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Archaeological Investigations at Lake Berryessa, California: Berryessa II

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IN 1976 an archaeological survey of lands slated for development for recreational purposes (Oak Shores) resulted in the discovery of a number of prehistoric artifacts along the shoreline of Lake Berryessa (Fig. 1), which was then receding because of a protracted period of drought. Results of the initial Berryessa survey were published in 1979 (True, Baumhoff, and Hellen 1979). At the time, it was unclear whether the observed artifact distributions were unique to the Oak Shores locale or represented evidence of a more widespread pattern present in other parts of the North Coast Range province. As a first step in the investigation of the latter possibility, two additional lines of inquiry were initiated: (1) a re-examination of several critical areas above the 440-foot contour (overflow elevation of Lake Berryessa) within the Oak Shores project area; and (2) an intensive survey of a second segment (designated the "bridge sector" [Fig. 2]) of the exposed shoreline and reservoir bed.

Results of the re-examination were essentially negative. Even though the drought had reduced normal grass cover, the only archaeological remains found above the 440-foot contour consisted of a small scatter of obsidian flakes at one, quite limited, locus in the Oak Shores area. The bridge-sector survey, in contrast, produced encouraging results with the recording of over 500 isolated artifacts and three clearly identified sites (NAP-432, -433, and -636). Several other artifact concentrations that may eventually deserve formal recognition as sites were also noted.

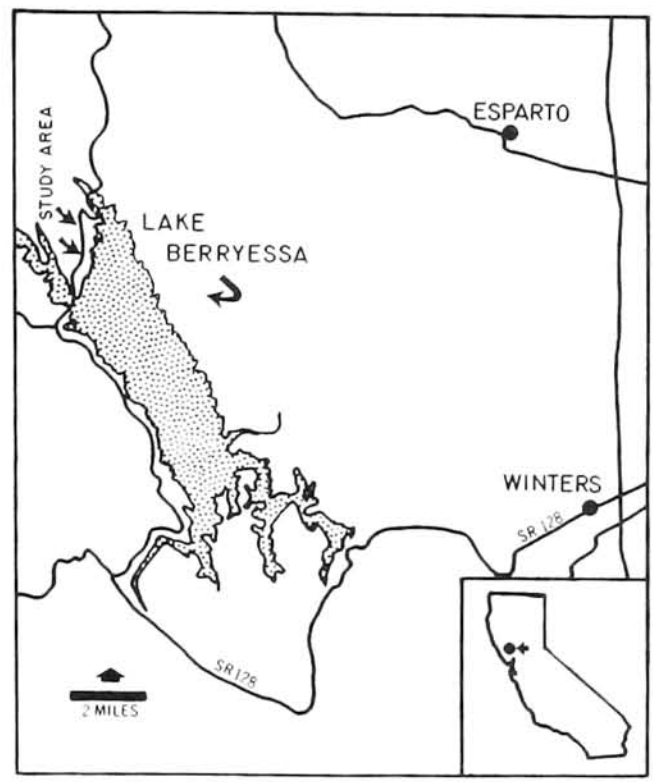

Fig. 1. Location map of the study area in relation to Lake Berryessa.

BERRYESSA II–THE BRIDGE SECTOR

For recording purposes, the bridge sector was subdivided into five survey units (A-E, see Fig. 2). Each unit was examined by walking

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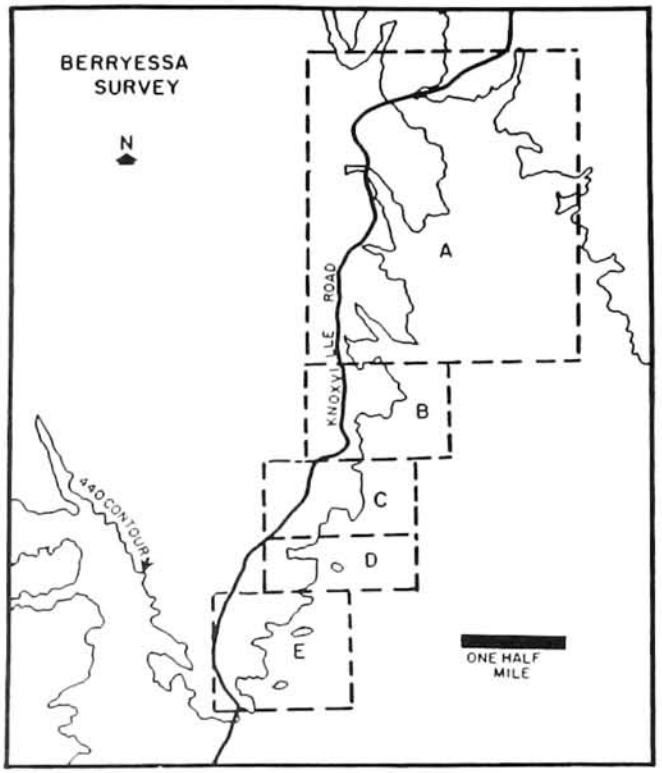

Fig. 2. Bridge-sector survey units A-E.

transects along the exposed reservoir bed parallel to the existing lake edge. Artifacts observed during the survey were flagged and their locations recorded on United States Geological Survey 7.5-minute topographic maps. When concentrations of artifacts were encountered, individual artifact locations were recorded on a larger scale topographic map (400 feet to the inch) or on enlargements made using a pantograph. All artifacts were marked in the field using a locational code and, except for most of the metates, all artifacts were collected and are currently housed at the Department of Anthropology, University of California, Davis, under accession number 223. Metates that were not retrieved were left in their original inverted positions and are presently under water. Distributional maps of the artifacts found in each survey unit are presented in Figures 3-7.

Preliminary results from the ongoing investigations at Lake Berryessa tend to confirm the pattern initially noted during the Oak Shores study, and suggest several potential long-term research directions. Because of this perceived interest, and given the likelihood that analysis and publication of data from the three major newly recorded sites (NAP-432, -433, -636) will not be possible in the near future, the decision was made to expedite data dissemination with a series of short papers each presenting the results of different survey phases.

Individually, the papers examine somewhat different but presumably related aspects of regional artifact distributions. The first paper (True, Baumhoff, and Hellen 1979) described the Oak Shores material, noted the presence of core-cobble tools in what appeared to be a Milling Stone context, and considered distributional patterns among isolated artifacts. Objectives in the second paper (this article) are to describe the morphological and spatial characteristics of artifacts located during the bridge-sector survey, and to propose a tentative hypothesis regarding topographic patterning in the distribution of artifacts. The third paper (in preparation) will present survey data for the remainder of the reservoir shoreline and discuss the types of isolated artifacts from the region as a whole as these relate to the topographic pattern examined here. Comprehensive evaluation of the hypotheses generated in each paper is planned as part of pending monographs on excavations at the three major sites (NAP-432, -433, -636) discovered during the bridge-sector survey.

Artifact Descriptions

A total of 535 artifacts was collected during the survey. These have been sorted into six tentative categories based on general morphology and certain assumed functional attributes: (1) grinding tools (metates, manos, mortars, pestles); (2) pounding tools (hammers); (3) scraping tools (cobble, core, and flake scrapers); (4) cutting tools (convention-

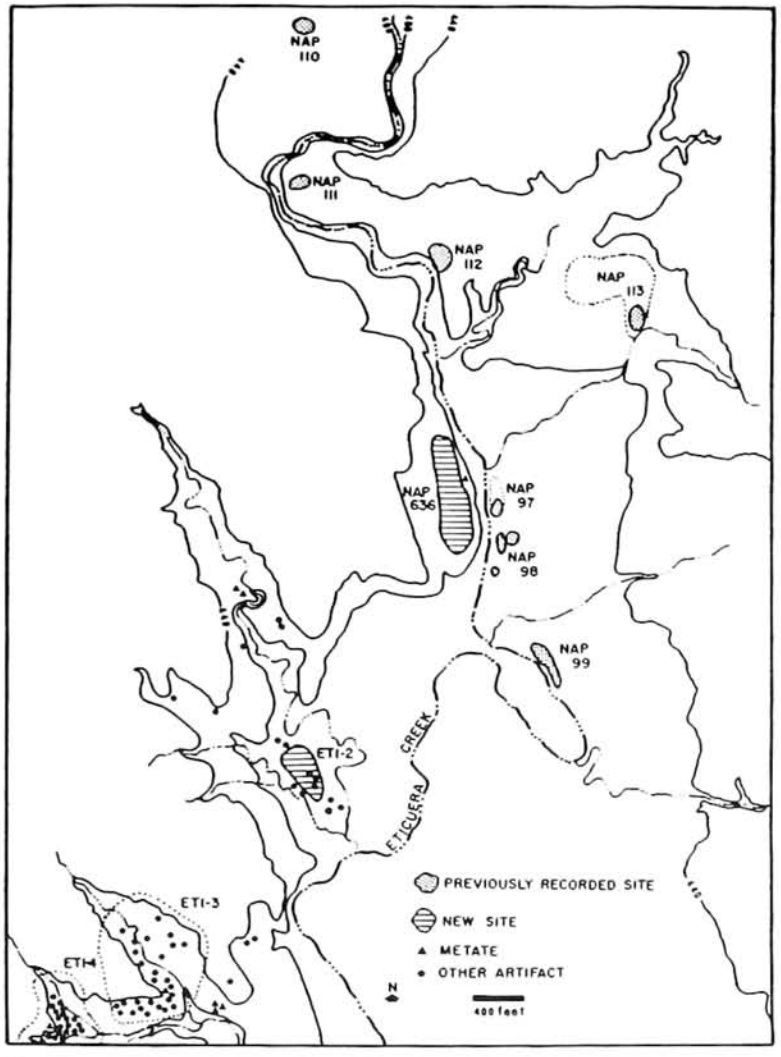

Fig. 3. Artifact and site locations in survey unit A. Dotted lines indicate boundary extensions at previously recorded sites, or artifact clusters at loci currently lacking formal recognition as "sites." The latter given informal, Eticuera Creek designations (ETI). Sites classified as villages include NAP-97, -98, -99, -110, -111, and -112; NAP-636 (ETI-1) is considered a major camp, locus ETI-2 a camp, and loci ETI-3 and -4 scatters (see text for definitions).

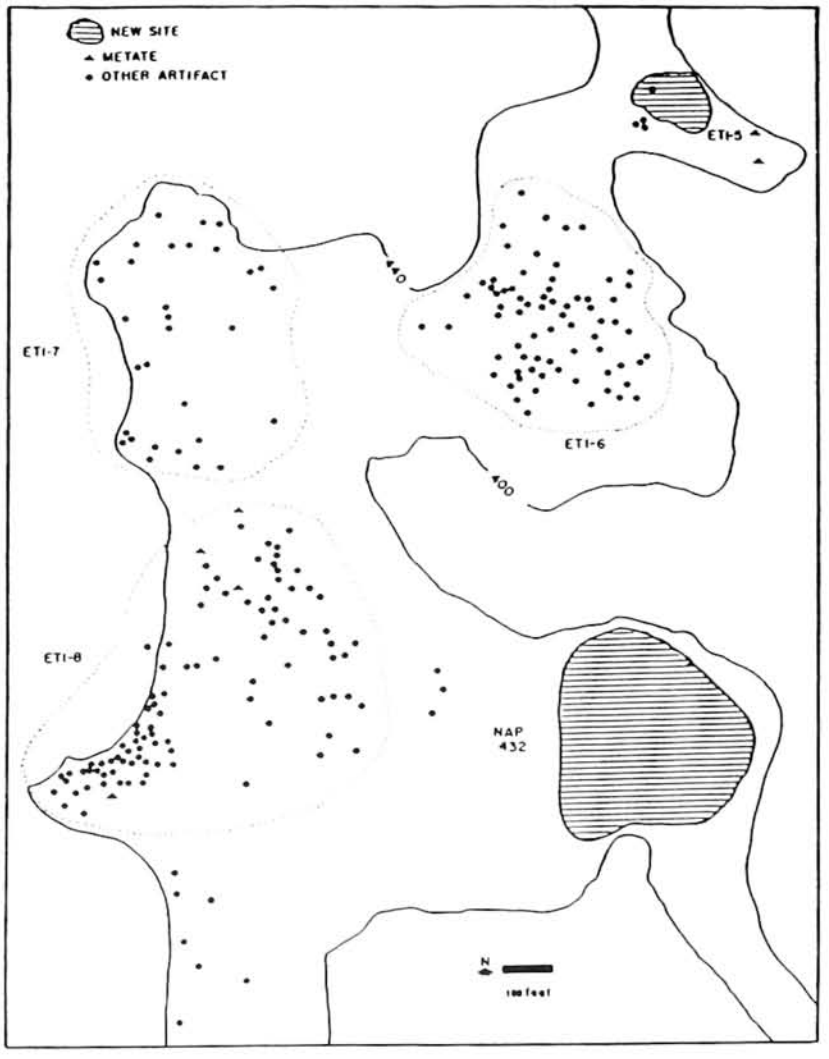

Fig. 4. Artifact and site locations in survey unit B. Dotted lines indicate artifact clusters at loci currently lacking formal recognition as "sites." Site NAP-432 is classified as a major camp, locus ETI-5 as a camp, locus ETI-6 as a concentration (tentative), and loci ETI-7 and -8 as scatters or possible concentrations (see text for definitions).

