STONE TOOL USE AND PREHISTORIC LAND-USE PATTERNS IN THE LOWER SANTA YNEZ RIVER VALLEY, VANDENBERG AIR FORCE BASE, CALIFORNIA

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ABSTRACT

This paper summarizes the results of an analysis of stone tool production and use in a series of sites along the Santa Ynez River in Santa Barbara County. Integrating studies of raw material sources, technology, and tool use, this analysis indicates that essentially the same kinds of tools (bifacial knives and core-struck flakes) were made and that these tools were used for essentially the same set of activities on all of the project sites. The wide range of tasks for which stone tools were used suggests that the project sites were occupied by family groups engaged in general group support activities. Furthermore, raw material sources imply that the sites were occupied during local movements within the Vandenberg area, and not while moving between the coast and distant portions of the interior. Chronological data indicate that this pattern of occupation persisted throughout the Holocene in the project area.

This paper summarizes the major results of the analysis of lithic assemblages from 21 sites in the lower Santa Ynez River Valley, on Vandenberg Air Force Base in Santa Barbara County (Figure 1), which were investigated as part of the archaeological mitigation program for the Union Project. As is the case for many sites in the Vandenberg region, those investigated for the Union project contain relatively sparse amounts of faunal material as well as a fairly limited array of other cultural debris. Flaked stone tools and their production waste therefore comprise the majority of the material which can be used to address the research problems the project hoped to consider.

The Union project was particularly designed to provide data on prehistoric mobility/land-use patterns in the study area. At the most basic level, studies of prehistoric land-use/settlement/mobility patterns rely on attempts to identify the kinds of activities which prehistoric people conducted in different parts of a landscape. The analysis of the lithic material recovered by the Union project follows this emphasis and

