghland and Valley Sites.

Site (SDI-)	Sediment Volume (L)	Carbonized Seeds (N)	Seed Density (Seeds/ L)	Charcoal Density (g/L)	Genera	Seasons Represented
5137 (CS)	120	74	0.6	0.02	16	spring; summer
5138 (CS)	84	92	1	0.04	12	spring; summer; fall
5139 (CS)	113*	648 *	109	4.68	37	spring; summer; fall
5145 (CS)	85.5	14	0.16	0.13	4	spring; summer
5146 (CS)	67	128	1.9	0.2	19	spring; summer; fall
6055	67.5	1041	15.42	0.45	16	spring; summer; fall
9824	30.5	616	20.4	0.26	15	spring; summer; fall
10,006	76	811	10.67	0.21	9	spring; summer; fall
10,697	21	113	5.38	0.19	5	spring; summer; fall
10,700	94.2	1068	11.34	0.19	7	spring; summer
10,712/713	87	988	11.36	0.35	10	spring; summer; fall
10,705	55.35	413	7.46	0.79	13	spring; summer
14,170	3.6	192	2.22	?	4	summer
14,417	117	81	0.69	0.02	7	spring; summer; fall
14,567	83	58	0.71	0.62	5	spring; summer
14,649 (CS)	30.5	1148	38.2	0.08	11	spring; summer; fall
14,665	130.5	409	3.35	0.58	8	spring; summer; fall
14,748	4.5	20	4.44	?	1	-
14,749	2.2	12	5.45	?	1	-

*Only 6 liters was analyzed due to high seed density.

Includes 184 seeds from dry screen and 8 from flotation; seed density is based on flotation only.

(CS)=Case Springs.

Table 6. Food Resources Utilized by Late Prehistoric Inland Highland and Valley Populations.

Site (SDI-)	Vertebrate Marine Fauna	Vertebrate Terrestrial Fauna	Invertebrate Fauna	Plant Resources
5137 (CS)	None	Low	None	Low
5138 (CS)	None	Moderate-High	Low	Moderate-Low
5139 (CS)	Low	High	Low	High
5145 (CS)	None	Low	None	Low
5146 (CS)	None	Low	None	Moderate-Low
6055	Low	High	Low	High
9824	Low	High	Low	High
10,006	Low	Moderate	Low	High
10,697	Low	Low	Low	High
10,700	None	Med	Low	High
10,712/713	None	Low	Low	High
10,705	None	Moderate	Low	High-Moderate
14,170	Low	High	High	Moderate
14,417	None	Low	None	Low
14,567	None	Low	Low	Low
14,649 (CS)	None	Low	None	High
14,665	None	Low	None	Low-Moderate
14,748	High	High	High	Moderate
14,749	Low	High	High	Moderate

*Santa Margarita Lagoonal Setting (CS) Case Spring