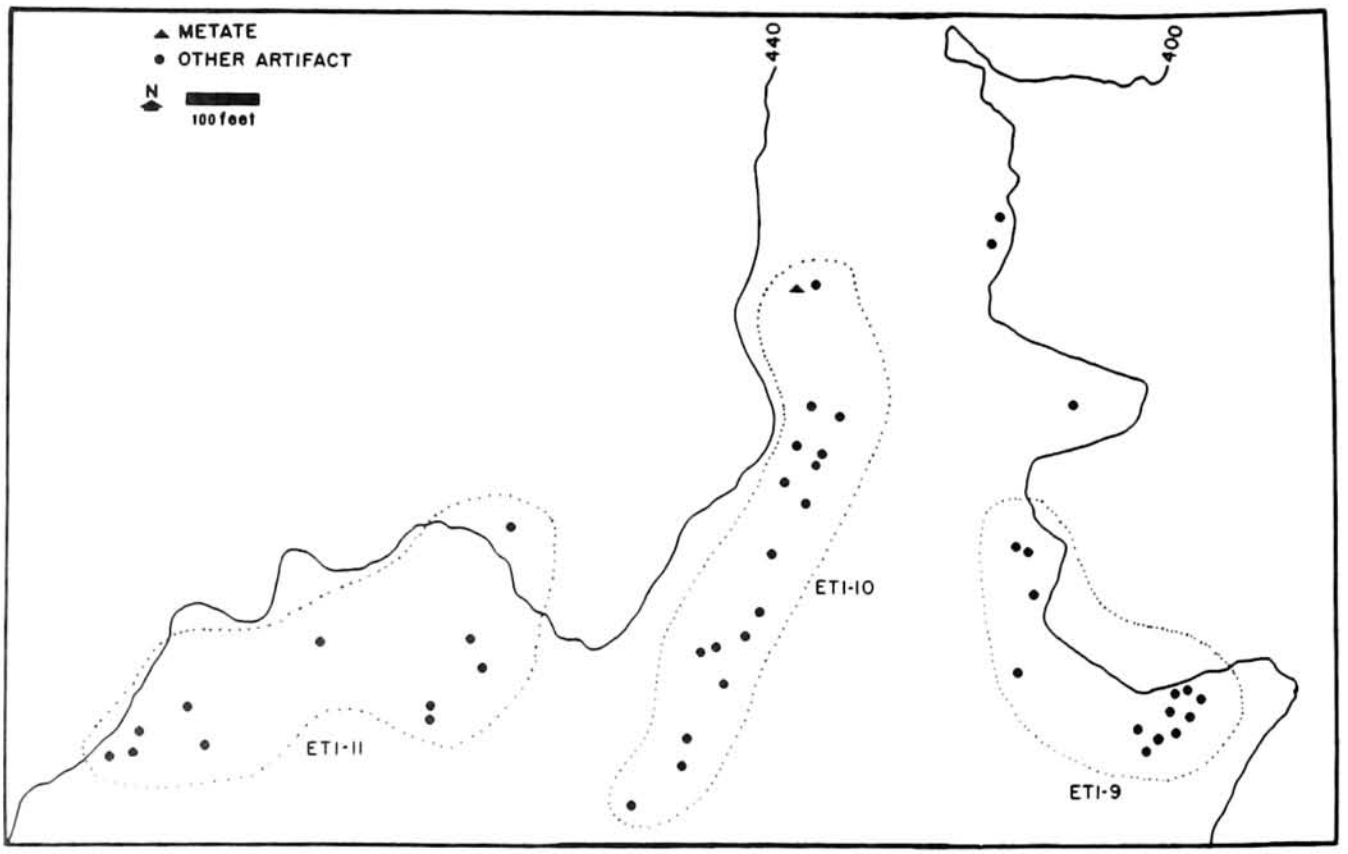

Fig. 5. Artifact locations in survey unit C. Dotted lines indicate artifact clusters at loci currently lacking formal recognition as "sites." Loci ETI-9, -10, and -11 are tentatively classified as scatters, but may consist of unrelated isolates (see text for definitions).

alized and irregular knife-like forms); (5) projectile points; (6) other (includes drills, grooved pebbles, worked flakes, possible chopping tools, pitted cobbles, unmodified flakes, and broken cobbles). These categories should not be viewed as formal artifact types, and the functional designations are probably best considered as an economical way of labeling and analyzing gross classes of artifacts that would otherwise require complicated, confusing descriptions. In short, the data presentation here has been deliberately minimized and, to the degree possible, reduced to tabular form. Representative examples of the artifacts comprising each category are illustrated so that interested readers can compare the items from Lake Berryessa with more formally defined artifact types found elsewhere in the North Coast Ranges.

The functions assigned to artifacts in each category have not been empirically demonstrated. This is especially true for those artifacts categorized as scraping tools. At least some of these artifacts may be cores resulting from the production of flakes for use as casual knives or for tool manufacture. Classification of an object as a scraping tool was based on overall morphology, roughly measured edge angles, evidence of use-wear on a few specimens, and comparisons with similar artifact forms from other California contexts that display clear-cut indications of use, e.g., polished and worn facets on working edges (cf. True 1958, 1980; Basgall and True 1985). A realistic assessment of this loosely defined scraper category suggests that, on the whole, the artifacts represent casual tools with more than one function, and that some specimens

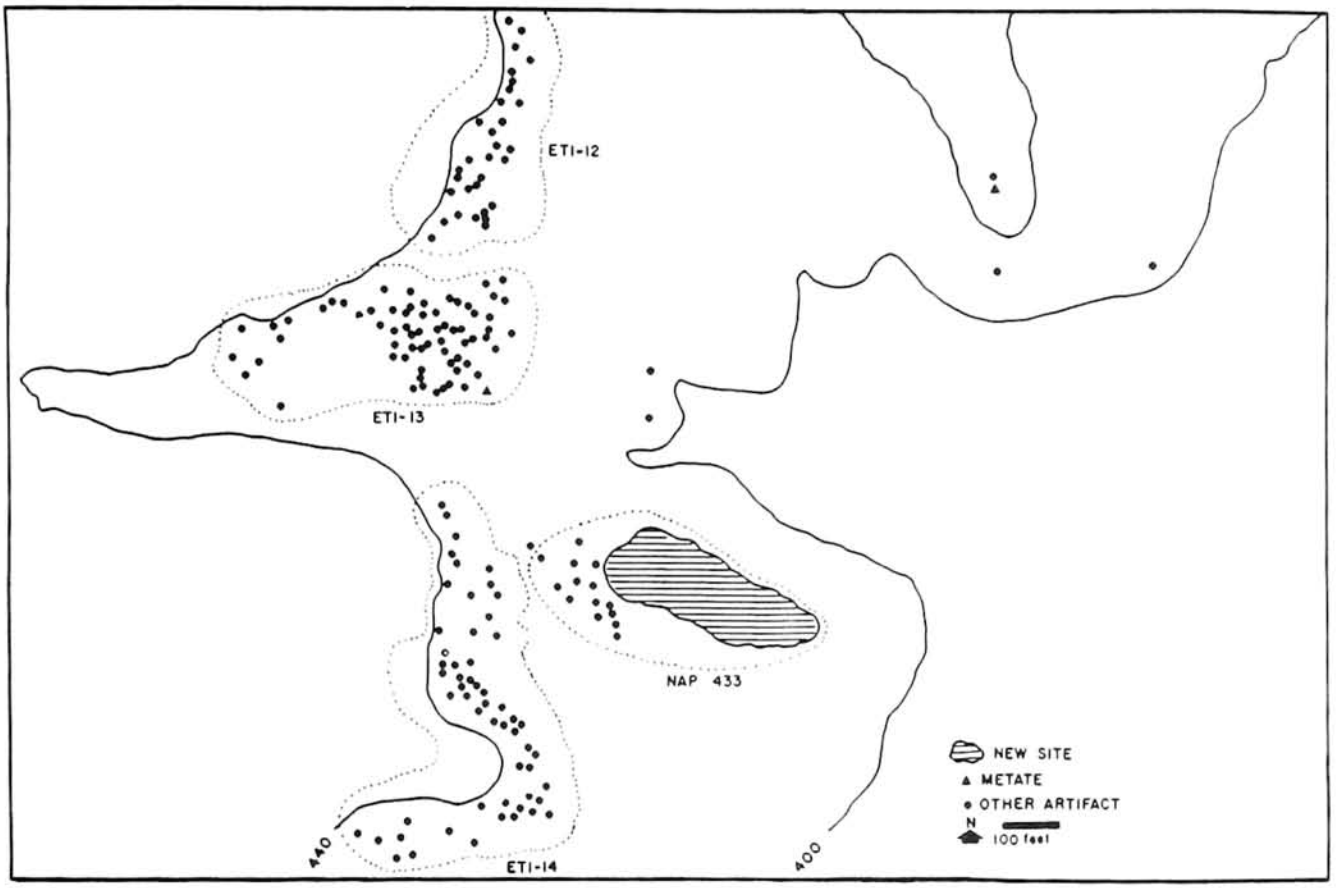

Fig. 6. Artifact and site locations in survey unit D. Dotted lines indicate possible boundary extensions at previously recorded sites, or artifact clusters at loci currently lacking formal recognition as "sites." Site NAP-433 is classified as a major camp, locus ETI-12 as a scatter, locus ETI-13 as a concentration (possibly a camp), and locus ETI-14 as (tentatively) a scatter (see text for definitions).

are quite probably cores. Further, it should be stressed that the generalized (versus specific) treatment of these artifacts is not accidental. Given the relatively limited understanding of core-cobble tools in general, the distinct probability that they represent multi-purpose, casual implements, and the recognition that particular artifact morphologies are likely a consequence of functional considerations (e.g., size, availability of material, preferred edge) rather than of aboriginal mental templates, development of a detailed, formal typology at this time is unwarranted and could be counterproductive.

Grinding Tools (Tables 1-2; Figs. 8-12). Metates and manos are the principal artifacts comprising this category. Mortars and pestles are present in the general Lake Berryessa region, but are rare or absent in the bridge-sector area.

The metates include both slab and basin forms. Most are unshaped and typically were fashioned from sandstone. The manos tend to display varied outlines and, for purposes of analysis, have been sorted into subcategories based on the presence or absence of deliberate shaping and the number of ground surfaces. Several specimens are pitted, and one subcategory is characterized by what appears to be a pestle-like end (Fig. 11).