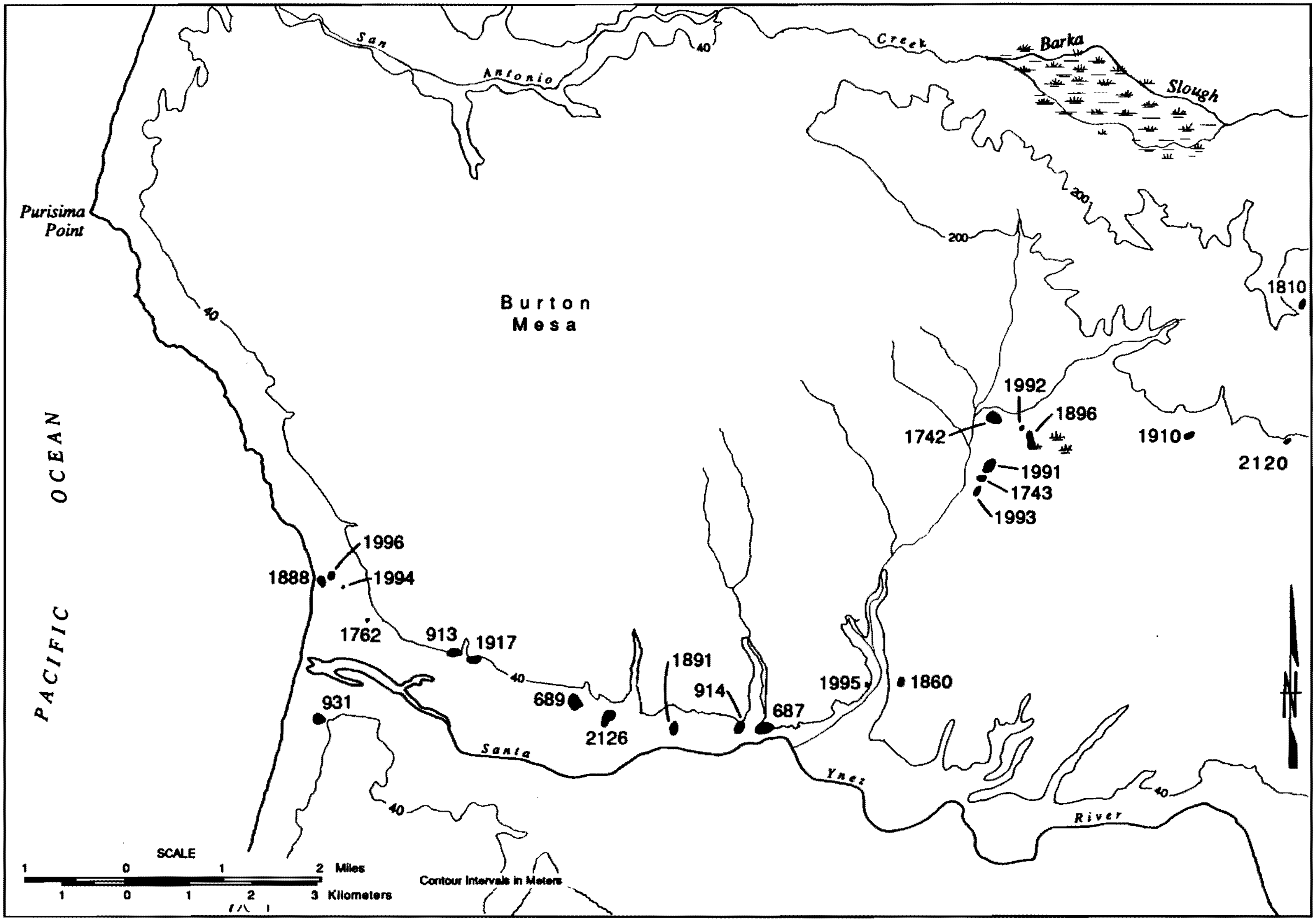


Figure 1. Prehistoric sites investigated during the Union Project.

focused on identifying as precisely as possible the kinds of tasks carried out on the project sites, as a basis for assessing the general place of those sites in the regional settlement pattern. To attain this goal, the analysis incorporated data on three important topics: the kinds of tools produced and stages of those tools' production carried out on the sites, the uses to which the tools recovered from the sites were put, and the kinds of raw material from which stone tools in the project sites were made. The remainder of this paper will briefly summarize the methods used to address these topics, the results of the analysis, and some of the implications of these results.

METHODOLOGY

Analysis of tools production on the project sites involved a 40 percent sample of the debitage from the sites along with all of the worked stone. A series of measurements was taken on a sample of the flakes. Flake measurements taken to examine the kinds of objects being produced include length, width, thickness, dorsal/ventral platform thickness, and exterior platform angle; to infer stages of production, we studied the presence and location of cortex on the dorsal surface, the presence of cortex on the striking platform, and the number of major flake removals on the dorsal surface.

The worked stone was classified into seven simple morphological categories: bifaces, unifaces, projectile points, cores, choppers, flaked hammerstones, and other. For all of these categories, the length, width, and thckness of each artifact was measured and its completeness was assessed. The worked edges of these objects were described using a system derived from Callahan (1979), which coded three variables: whether any flaking which was present was bifacial or unifacial, whether it was irregular, semi-regular, or regular, and whether it was confined to the edge or extended to the midline or beyond. The bifaces recvered from the project sites fall into Callahan's (1979) production Stages 2 and 3 on the basis of these three variables and their width/thickness ratio: Stage 2 bifaces show irregular bifacial flaking which is generally confined to the edge and have width/thickness ratios between 2.0 and 3.0, while Stage 3 bifaces show regular or semi-regular bifacial flaking extending to the midline or beyond and have width/thickness ratios between 3.0 and 4.0.

Finally, the presence or absence of heat alteration was assessed in two ways. For the majority of the collection, whether an artifact was thermally altered was determined by macroscopic comparison with experimentally heated Monterey chert. For that portion of the collection which was examined microscopically, heat alteration was assessed by its effects on the microtopography of the stone.

The second major area of investigation, how flaked stone tools were used on the project sites, was investigated by highmagnification microwear analysis, following Keeley (1980; also see Vaughan 1985). This approach to microwear analysis integrates information on patterns of edge damage, striation, and polish appearance and distribution, in conjunction with experimental controls, to infer how and on what kind of material stone tools were used. Blind tests, including a test conducted specifically for the Union project, indicate that, when this approach is applied cautiously, it allows the analyst to recognize confidently tools used on wood, bone/antler, shell, dry hide, fresh hide, meat, and plants (cf. Bamforth 1988; Bamforth et al. 1990). The material examined included a sample of both the worked stone and the unworked flakes larger than 1/2 inch, for a total of 172 items (44 bifaces, 66 other worked stone, and 62 unmodified flakes).

Finally, the kinds of stone from which the project tools were made was assessed by reference to comparative specimens. For this project, we distinguished between tools made from the five varieties of Monterey chert which Grivetti (1984) showed to have distinctive distributions around the San Antonio Terrace to the north of the project area, as well as a tan variety which is found in the mountains south of the Santa Ynez River, outside of Grivetti's study area. In addition, we recognized small amounts of Franciscan chert, obsidian, fused shale, and a variety of cryptocrystalline silicates whose sources are unknown.