Pounding Tools (Table 3; Figs. 13, 15h). Relatively few pounding tools were found during the bridge-sector survey. Two different forms are recognized: cobble hammers and

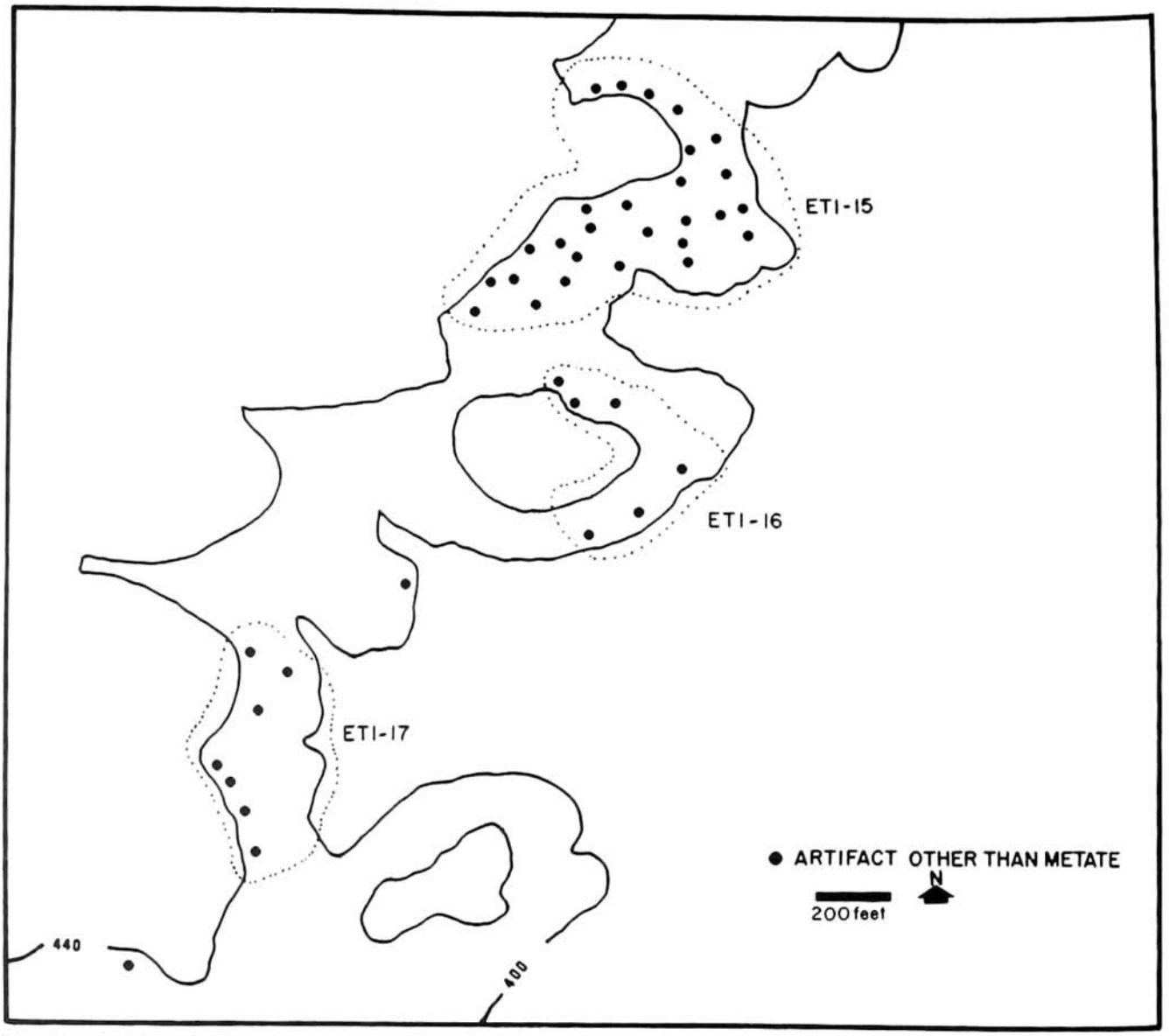

Fig. 7. Artifact locations in survey Unit E. Dotted lines indicate artifact clusters at loci currently lacking formal recognition as "sites." Locus ETI-15 is classified as a scatter, and loci ETI-16 and -17 as possible scatters or as groups of unrelated isolates (see text for definitions).

shaped-core hammers. It can be assumed that many more casual, hammer-like artifacts occur in the region, but were not collected because they lack definitive indications of human use.

Scraping Tools (Tables 4-5; Figs. 14-17). The most common tools in the bridge-sector collection are implements presumably employed in as yet undefined scraping activities. These objects were fashioned from large, heavy flakes, occasionally from cores, and most often from small cobbles or large pebbles. Although the classifications are quite tentative, cobble scrapers have been sorted into 14 provisional subcategories based on overall morphology and flake-removal locations relative to a planar surface (Table 4; Figs. 14-15). These subcategories are recognized, in part, to maintain continuity and comparability with artifacts described in the

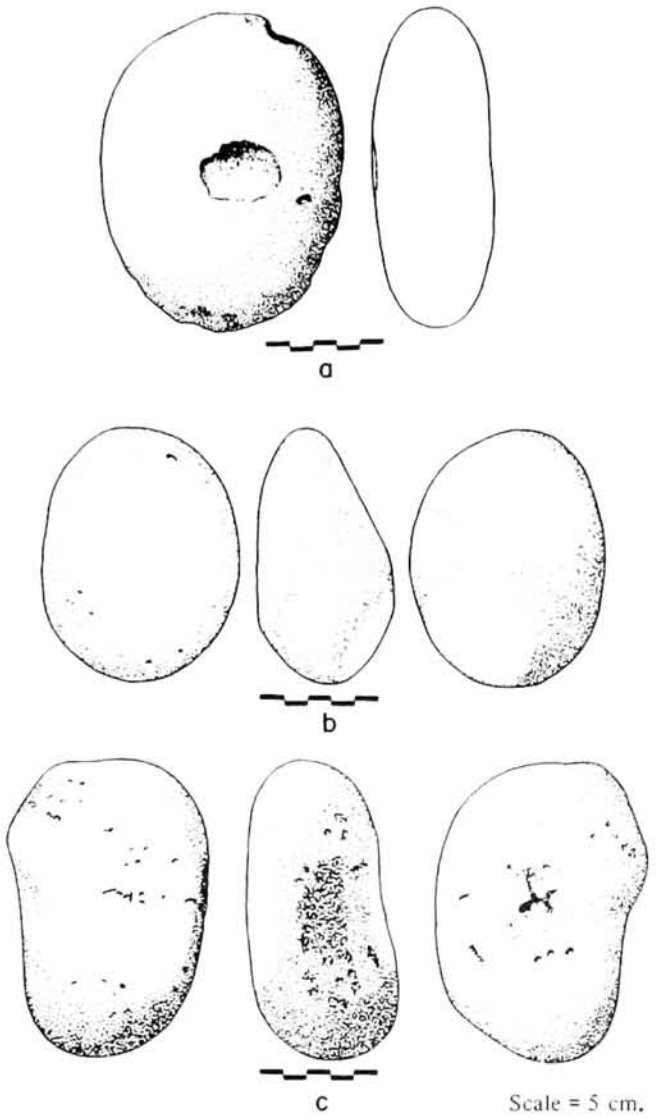

Fig. 8. Unshaped unifacial manos.

initial Berryessa report (True, Baumhoff, and Hellen 1979) and, in part, to isolate potentially meaningful morphological and technological differences that may ultimately be shown to have cultural, temporal, or functional significance. In general, the classificatory system used here follows that developed for the earlier report. However, because of certain questions raised by reviewers about the subcategories proposed in 1979, the present categorizations have been simplified. Readers interested in the cobble scrapers from the Lake Berryessa region should consider those

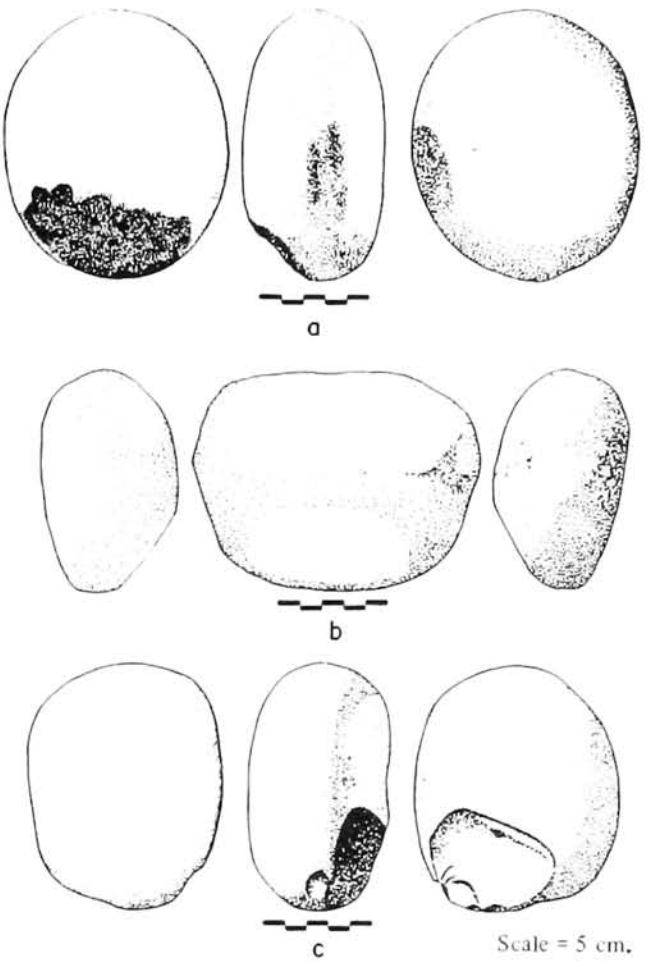

Fig. 9. Unshaped bifacial manos.

Table 1

GRINDING TOOLS

Category	Number	Percentage of Manos	Percentage of Grinding Tools
Metate	16	n/a	14.5
Unshaped unifacial mano	8	9.5	7.3
Shaped unifacial mano	–	–	–
Unshaped bifacial mano	35	41.7	31.8
Shaped bifacial mano	24	28.6	21.8
Mano/pestle	5	6.0	4.5
Nondiagnostic mano fragment	12	14.3	10.9
Pestle	2	n/z	1.8
Smoothing stone	8	n/a	7.3
Total	110	76.4*	99.9

*Percentage of grinding tools consisting of manos.

Table 2

ATTRIBUTE DATA FOR GRINDING TOOLS*

Category	Number		Length	Width	Thickness	Figure
Unshaped unifacial mano	8	average	131.2	103.2	58.3	8 a-c
		s.d.**	16.0	12.3	10.6	
		range	110-148	85-118	37-71	
Unshaped bifacial mano	35	average	127.5	91.7	57.9	9 a-c
		s.d.	21.1	13.3	10.5	
		range	91-172	68-125	42-85	
Shaped bifacial mano	24	average	126.0	91.9	56.4	10 a-c
		s.d.	15.7	10.3	8.6	
		range	97-153	65-114	42-71	
Mano/pestle	5	average	121.2	77.2	62.8	11 a-c
		s.d.	9.5	11.7	8.9	
		range	110-133	61-96	47-75	
Pestle	2***		288	75	73	12 a
Smoothing stone	8	average	88.7	63.6	37.1	12 b-e
		s.d.	5.2	11.6	7.3	
		range	81-94	48-86	29-47	
Nondiagnostic mano fragment	12					not illustrated
Metate	16					not illustrated

*All measurements in mm.
**Standard deviation.
***One specimen fragmentary.

Table 3

ATTRIBUTE DATA FOR POUNDING TOOLS*

Category	Number		Length	Width	Thickness	Figure
Cobble hammer	2	average	102.5	74.5	50.5	13 a-b
		s.d.**	4.5	1.5	2.5	
		range	98-107	73-76	48-53	
Shaped core hammer	2	average	70.5	66.0	28.5	13 c-d, 15 h
		s.d.	20.5	17.0	0.5	
		range	50-91	49.83	28-29	

*All measurements in mm.
**Standard deviation.

found during the bridge-sector survey in conjunction with those described for Oak Shores (True, Baumhoff, and Hellen 1979: 135). Also, though of minimal importance to this paper, approaches to more generalized treatment of large classes of related casual and multi-purpose tools are being further developed, by the senior author and M. E. Basgall (Univ. of California, Davis), as part of a comprehensive re-evaluation of core-cobble tools in southern California Milling Stone complexes.

The possibility that core-cobble scraping tools display potentially meaningful functional and/or temporal differences in the Berryessa region will be a focal issue in ongoing investigations. Hopefully, analysis of the artifacts and other data from NAP-432, -433, and -636, and discovery of well-defined, datable components, will provide the basis for

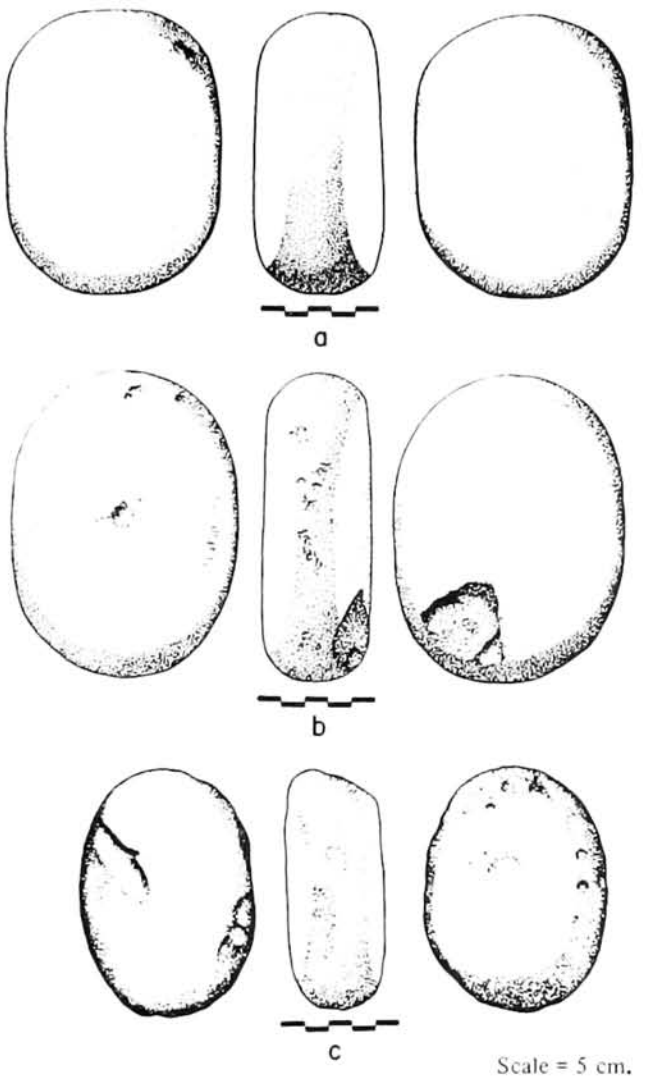

Fig. 10. Shaped bifacial manos.

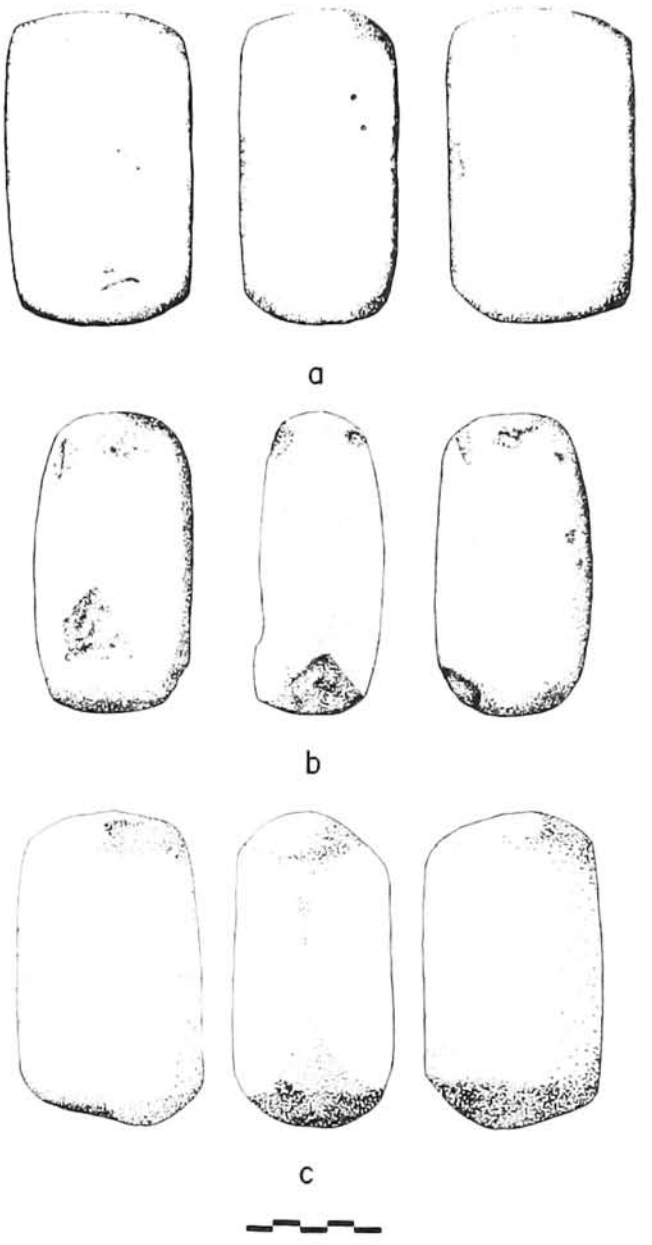

Fig. 11. Mano/pestle grinding tools.

a useful, refined typology of core-cobble tools. On the other hand, regardless of possible temporal differentiation, it should be stressed that there is a strong likelihood that the aggregate of tools seen here as core-cobble scrapers represents a functional and formal continuum. At present, available evidence supports the suggestion that these objects are indeed casual tools – made on the spot for one or more undefined purposes, used but once or twice, and then discarded.

Cutting Tools (Table 6; Fig. 18). Although some of the objects categorized as scrapers may also have functioned as cutting tools, several other artifacts were found during the bridge-sector survey that bear edges suitable for cutting. These tend to be minimally modified, casual tools, and most are simply flakes with possible evidence of use on one or more edges.

Projectile Points (Table 7; Fig. 19a-b). Only two projectile points were recovered during the bridge-sector survey. Both are

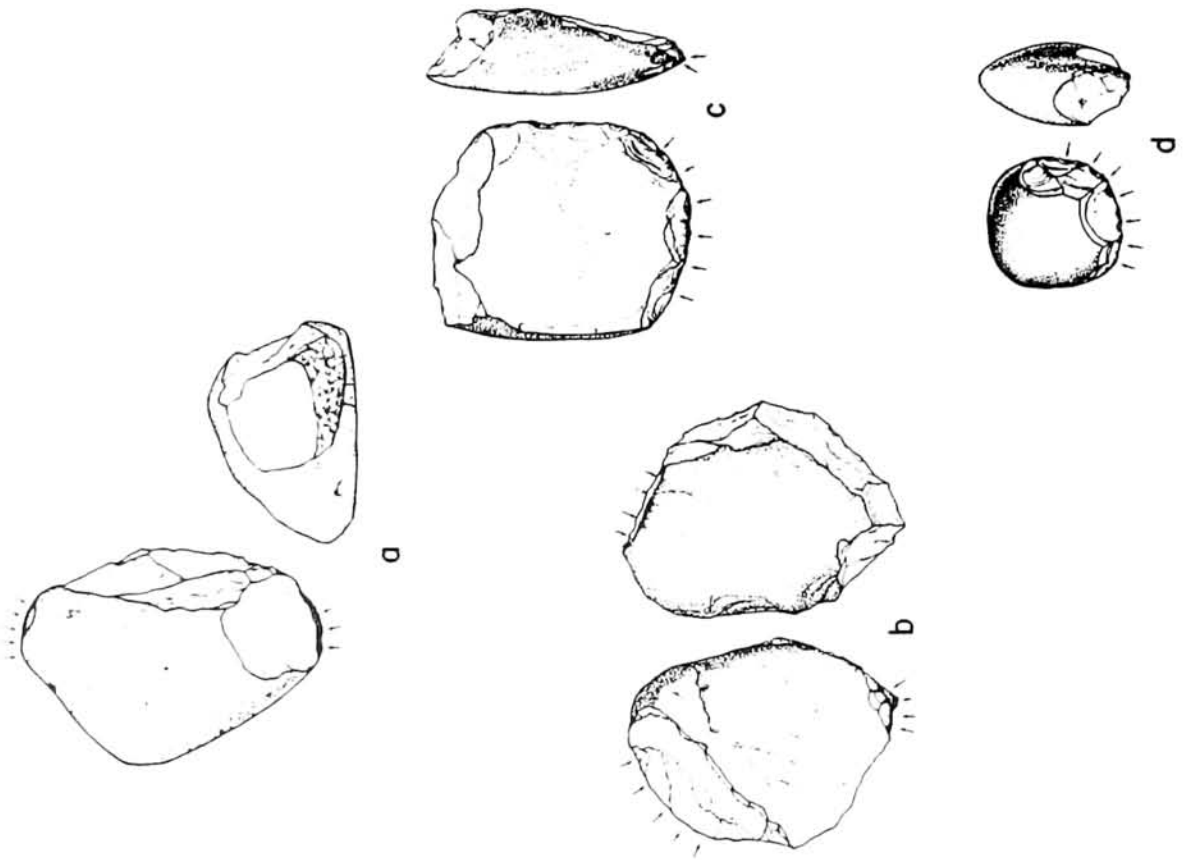

Fig. 13. Cobble hammers (a-b) and shaped core hammers (c-d).

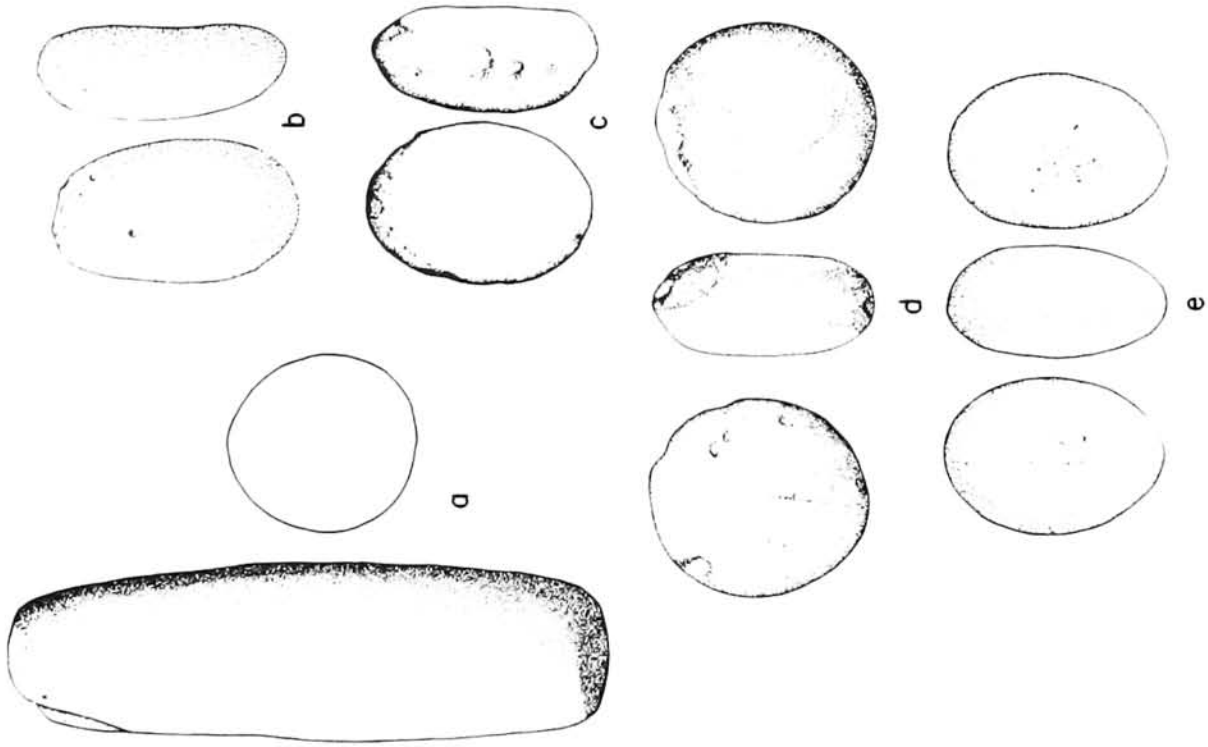

Fig. 12. Pestle (a) and smoothing stones (b-e).