In addition to collecting these classes of data, the project carried out two tests of the accuracy of the collection techniques. The first of these, a blind test of the microwear analyst, was noted above; reporting its results fully is beyond the scope of this paper, beyond noting that it was quite successful. In addition, we tested the technological and raw material analyses by measuring samples of artifacts from a number of sites at the beginning of the study and again at the the end. These tests indicated that the identifications made by at least one of the laboratory analysts altered over the course of the project, a pattern which had important implications for interpretations of the data from some of the sites.

RESULTS

Analysis of the technological data was structured to take account of the great differences in the size of the samples of material available from the 22 sites included in the study. Four of these sites (SBa-698, SBa-913, SBa-1742, and SBa-1917) produced very large samples of both worked stone and unmodified flakes; the other 18 produced much smaller samples. The four large collections were therefore analyzed first, to provide a baseline against which the smaller collections could be compared.

Examination of the worked stone indicates unambiguously that there were two basic classes of tools manufactured on the project sites: bifacial knives, represented by discarded bifacial preforms and fragments of finished pieces, and flake tools, represented by the few cores recovered. These two classes of artifact can be distinguished not only on the basis of reduction strategy, but also on the basis of heat alteration: 85 percent (38 of 45) of the bifaces examined show evidence of such alteration, while none of the cores show it.

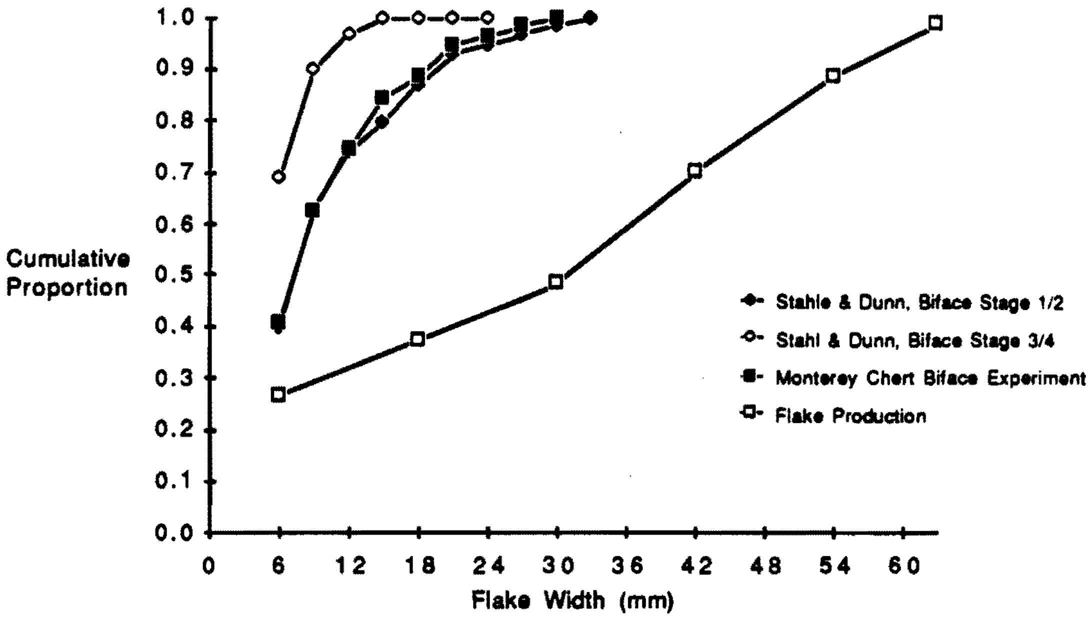
Bifaces are far more numerous in the collection than cores, and their numerical dominance is also reflected in the debitage, which overwhelmingly conforms to the patterns produced by biface manufacture. First, the general kinds of production represented by an assemblage of debitage can be assessed by examining the cumulative size distribution of the flakes in that assemblage (Stahle and Dunn 1982). Figure 2 shows the experimentally derived pattern produced by biface manufacture and core/flake reduction, and also shows that different stage in biface manufacture can be distinguished from one another by such distributions.

Figures 3 and 4 are obviously virtually identical with the experimental biface pattern. Furthermore, these patterns do not change when the assemblages from these sites are broken down by raw material type or when the assemblages from SBa-689 and SBa-1917 are divided horizontally or vertically. The shape of these curves is clearly characteristic of biface rather than core/flake production, indicating that bifaces were the most common class of material produced on the four baseline sites. This is also indicated by the high frequency (85 percent) of heat alteration among the unaltered, unused flakes: as bifaces in the collection are heat-altered and cores are not, heat-altered flakes must have been driven from them.

Although bifaces were often produced on the Union sites, they were not completely produced there. Rather, they appear to have been heat altered and partially worked when they were introduced to the sites. Heat alteration is indicated by the fact that all of the altered flakes show the lustre which is characteristic of heat alteration on both their dorsal and ventral faces. Because this lustre is visible only on surfaces which were flaked <u>after</u> they were heated, the first flakes removed from heated stone should show it only on their ventral faces, and their dorsal faces should be unchanged. The absence in the collection of flakes showing this pattern implies that the bifaces found in the Union sites were heated elsewhere.

Introduction of the bifaces into the project sites in intermediate stages of manufacture is also indicated by virtually all of the variables measured, particularly by very low rates of cortex on both the striking platforms (1.5 to 2.4 percent) and the dorsal faces of the flakes (2.2 to 5.5 percent) at all four baseline sites and by length/width ratios between 2.0 and 4.0 for the discarded and measurable preforms (cf. Callahan 1979).

The pattern of tool production thus appears to have been uniform across all of the project sites, and a similar uniformity can be



Note; Some symbols are obscured by other symbols.

Figure 2. Cumulative flake size distributions for various stages of biface production and for core/flake production.

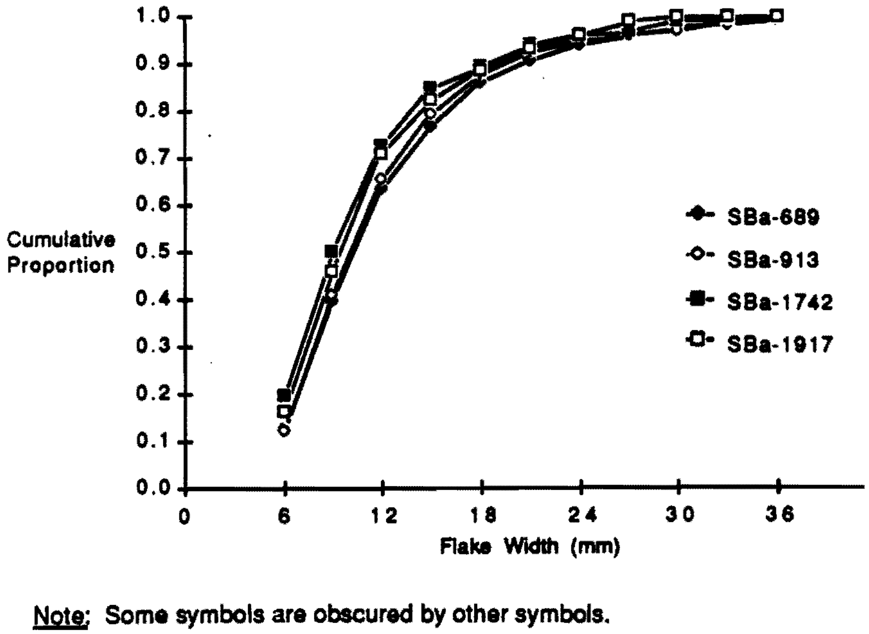
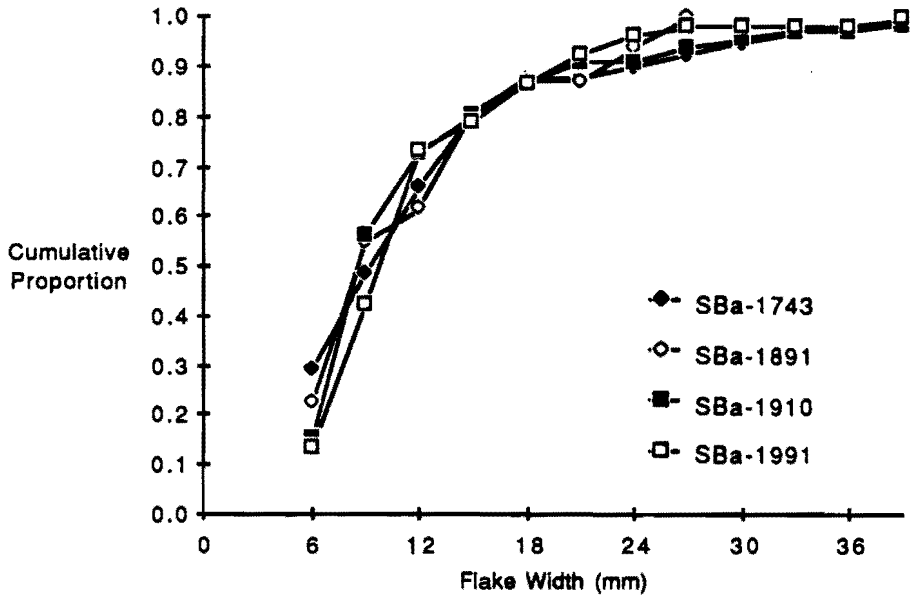


Figure 3. Cumulative flake size distributions of flakes from the baseline sites.