Table 4

ATTRIBUTE DATA FOR IRREGULAR COBBLE SCRAPERS*

Subcategory	Number		Length	Width	Thickness	Edge Angle	Figure
1	14	average	85.0	81.7	27.8	58.8	14 a
		s.d.**	14.1	19.9	6.2	--	
		range	65-110	42-113	12.39	47-71	
2	29	average	92.0	74.3	46.5	67.4	14 b
		s.d.	26.8	16.9	10.9	--	
		range	62-175	44-109	27-68	45-89	
3	14	average	148.2	95.7	64.7	74.4	14 c
		s.d.	33.4	13.7	15.0	--	
		range	89-230	76-127	42-92	60-90	
4	22	average	114.2	95.4	50.4	65.8	14 d
		s.d.	33.4	15.0	12.2	--	
		range	63-173	65-135	33-77	55-90	
6***	21	average	102.9	78.2	45.9	73.6	14 e
		s.d.	21.0	15.2	7.3	--	
		range	48-132	48-100	29-56	65-87	
7	21	average	97.0	78.3	47.1	75.8	14 f
		s.d.	16.8	15.3	8.3	--	
		range	75-126	51-111	34-61	70-90	
8	12	average	58.9	80.5	57.9	65.6	15 e
		s.d.	14.7	12.5	18.5	--	
		range	35-92	59-100	38-107	57.77	
9	11	average	88.2	84.4	53.4	80.0	15 a
		s.d.	13.8	14.0	12.2	--	
		range	66-109	55-104	40-81	63-93	
10	9	average	88.0	102.0	45.6	72.0	15 b
		s.d.	20.9	34.1	15.5	--	
		range	57-123	65-160	28-82	65-80	
11	21	average	80.0	72.6	59.9	79.7	15 c
		s.d.	16.9	19.2	12.5	--	
		range	59-122	45-120	41-85	67-95	
12	14	average	120.3	106.6	65.6	78.8	15 d
		s.d.	25.2	21.5	16.2	--	
		range	81-162	80-140	43-104	67-90	
13	9	average	102.5	75.5	51.0	77.5	15 f
		s.d.	22.9	14.4	11.1	--	
		range	73-158	65-107	37-65	65-90	
14	12	average	68.0	59.5	31.7	70.7	15 g
		s.d.	6.9	4.2	6.1	--	
		range	62-75	53-67	22-40	50-90	
15	16	average	73.7	66.4	42.2	74.8	not
		s.d.	15.7	17.7	12.1	--	illustrated
		range	52-100	42-108	28-68	55-90	
Total	225						

*Edge angle measurements in degrees, all other measurements in mm.
**Standard deviation.
***No Subcategory 5.

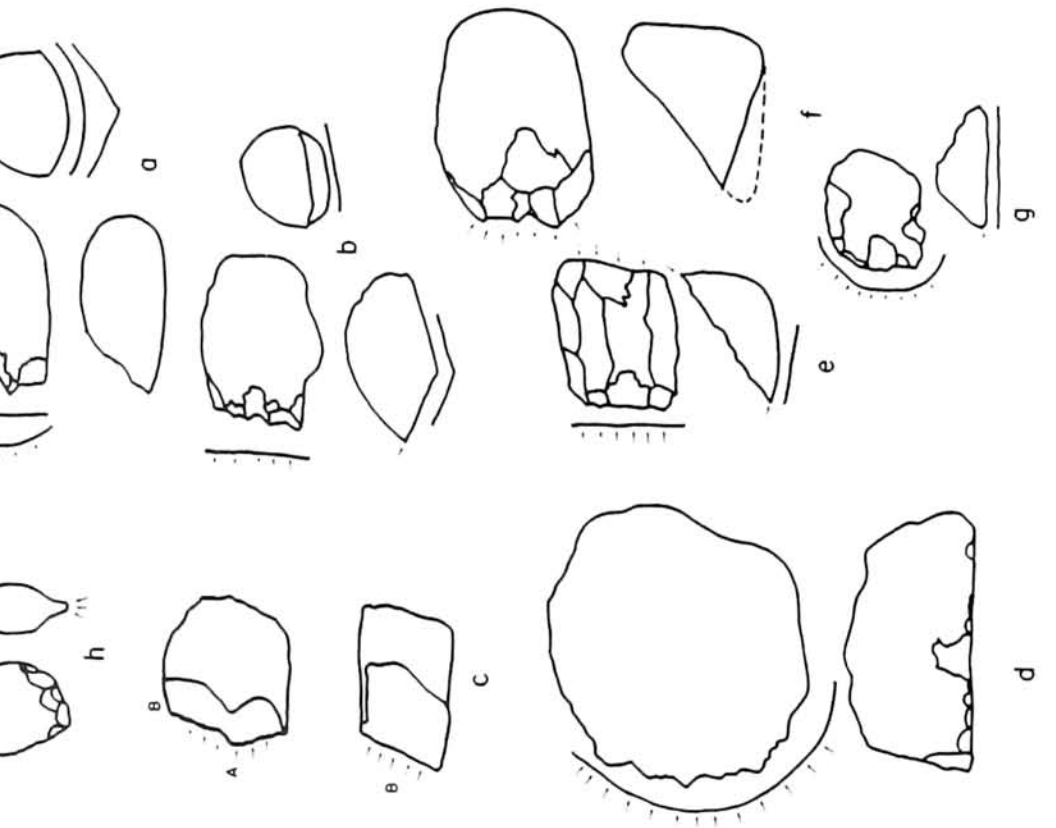

Fig. 15. Additional schematic representations of tools tentatively identified as irregular cobble scrapers; subcategories 8(e), 9(a), 10(b), 11(c), 12(d), 13(f), and 14(g); shaped core hammer (h).

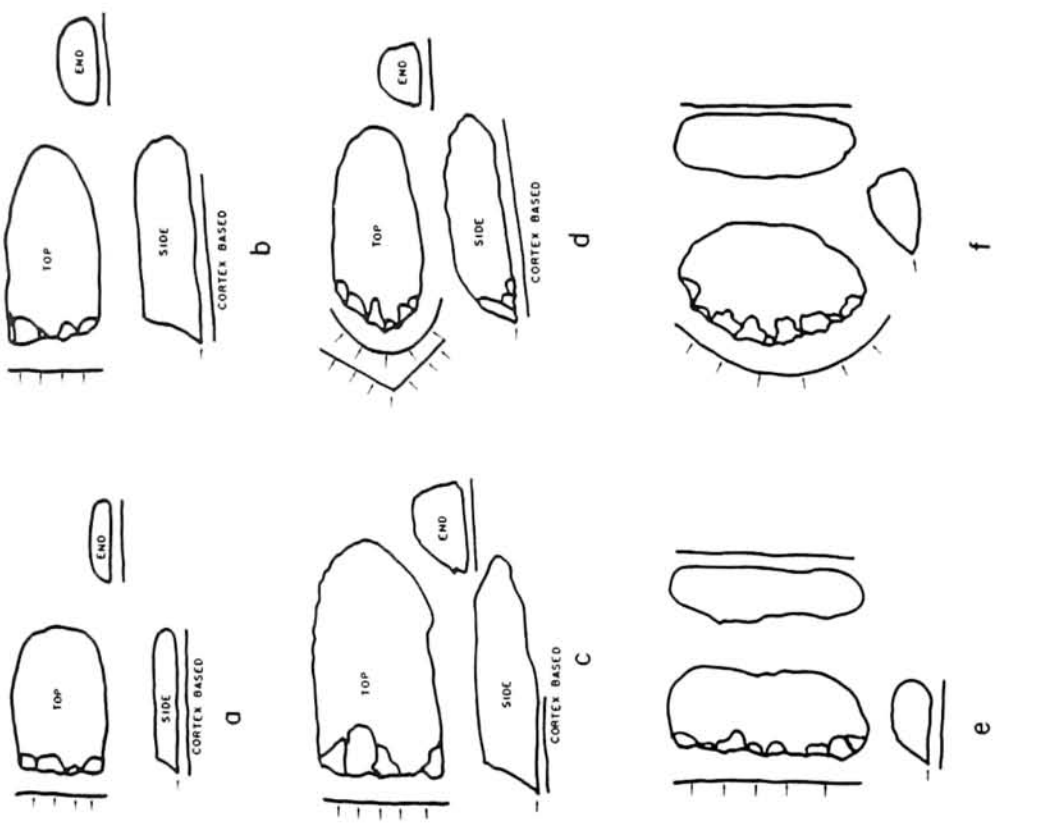

Fig. 14. Schematic representations of tools tentatively identified as irregular cobble scrapers; subcategories 1(a), 2(b), 3(c), 4(d), 6(e), and 7(f).

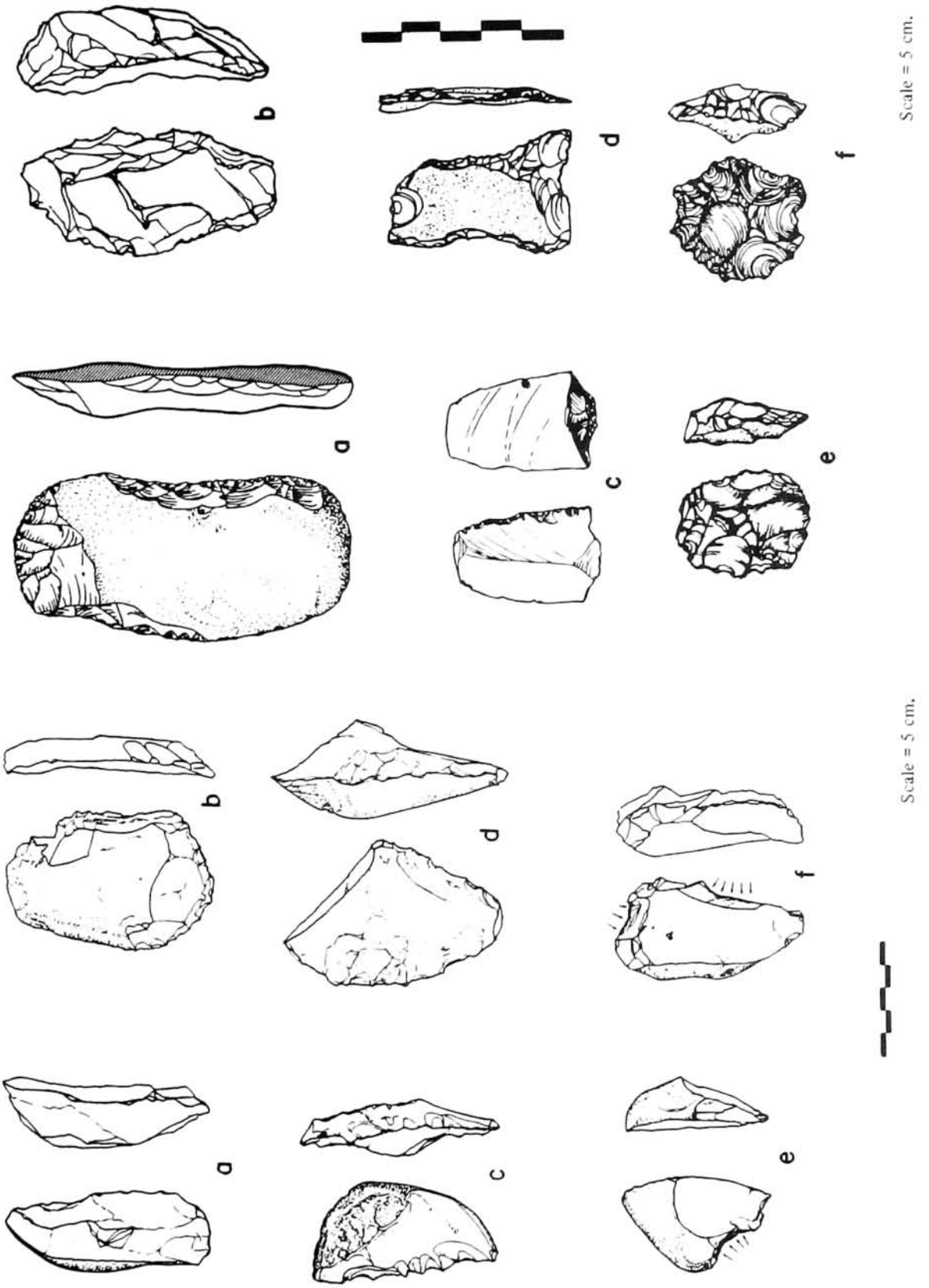

Fig. 16. Tools tentatively identified as irregular flake scrapers: heavy (a-d) and spokeshave (e-f).