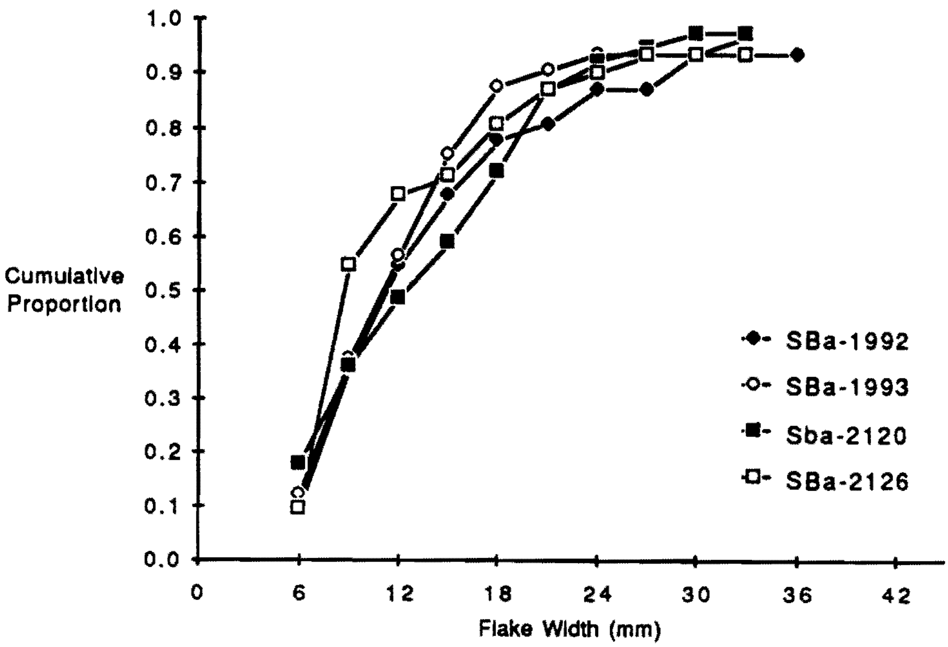


Figure 4. Cumulative width distribuitons of flakes from smaller project sites.

seen in the pattern of tool use. The tools in the collection showed traces of use on a wide range of materials, including both dry and fresh hide, bone and antler, wood, shell, and skinning and butchery (Table 1). Although not all sites in the sample showed this full range of uses, intersite differences in tool uses appear to derive primarily from differences in sample size: the correlation between the number of different tasks represented at each of the sites against the total amount of flaked stone from those sites is 0.96 (Figure 5).

Although it is therefore not possible to distinguish distinct sets of tasks which occurred together at different sites, it is possible to distinguish between tasks which tend to be found at all sites and tasks which tend to be found less ubiquitously. The probability of finding on any single site a tool used on a given worked material can be estimated roughly by the proportion of tools used on that material in the collection as a whole. It is then possible to tabulate the number of sites in which that use is represented and to compute the probability of finding the use in that many sites by the binomial theorem. Table 2 presents the results of such an analysis, including projectile points along with the tools whose use was identified microscopically.

Three groups of tools appear to be visible in this table: 1) projectile points and bone/antler working tools, 2) butchering and skinning tools, and 3) the other categories of tools. The first group is clearly found on more sites than expected and, considering the relatively small sample involved, so is the second, while the third group fits comfortably with random expectation. This suggests that bone or antler working, carcass processing, and hunting (the activity in which we may assume projectile points were used) were performed more regularly than the other tasks represented in the sites, and perhaps that they can be considered, along with biface production, to form a sort of "core" of tasks carried out on all sites along with a more variable set of other tasks.

Finally, the proportions of different raw materials in the sites vary somewhat, although all sites are dominated by the various kinds of Monterey chert (Table 3). The major classes of chert represented are tan Monterey from the mountains south of the study area and black Monterey from the extensive coastal outcrops morth of the study area. Stone which can be considered exotic to the Vandenberg area, particularly Franciscan chert from the interior mountains, is quite rare. The major sources of site-to-site variation in raw material frequencies appear to be minor chronological shifts in the frequencies of raw materials represented (Table 4): black Monterey chert tends to become less frequent while tan Monterey chert tends to become more frequent, and there are minor shifts in the frequencies of red/yellow Monterey chert and "other" materials. However, the clear dominance of local Vandenberg materials in assemblages from all time periods is quite clear.