Fig. 17. Tools tentatively identified as irregular conventional flake (a-d) and spokeshave (e-f).

Table 5

ATTRIBUTE DATA FOR IRREGULAR FLAKE SCRAPERS*

Subcategory	Number		Length	Width	Thickness	Edge Angle	Figure
Heavy	19	average	79.8	62.3	25.7	67.4	16 a-d
		s.d.**	17.1	12.7	6.2	--	
		range	44-104	34-83	15-35	50-85	
Spokeshave	4	average	66.7	48.0	22.5	93.7	16 e-f
		s.d.	11.2	1.2	3.8	--	
		range	51.80	46-49	19-29	90-100	
Conventional	8	average	46.2	31.1	12.7	67.2	17
		s.d.	17.9	5.7	4.7	--	
		range	30-83	25-41	5-20	65-70	
Total	31						

*Edge angle measurements in degrees, all other measurements in mm.
**Standard deviation.

Table 6

ATTRIBUTE DATA FOR FLAKE CUTTING TOOLS*

Subcategory	Number		Length	Width	Thickness	Figure
Used flake, heavy, irregular	27	average	84.6	61.8	22.0	not
		s.d.**	22.9	17.6	6.9	illustrated
		range	34-140	25-107	10-35	
Used flake, regular	18	average	25.2	19.5	5.5	18
		s.d.	7.1	4.7	2.6	
		range	15-41	14-35	2-12	
Total	45					

*All measurements in mm.
**Standard deviation.

Table 7

ATTRIBUTE DATA FOR PROJECTILE POINTS, DRILLS, WORKED FLAKES, AND CHOPPING TOOLS*

Artifact	Catalog No.	Length	Width	Thickness	Material	Figure
Projectile point	223-9**	49	21	12	basalt	19 a
	223-520	55	17	7	obsidian	19 b
Drill***	223-65	24	16	8	obsidian	19 c
Worked flake	223-132	59	45	19	chert	--
	223-137	25	23	7	obsidian	--
	223-263	43	26	11	obsidian	--
	223-354	39	24	10	chalcedony	--
Chopping tool***	223-26	100	92	67	basalt	--
	223-285	109	98	56	volcanic	--
	223-301	96	103	70	chert	--

*All measurements in mm.
**Fragment.
***Tentative functional designation.

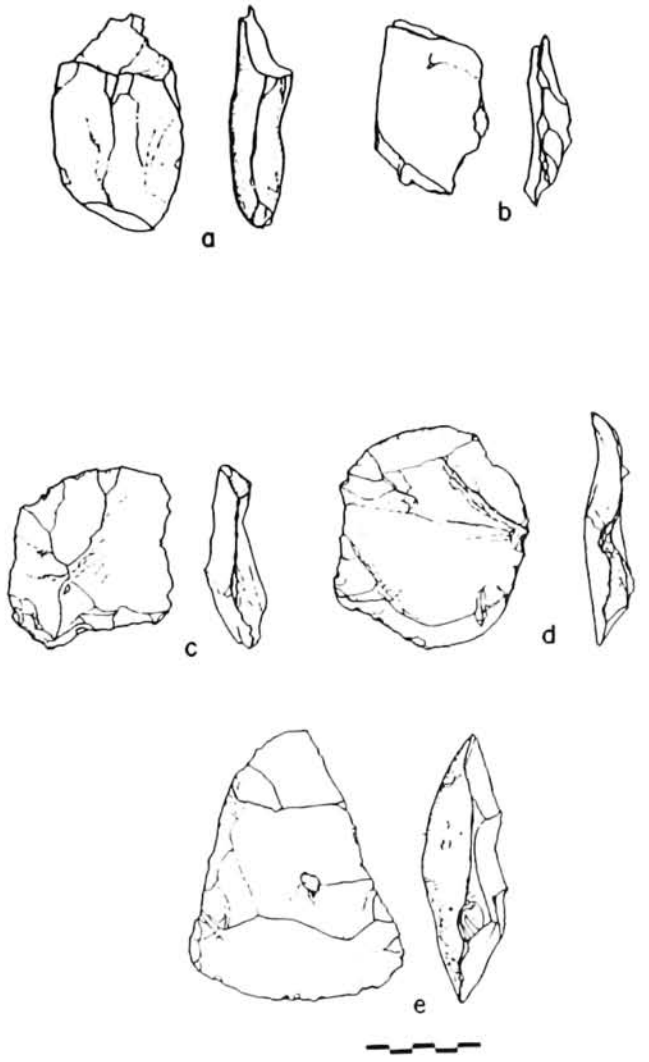

Fig. 18. Tools tentatively identified as flake cutting tools (used, regular).

relatively thin, leaf-shaped forms. Neither specimen displays temporally diagnostic morphological characteristics.

Other. Several additional artifacts were collected during the survey that cannot be assigned to the five previous categories. These items are briefly described below.

Drill (Table 7; Fig. 19c). One obsidian artifact is identified as a possible drill because of its overall morphology and cross-sectional configuration. No obvious wear is evident on the specimen. This single isolate is relatively unimportant in the greater bridge-sector artifact assemblage and any further interpretational analysis must await more extensive distributional analyses within the Lake Berryessa region.

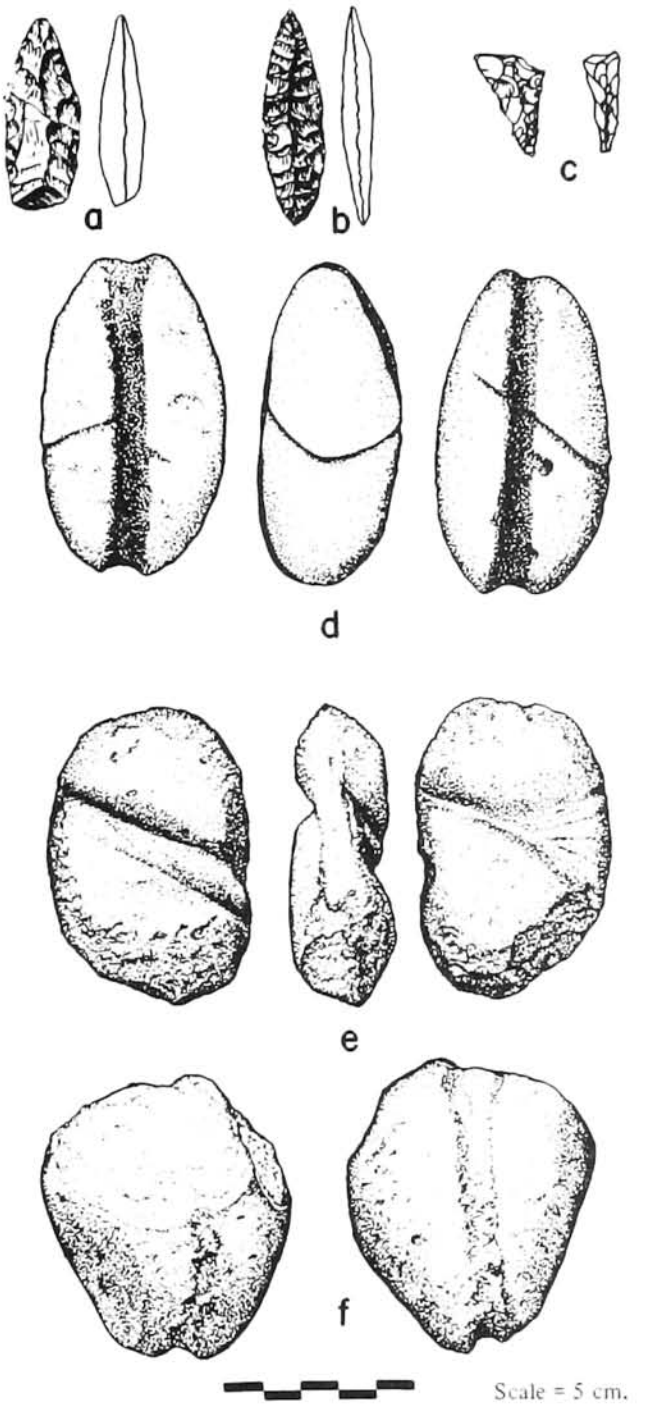

Fig. 19. Projectile points (a-b), possible drill (c), and grooved pebbles (d-f).

Grooved Pebbles (Table 8; Fig. 19d-f). Three grooved pebbles were found during the bridge-sector survey. Two of the specimens feature longitudinal grooves around the long axis of the pebble. Both of these are believed to have functioned as net weights or in some similar capacity. The third specimen is characterized by irregular lateral grooving that appears to be the result of some kind of sharpening activity.

Worked Flakes (Table 7). This is a catchall category for objects that show evidence of modification (i.e., flaking scars), but which are nondiagnostic in terms of any recognizable form or function. Included here are fragments of finished and unfinished tools, and tool rejects. Such artifacts are not common in the bridge-sector area of Lake Berryessa.

Chopping Tools (Table 7). Cobbles or heavy, core-like objects that possess attributes suggestive of use as chopping tools were located during the survey, but were relatively scarce. Three specimens are included here, but the functional interpretation is tenuous. It is also reasonably possible that these items represent accidental manufactures, cores, or natural but fortuitously shaped objects that have no cultural significance at all.

Pitted Cobbles (Table 8; Fig. 20). Twelve small- to medium-sized pitted cobbles were collected during the bridge-sector survey. Typically fashioned from sandstone, these artifacts display clearly defined pits pecked into one or more surfaces. No mano-like wear surfaces are apparent, but the general appearance of the pits is similar to those observed on the pitted manos described above.

Unmodified Flakes (Table 8). A number of stone flakes that appear to be cultural in origin were recovered during the survey. They are primarily cortical and seldom exhibit secondary flaking. The flakes may be by-products of tool manufacture (e.g., cobble scrapers), or may have been produced for use as casual knives. Most of the potentially functional pieces are basaltic, although a small number of obsidian flakes were also found. Distributionally, these unmodified flakes were usually discovered in the general vicinity of major sites or postulated camp locations.

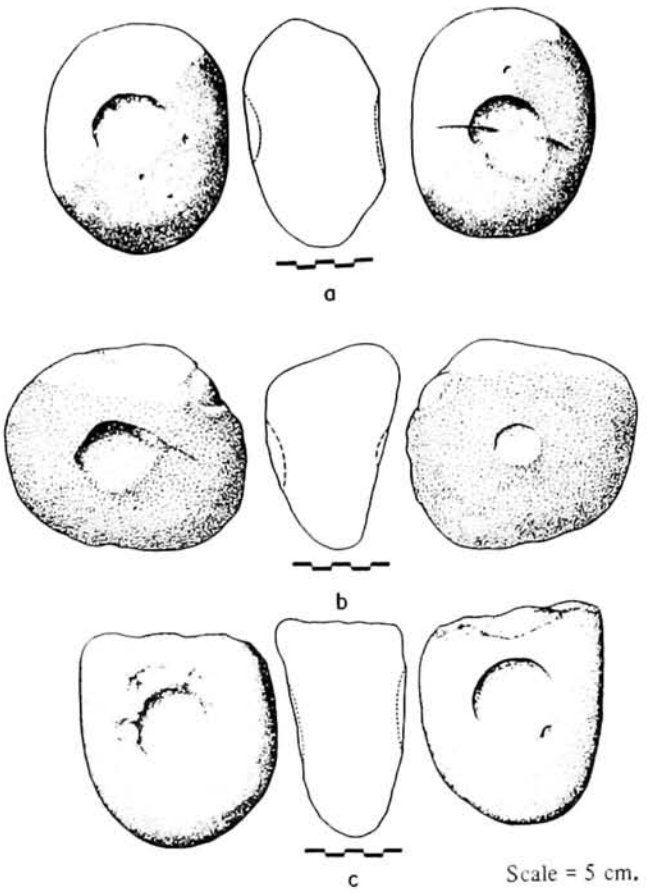

Fig. 20. Pitted cobbles.