TABLE 1

FREQUENCIES OF DIFFERENT TOOL USES ON THE PROJECT SITES

Site	Task	Number of Used Edges
SBa-689	cut wood	2
	whittle wood	1
	skinning	1
	cut fresh hide	1
	scrape fresh hide	2
	scrape dry hide	1
	butchering	3
	cut bone/antler	1
	drill shell	1
	drill unknown hard	1
	cut unknown hard	3
	scrape/whittle unknown hard	3
SBa-1917	scrape dry hide	2
	scrape fresh hide	2
	cut dry hide	1
	cut fresh hide	1
	butchering	1
	unknown use on fresh hide	1
	cut unkown medium hard	1
SBa-1742	cut fresh hide	1
	scrape dry hide	3
	butchering	1
	scrape bone/antler	1
SBa-913	butchering	1
	scrape unknown hard	1
SBa-931	rip dry hide	1
	cut bone/antler	1
SBa-1743	scrape fresh hide	1
	skinning	1
	grave/drill unknown medium hard	1
SBa-1992	cut bone/antler	1
SBa-2120	cut bone/antler	1
SBa-687	scrape bone/antler	1
SBa-1995	scrape/whittle woody plant	1
SBa-1910	split plants	1

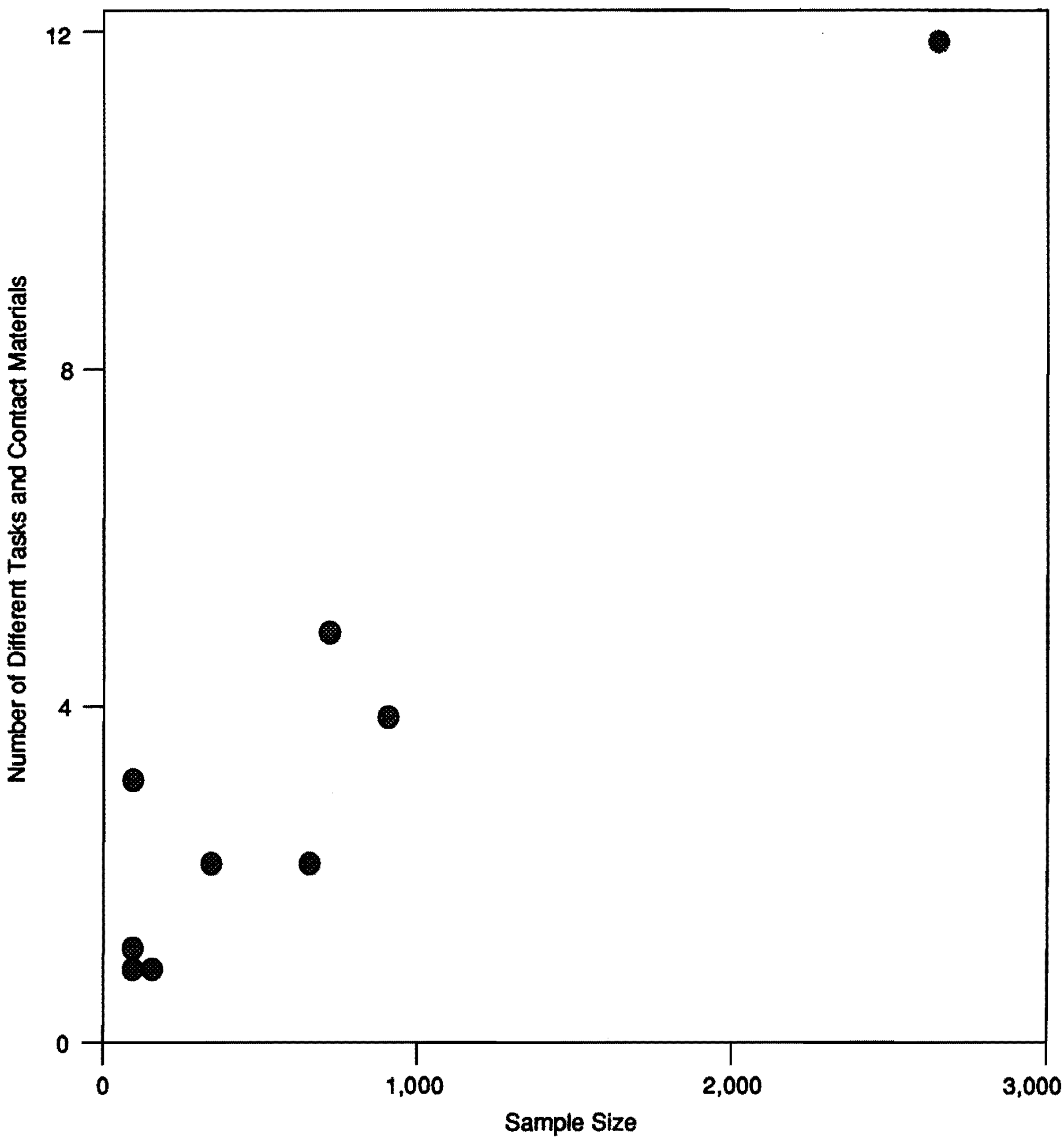


Figure 5. Number of distinct tasks inferred from the microwear analysis plotted against the size of the lithic assemblages from the project sites.

TABLE 2

PROBABILITIES OF FINDING OBSERVED FREQUENCIES OF TOOLS USED ON DIFFERENT CONTACT MATERIALS ACROSS THE PROJECT SITES AT RANDOM

Material	Proportion in Collection	Number of Sites	Binomial Probability
projectile points	0.28	9	0.0003
dry hide	0.19	4	0.10
fresh hide	0.15	4	0.05
bone/antler	0.11	6	0.0005
butchery	0.11	4	0.02
wood	0.09	2	0.19
skinning	0.04	2	0.06
shell	0.02	1	0.18
plants	0.02	1	0.18

TABLE 3

FREQUENCY OF DEBITAGE BY RAW MATERIAL IN THE LOWER SANTA YNEZ VALLEY

Site	Black Monterey n	Black Monterey %	Tan Monterey n	Tan Monterey %	Red/Yellow Monterey n	Red/Yellow Monterey %	Other n	Other %
SBa-689	1653	63.6	873	33.4	60	2.2	25	0.9
SBa-913	333	53.7	187	30.1	73	11.7	27	4.3
SBa-1742	564	67.6	190	22.7	69	8.2	11	1.3
SBa-1917	270	40.4	289	43.2	54	8.0	55	8.2
SBa-687	168	75.3	36	16.1	19	8.5	0	0.0
SBa-914	7	38.9	3	16.7	6	33.3	2	11.1
SBa-931	141	80.6	21	12.0	10	5.7	3	1.7
SBa-1743	40	41.2	26	26.8	28	28.9	3	3.1
SBa-1860	76	61.3	31	25.0	15	12.1	2	1.6
SBa-1891	70	72.9	22	22.9	2	2.1	2	2.1
SBa-1896	58	73.4	13	16.5	8	10.1	0	0.0
SBa-1910	36	29.3	64	52.0	15	12.2	8	6.5
SBa-1991	63	62.4	26	25.6	11	10.9	1	1.0
SBa-1992	32	41.0	33	42.3	9	11.5	4	5.1
SBa-1993	23	47.9	11	22.9	12	25.0	12	25.0
SBa-2120	37	64.9	13	22.8	7	12.3	0	0.0
SBa-2126	50	49.5	42	41.6	6	5.9	3	3.0

TABLE 4

FREQUENCY OF DEBITAGE BY RAW MATERIAL AND CHRONOLOGICAL PERIOD IN THE LOWER SANTA YNEZ VALLEY

	Period					
	Early		Middle		Late	
Material	n	%	n	%	n	%
Black Monterey	705	69.9	1928	64.7	479	53.5
Tan Monterey	211	20.9	951	31.9	299	33.4
Red/Yellow Monterey	79	7.8	103	3.4	118	13.2
Other	14	1.4	28	0.9	40	4.5

DISCUSSION/COMPARISONS

The technological and use data thus show no meaningful differences among the project sites, implying that similar activities were carried out in and around all of them. These activities seem most frequently to have included production of bifacial knives, hunting, processing of animal carcasses, and working bone or antler. Insofar as the sources of stone found in a site indicate the areas from which that site's occupants came, the data on raw material frequencies further suggest that the groups occupying the project sites may have travelled to the study area from both the north and the south, but offer no evidence that they came from very far away: stone from outside of the Vandenberg region is extremely rare, and even stone from more distant portions of the base, such as the Casmalia Hills to the north or the more southern coastal zones, is infrequent in the collections.