Broken Cobbles. Several cobble and pebble fragments that *may* be the result of cultural activity were observed during the survey. These appear to have been broken deliberately, but no evidence of use or secondary modification is apparent.

Artifact Discussion

An examination of the bridge-sector artifact inventory, summarized by material type in Table 9, suggests several observations: (1) the dominant artifactual form is a cobble-derived tool (42% of the inventory consists of

Table 8

ATTRIBUTE DATA FOR GROOVED PEBBLES, PITTED COBBLES, AND UNMODIFIED FLAKES*

Artifact	Number		Length	Width	Thickness	Figure
Grooved pebble	3	average	78.5	55.0	39.3	19 d-f
		s.d.**	1.5	7.3	9.8	
		range	75-80	48-65	28-52	
Pitted cobble	12	average	127.0	95.3	64.9	20
		s.d.	16.7	17.5	10.1	
		range	102-165	62-116	44-82	
Unmodified flakes (obsidian)	7	average	19.0	13.2	2.6	–
		range	15-24	12-15	1-6	
Unmodified flakes (basaltic)	45	average	69.1	51.2	19.2	–
		range	36-128	25-79	7-29	

*All measurements in mm.
**Standard deviation.

Table 9

ARTIFACT MATERIAL TYPES

Artifact	Basalt	Volcanic	Sandstone	Metamorphic	Other	Total
Metate	–	–	–	–	–	16
Mano	12	33	30	9	–	84
Pestle	–	–	1	–	1	2
Smoothing stone	–	–	7	–	1	8
Hammer	2	1	–	–	1	4
Irregular cobble scraper	141	31	6	39	8	225
Irregular flake scraper (heavy)	16	2	–	–	1	19
Irregular flake scraper (spokeshave)	4	–	–	–	–	4
Irregular flake scraper (conventional)	–	–	–	–	8	8
Used flake, heavy, irregular	26	1	–	–	–	27
Used flake, regular	–	–	–	–	18	18
Projectile point	1	–	–	–	1	2
Drill	–	–	–	–	1	1
Grooved pebble	–	–	3	–	–	3
Worked flake	–	–	–	–	4	4
Chopping tool	1	1	–	–	1	3
Pitted cobble	–	1	11	–	–	12
Unmodified flake (small)	–	–	–	–	7	7
Unmodified flake (large)	43	1	–	–	1	45
Broken cobble	37	1	–	4	1	43
Total	283	72	58	52	54	535

irregular cobble scrapers); (2) basalt is the predominant and/or favored lithic material in the survey area (53%), followed by an unidentified volcanic rock (13%); (3) collectively, metates and manos comprise 19% of the total inventory; and (4) flakes or artifacts fashioned from flakes represent 24% of the total inventory – but it should be stressed that few specimens possess definitive evidence of use or purposeful secondary modification, and their function(s) or significance is not at all clear.

For descriptive purposes, the cobble-derived implements (i.e., cobble scrapers) have been sorted into 14 arbitrary subcategories based on size and the nature, location, and number of working edges. Although these simple morphological divisions can be readily identified in the bridge-sector assemblage and have some degree of empirical validity, it is considered unlikely that the subcategories are, in actuality, culturally significant. Further, there is increasing reason to believe that core-cobble tools found in generally comparable cultural contexts more often than not represent casual tools – and that they constitute multi-purpose tools potentially reflective of numerous use-events spread over a considerable period of time. Also, based on a preliminary examination of the limited Lake Berryessa sample, a morphological continuum between the recognized subcategories may be evident for several different attributes.

A more detailed and definitive statement relative to core-cobble tools and their presumed (scraping) function(s) is in order, but must await accumulation of data from a larger and more varied geographic sample. The basic concern here, in any case, is not with the viability of the above admittedly arbitrary and deliberately generalized categorizations, it is with the demonstrable occurrence of a large number of core-cobble artifacts that may reflect a potentially important but as yet undefined cultural activity.

Since it has long been assumed, in other contexts, that the angle of a flaked-stone working edge is an important indicator of tool function (e.g., Wilmsen 1968), edge-angle measurements were obtained for all relevant artifacts in the bridge-sector assemblage. However, inasmuch as almost every specimen is by definition "irregular" rather than conventionalized, these edge angles are highly variable and a considerable range is evident for most artifacts. In light of this complication, three angle measurements were taken from the *apparent* working edge of each tool. The measurements were then averaged for each implement. In turn, averages, standard deviations, and ranges were determined for each of the 14 subcategories of cobble scrapers (Table 4). Because of the irregular morphology of these tools, the edge-angle data presented here must be viewed in a general rather than specific sense.

As can be seen in Table 4, average cobble-scraper edge angles range from 59 to 80 degrees. Although there appear to be potentially significant differences in average edge angles among several of the subcategories, the range of edge angles per subcategory indicates considerable overlap. Consequently, it is evident that edge angles themselves do not clearly distinguish the subcategories from one another. What is probably significant, however, is that all of the cobble-scraper edge angles exceed 40 degrees and, with one minor exception (59 degrees), all of the subcategory averages exceed 60 degrees. Moreover, 12 of the 14 subcategories contain specimens displaying edge angles greater than 80 degrees. Based on prevailing notions about flaked-stone edge angles, therefore, the evidence suggests a scraping or planing rather than cutting function. Given this possibility, all of the specimens were examined for direct indications of use (e.g., wear facets, striations, battered surfaces, etc.) and, though only in a few instances, what *appeared to be* use-related

wear was recognized and noted. It was clear, however, that battered edges are virtually nonexistent and that most cobble scrapers were casual tools used a few times at most and then discarded.

ARTIFACT DISTRIBUTIONAL UNITS: SITES AND NON-SITES

Recognizing that the spatial characteristics of artifacts recovered from the bridge-sector area of Lake Berryessa may reflect only local patterns, for purposes of this discussion artifact locations have been organized into a hierarchy of "site" circumstances (i.e., "distributional units") differentiated by the extent to which artifacts are concentrated in particular places. The basis for this organizational system is primarily artifact density over space, but presence or absence of midden, presence or absence of obsidian, and locational contexts have also been taken into account. Two considerations come to mind with respect to this approach. First, it is important to state that the distributional units delineated below are only tentative constructs and that they probably reflect the special circumstances thus far observed in the investigations at Lake Berryessa. It is also important to note that these units have been documented in the specified spatial contexts and, although intuitively defined for purposes of discussion, they are no less real. Their significance and place in the larger cultural matrix of the North Coast Ranges, of course, remains to be seen. This leads to the second consideration which relates to the work of other investigators in the general region.

The distributional units outlined here are simple organizational devices designed to aid explanation of the archaeological record to no more than a local level. They are not proposed as classificatory divisions with specific regional or areal significance. The degree to which these quite tentative distributional units hold up will depend upon the outcome of ongoing and future research in the Lake Berryessa region and throughout the North Coast Ranges. Moreover, it is acknowledged that to date the work at Lake Berryessa has been conducted largely in isolation of other important and valuable studies carried out in recent years in the general region. Of particular interest in this regard are settlement patterns reconstructed for other North Coast Range areas (e.g., Jackson 1976; Jackson and Fredrickson 1978; Fredrickson and Hayes 1978; Stewart and Fredrickson 1979) that appear to be associated with artifact distributions similar to those recognized at Lake Berryessa. (As an aside, it might be noted that the eventual utility of these and other studies to the work at Lake Berryessa is directly related to their accessibility – which would be enhanced considerably by formal publication of research results in journals and monographs available to the wider academic community. Since 1960, for example, of over 60 documents on the prehistoric archaeology of north coastal California, only a handful have actually been published [e.g., Fredrickson 1974, 1984; Hildebrandt 1984; Meighan and Haynes 1968, 1970].)

In that a detailed discussion of the Lake Berryessa artifact assemblage is planned for the third paper in the present series (Berryessa III), minimal attention is given here to quantifying the *kinds* of artifacts characterizing the distributional units outlined below. It is understood that this is a crucial gap and that such data are ultimately indispensable to the analysis and interpretation of the artifactual evidence. Nevertheless, to maintain the flexibility of a phased investigative approach, this aspect of the research at Lake Berryessa will not be addressed directly until after all project-related surveys have been completed and larger artifact samples obtained. This work is in progress. Most of the shoreline has now been surveyed at least once, a data-recovery program has been completed in one

new study sector (Putah Creek), and other sectors will be investigated as soon as circumstances (natural or cultural) bring about a lowering of the lake level.

Isolate

Single artifacts located in isolated contexts comprise this non-site distributional unit. No specific criteria are proposed to define precisely the degree of spatial separation required to distinguish isolates from one another and from more inclusive distributional units, but a threshold of at least several meters seems likely.

Scatter

Scatters are distributional units consisting of low-density artifact aggregates more spatially concentrated than isolates, but which still lack the integrity usually required for formal site recognition. No attempt has yet been made to formalize the attributes of this distributional unit with respect to size, boundary definition, or artifact density. The unit differs from a concentration (see below) in that the latter is characterized by a distinct spatial focus. Scatters are variable units that can range in size and artifact density from a few items spread over a dozen square meters to over a hundred items located along a linear axis hundreds of meters in length.

Concentration

These distributional units consist of relatively low-density artifact aggregates, typically more concentrated than scatters, but which have as one of their principal diagnostic attributes a location on some clearly defined, small-scale geographic feature. In their modern setting at Lake Berryessa, concentrations occur on elongate land features extending into the lake – as peninsulas, knolls, or islands, or as saddles between knolls or islands. However, these locations must be viewed in terms of their pre-reservoir setting and in that context they represent low ridges and small knolls overlooking adjacent drainages.

Two other diagnostic attributes of concentrations in the Lake Berryessa region are that they lack midden and rarely contain anything beyond core-cobble tools. Distributional units occurring between concentrations appear to be limited to isolates and scatters. Generally, concentrations, as envisioned here, would qualify for formal recognition as sites.

Station

Stations are distributional units comprised of small flake scatters lacking formal tools and midden. At present, only obsidian flakes are found at stations in the Lake Berryessa region, but it is possible that other materials will characterize stations encountered during future fieldwork. Stations tend to be small, covering a few square meters at most, and rarely contain more than a few dozen flakes.

Camp

In the context of the ongoing studies at Lake Berryessa, a camp consists of a small area of midden, associated obsidian flakes, and usually a few other artifacts (e.g., manos, scrapers, etc.). Critical attributes of this distributional unit are the presence of midden, flakes, and a small number of different kinds of artifacts. Camps are typically small (a few dozen square meters) and, based on all known examples to date, feature shallow midden deposits.

Major Camp

This distributional unit is distinguished from a camp on the basis of its greater size and larger number of artifacts. Major camps (e.g., NAP-432, -433, -636) usually cover relatively large areas (more than 1,000 sq. m.), and their artifact assemblages typically contain a variety of tools and debitage. Midden is present, but can vary in depth,

development, and degree of induration. Large quantities of waste flakes are present, presumably indicating recurrent occupations over more than short periods of time.

Village

The most inclusive distributional unit is the village. Village sites are situated immediately adjacent to the principal streams in Berryessa Valley (Eticuera and Putah creeks), and typically feature well-developed, dark middens. Villages thus far examined in the region contain diverse artifact inventories, large quantities of flakes, and extensive faunal remains. At present, and for purposes of this tentative organization of artifact distributional units, villages are characterized by assemblages attributed to the most recent prehistoric occupations in the region (see Arnold and Reeves [1959] for a description of these sites prior to the filling of the reservoir). Village site artifact inventories include shell beads, *Haliotis* ornaments, burials, small obsidian projectile points, mortars and pestles, and a variety of less common but usually diagnostic artifacts. Based on available evidence, heavy core and cobble tools are conspicuous by their rarity and a milling complex (mano/metate) appeared to be absent at lakeshore and reservoir-bed sites exposed as a result of the 1976-1977 drought. Currently, all village sites within the immediate Lake Berryessa project area lie under water. Site NAP-539, located upstream from the lake on Eticuera Creek, appears to be the only intact prehistoric village in the general vicinity.