Fitting the project sites into the overall regional pattern of settlement, though, is a more complex problem than it appears at first glance. It is particularly useful here to compare the data from the present study with those derived from the MX project on the San Antonio Terrace to the north (Bamforth 1984, 1986). Sites in both of these areas produce a similar range of stone tools to that found in the Union sites, and production waste from both areas appears to represent intermediate to late stages of biface production. However, the Union study collection and the San Antonio Terrace material differ in two important ways.

The first of these is the pattern of raw material frequencies just noted. In contrast to the dominance of two geographically distinct types of Monterey chert on the Union sites, the San

Antonio Terrace sites uniformly show frequencies of black Monterey chert above 90 percent, with no substantial representation of other sources. The San Antonio Terrace therefore appears to have been exploited by people from a smaller area than the Union study region.

A second difference between the sites located in the Santa Ynez River Valley itself and on the San Antonio Terrace some five miles to the north becomes apparent when we examine the kinds of tasks for which the tools recovered from the sites were used (Table 5). In particular, tools used to process animal carcasses are three times as common on the San Antonio Terrace, where they make up 60 percent of the total, than they are to the south. The Santa Ynez River valley assemblages clearly differ substantially from the San Antonio Terrace material in the greater range of tasks represented in them, the more even distribution of tools across these tasks, and the relatively less frequent use of tools in tasks related to hunting, although tools used for such tasks remain a substantial component of the assemblage.

TABLE 5
FREQUENCIES OF TOOLS USED ON DIFFERENT CONTACT MATERIALS FROM THE LOWER SANTA YNEZ RIVER VALLEY AND SAN ANTONIO TERRACE

	Material					
Area	Skin/ Butcher	Fresh Hide	Dry Hide	Bone/ Antler	Wood	Other
Santa Ynez River:						
N	8	8	10	6	5	2
%	20.5	20.5	25.6	15.4	12.8	5.1
San Antonio Terrace:						
N	36	6	2	5	4	5
%	62.1	10.3	3.5	8.6	6.9	8.6

The San Antonio Terrace sites appear to be field camps occupied primarily in order to procure animals, probably deer, for nearby communities. In contrast, Union sites were the scenes of more generalized and, possibly, longer occupations. The kinds of tasks represented appear to be the generalized range of tasks which would be expected in a residential base: for example, the dry hide working tools suggest clothing manufacture and repair, and drilling, cutting, whittling, and scraping wood, shell, and bone or antler were probably part of the production and repair of many tools used for household and off-site activities. However, the project sites clearly produce a narrower range and lower density of material than many other sites in the Vandenberg region: they are not permanent villages, for example, but rather were probably occupied by relatively small groups of people for fairly short periods of time.

There are at least two distinct interpretations of such a pattern of occupation in a regional context. First, it is possible that the project sites represent a seasonal or otherwise periodic dispersion of the populations of nearby villages into small, self-sufficient groups supporting themselves on locally available resources. In Binford's (1980) terms, the project sites may then represent a "foraging" pattern of behavior which occurred seasonally or, possibly, irregularly, in response to unpredictable regional shortages of food.

However, there is another interpretation of the results of this analysis which recognizes the limits on the ability of stone tools to tell us about human behavior. Simply put, stone tools were not involved in everything that prehistoric people did, and they provide a particularly biased view of subsistence activities because they were rarely involved in gathering or processing plant foods. Ethnohistoric data summarized by King (1988) suggest that the Union study area was used in recent times by small groups travelling out of nearby villages seasonally to gather a variety of seeds to be stored in bulk. If this pattern can be extended into prehistory, the kinds of support activities carried out in the project sites could simply represent activities carried out to support families or other small groups in the region to gather seeds.

Given the period of time to which the Union sites date, in fact, it is likely that both of these interpretations may be correct. Early Period adaptations on the Central Coast are generally described as forager-like, with small groups of people moving residences relatively frequently. In contrast, later occupations are generally seen as more sedentary, with resources transported to permanent villages by special task groups (cf. Bamforth 1984; Glassow et al. n.d.; King 1976; Landberg 1965; Spanne 1975). Both of these adpatations would have placed small groups of people in the project area for fairly short periods of time, producing a reltively homogeneous archaeological record despite the importance of the adaptive change which probably occurred in the region around that area.

Data other than those provided by stone tools are needed to choose between these very different interpretations of the place of the project sites in the overall regional pattern of human adaptation. It may be that changes in the integration of the Union study area into the overall adaptation of the prehistoric occupants of the Vandenberg region will be evident only when more data are available on the portions of the regional settlement pattern outside of the area considered here. Whether this is true or not, though, the presently available data allow us to see important aspects of at least part of this regional pattern, and clearly point the way for future research.

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