The artifact categories and distributional – i.e., site – units delineated above have been documented in diverse enough settings throughout the Lake Berryessa region to suggest, with a certain degree of security, that they are indeed representative of late prehistoric land-use patterns. Explanation of the *meaning* of such a hierarchy of sites in terms of adaptive strategies and cultural development over time has yet to be addressed. Temporally diagnostic patterns are probably evident in the archaeological record and there are no doubt reasons to attribute at least part of the observed patterning to atemporal adaptive traditions. These potentially critical issues will be addressed as best possible in the course of planned future investigations.

Sites such as those described here as stations, camps, major camps, and villages almost certainly have previously described counterparts in other regions of the North Coast Ranges, and it seems likely that at least some degree of functional comparability and/or direct historical relationship will become apparent when the Lake Berryessa data are subjected to a geographically broad, comprehensive analysis. Notwithstanding the interpretive potential of such correlations, it is the documentation and explanation of artifact isolates, scatters, and concentrations that to date represent perhaps the most important or interesting aspects of the Lake Berryessa research project.

CONCLUSIONS

Although data collection and analysis are far from complete, initial results suggest that there is significant patterning in the artifact distributions thus far compiled. As a tentative hypothesis, therefore, it is proposed that in the extant artifact distributions there is evidence for a hierarchical use of space related to: (1) terrain; (2) distance from primary water sources; and (3) probable locational differentials in the kinds and quantities of subsistence resources available for exploitation.

It is recognized that an explicit discussion of the objects comprising these artifact distributions, as well as detailed descriptions of the sites thus far recorded, are crucial necessities that must be dealt with at some point. The present concern, however, is by design limited

to the nature of artifact distributions (i.e., relatively distinguishable artifact concentrations over space) and to differences in their elevation above and distance from adjacent primary drainages. Despite this obviously overly simplistic assessment of what is in reality probably a very complex set of relationships across space and time, the explanatory hypothesis put forth here is seen as a not unreasonable first step toward unraveling components of the larger and more complex regional subsistence-settlement system.

Specifically, it is hypothesized that the greater the elevation above and distance from Eticuera and Putah creeks, the more widely dispersed and apparently casual are the prehistoric artifacts. Based on an extrapolation of data thus far generated during the Oak Shores and bridge-sector surveys, a schematic illustration of this distributional patterning is presented in Figure 21. Site locations and artifact distributions in the bridge sector of Eticuera Creek were examined during the 1976-1977 drought when the surface of Lake Berryessa dropped below the 400-foot contour. The predicted location of major camps and villages in the Oak Shores area cannot, of course, be verified without a substantial lowering of the lake. This inhibits comprehensive testing of the hypothesis. It is possible, though, to achieve at least a partial evaluation of the hypothesis by examining survey data from intermediate areas lying between the bridge sector and Oak Shores. To obtain the necessary data, surveys are in progress along Putah Creek and in areas of the reservoir where the old Putah Creek stream bed is most distant (laterally and vertically) from the normal surface elevation of the lake (440-foot contour).

As suggested above, the simplistic straight-line distribution of artifacts and sites depicted in Figure 21 would probably be altered by the presence of significant tributaries (which might themselves be characterized by comparable, but highly localized, distributional patterns), and by the irregular distribution of potential vegetal subsistence resources. The prehistoric significance of a particular resource certainly depended on its economic value and, to an important degree, on its accessibility. Given these hypothesized but not improbable circumstantial variables, it seems possible that relative isolate frequencies and the development over time of artifact scatters and concentrations would be related directly to local resource potential and accessibility – and to relative distances from primary drainages.

An important aspect of the available survey data that is also relevant to the speculations offered here is the fact that non-site artifacts (i.e., isolates, scatters, concentrations) are not evenly distributed across the landscape, and there may well be meaningful correlations between these distributional units and potential vegetal resources. It is also assumed that there would be at least some differentiation in the kinds of artifacts associated with particular distributional units. Logically, of course, the kinds of artifacts present should show some relationship to the nature of the resource being exploited, just as the degree of artifact concentration is probably related to the accessibility and relative importance of a specific resource locale. Intuitive and non-quantified assessments of the artifact distributions thus far compiled seem to indicate differential distributions by artifact type as well as by degree of concentration.

Based on the extant survey data, locales on moderate slopes a considerable distance above principal drainages are primarily characterized by isolates or well-dispersed artifact scatters. No convincing evidence of significant milling activities has thus far been found in such contexts, and most of the artifacts appear to represent casual tool use. Artifact densities (scatters and concentrations) in-

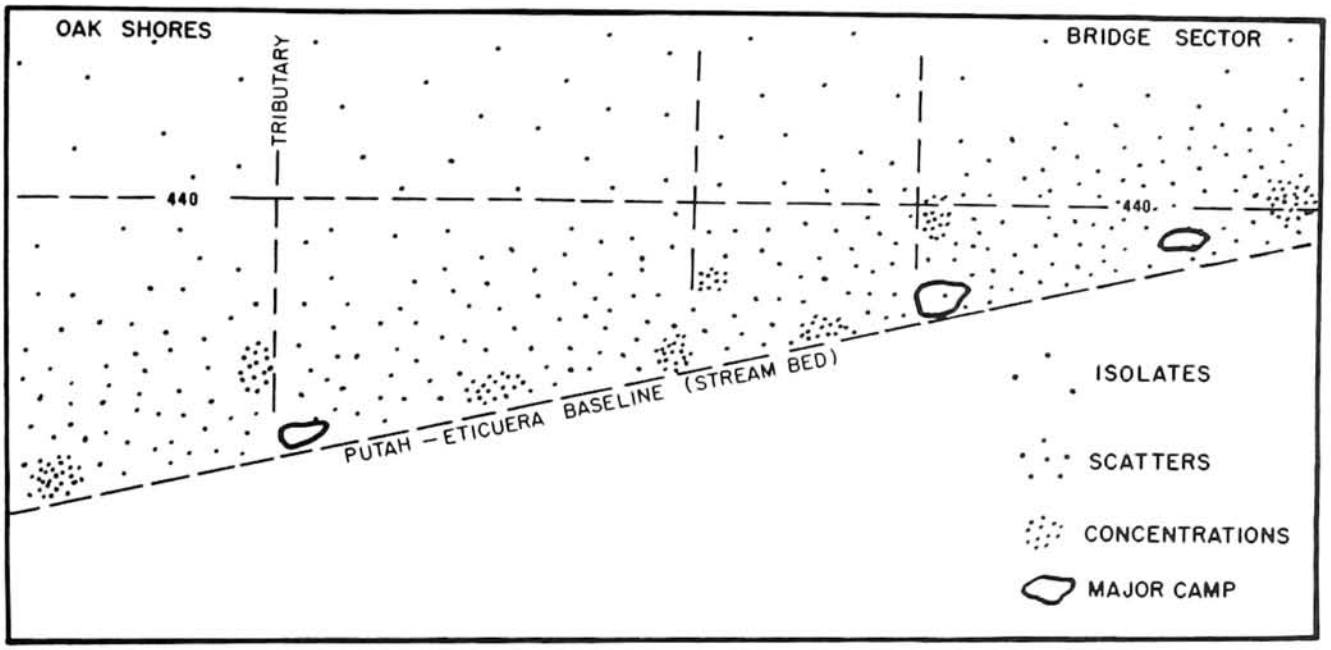

Fig. 21. Idealized schematic depiction of postulated distribution of isolates, scatters, concentrations, and major camps along Putah-Eticuera drainage; village locations on creek not shown (see text for definitions).

crease on knolls, ridges, and generally accessible terrain adjacent to but not necessarily close to the base-line drainage. Milling equipment is occasionally represented. As shown schematically in Figure 22, there appears to be a hierarchy of collecting and processing activities dependent, in part, upon the distance from a base camp and, in part, upon the nature of the processing tasks (e.g., preliminary processing done as part of resource acquisition and preparation for transport, as opposed to multi-stage processing conducted as part of the food-preparation process itself).

Although it might be argued that the artifact aggregates designated here as concentrations actually represent small camping sites, this possibility is set aside for now due to two factors. First, even though concentrations may, in rare instances, contain milling implements in addition to the usual core-cobble tools, they do not display the wide array of artifacts found at sites here referred to as camps or major camps (e.g., obsidian flakes, flaked obsidian tools, a variety of core and cobble tools, common milling elements). Second, known major camps at Lake Berryessa are characterized by the presence of subsurface features that may have functioned as earth ovens or in some other way been related to food processing. No evidence of such features has been found at any of the recorded scatters or concentrations.

The possibility that the extant artifact distributions reflect temporally as well as (or instead of) spatially differentiated subsistence-settlement activities must also be considered. In this regard, a clear-cut difference has been noted between the assemblages found at major camps and those known for villages located along the principal streams. Temporal differentiation is suggested by divergent artifact inventories and settlement locations, and by the degree of midden induration. All of the village locations thus far examined, for example, have relatively well-developed non-indurated middens marked by the presence of molluscs, burials, small obsidian projectile points, a variety of shell

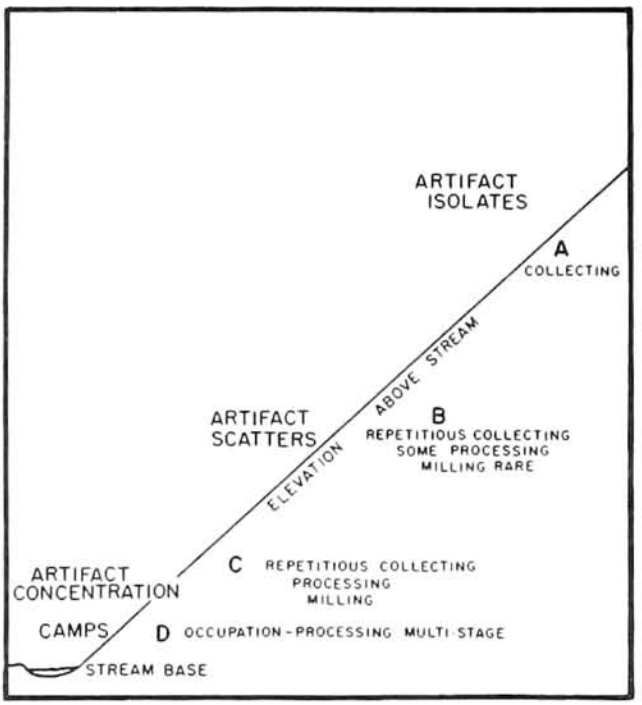

Fig. 22. Schematic representation of hypothesized topographic patterning in artifact distributions.

beads and ornaments, and the mortar-and-pestle (Arnold and Reeves 1959). In contrast, known major camps contain somewhat more indurated middens, less evidence of soil discoloration, the mano-and-metate, cobble tools, and medium- to large-sized obsidian and basalt projectile points (e.g., leaf-shaped, Excelsior, possibly Borax Lake forms). Therefore, it seems likely that there may be at least some chronological differentiation between what are here called major camp and village sites. For the moment, however, the important question is not how major camps and villages ultimately relate to one another; rather, it is the relationship(s) between isolates, scatters, and concentrations and the more-inclusive distributional units (camps, major camps, villages) that is of primary interest. Available data tentatively suggest a relationship between the scattered core-cobble tools and major camps, and it may be that an as yet undefined subsistence shift (either in terms of resources exploited or modes of collection and processing) took place between the end of the camp-oriented settlement pattern and development of the late prehistoric village-oriented settlement pattern.

As mentioned at the outset of this paper, several further phases of the research at Lake Berryessa are underway or in planning. Research questions and strategies for each phase will build upon the results obtained during earlier investigations. This cumulative process allows for the constant evaluation and refinement of explanatory hypotheses such as those considered here, and for the development of new, potentially insightful perspectives on the nature of hunter-gatherer adaptation in the North Coast Ranges.

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