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On the Subsistence Ecology of the "Late Inland Millingstone Horizon" in Southern California

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THE assumption that milling tool technology (manos/metates and mortars/pestles) was used primarily to process plants is pervasive in California archaeology and it is always the case that such artifacts recovered from archaeological sites are used to demonstrate the processing of plants at those sites. This line of reasoning is central to the ecological interpretation of those archaeological cultures in southern California in which it appears that millingstones constituted the primary food processing technology. These "Millingstone Horizon" cultures are viewed as having been heavily dependent on plant foods; the general paucity of vertebrate animal remains or of hunting-related technology generally reinforcing that interpretation.

The fact that there is ethnographic evidence that manos and metates were used to process animals (see review by Yohe et al. [1991:659-660]) has done little to enlighten archaeologists of that possibility. However, with the development of techniques to detect protein residues (Hyland et al. 1990; Kooyman et al. 1992; Newman et al. 1993) on archaeological specimens, there is now evidence from a number of prehistoric sites in southern California that animals were processed on milling tools (e.g., de Barros and Schneider 1989; Yohe et al. 1991; Newman 1992).

Thus, ecological models dependent on the "millingtools equals plants" assumption are in need of testing and perhaps revision. One such model involves the Late Inland Millingstone Horizon defined by Kowta (1969) in the San Bernardino Mountains of southern California (Fig. 1) where a dependence on yucca, coupled with a de-emphasis on animal resources, was hypothesized. Macrofloral, macrofaunal, and protein residue data from the nearby Siphon Site (CA-SBR-6580; Sutton et al. 1993) suggest the opposite: that yucca was little used and that a variety of animals formed a major aspect of the diet.

THE "MILLINGSTONE HORIZON"

The temporal and/or cultural unit commonly called the Millingstone Horizon in southern California has so far evaded clear definition. Various archaeological cultures and complexes have been attributed to it (Pauma, La Jolla, Topanga, Zuma Creek, Malaga Cove, Oak Grove, and Sayles) and both coastal and inland aspects have been designated. In spite of the designation "horizon" implying primarily a spatial continuity of traits and assemblages (Willey and Phillips 1958:33), the common usage of the Millingstone Horizon concept has expanded to include both temporal and ecological meanings, i.e., that it equates to a particular ecological adaptation within a broad span of time.

Wallace (1955:219) defined the Millingstone Horizon (his Horizon II; ca. 8,000-2,500 B.P.) as reflecting an increase in vegetal resource exploitation (from Horizon I times) marked by the abundant occurrence of milling equipment. Artifacts typically associated with this horizon include manos, metates, scraper planes, choppers, core tools, and few projectile points. The

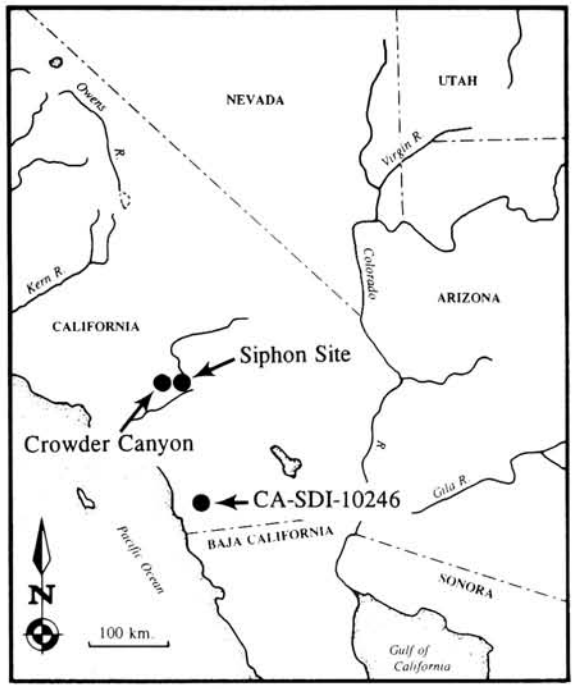

Fig. 1. Vicinity map and location of sites discussed in text.

diversification of subsistence practices and the incorporation of mortars and pestles marked the end of Wallace's Millingstone Horizon and the beginning of Horizon III (ca. 2,500 B.P. to A.D. 1000; Wallace 1955:223).

Subsequent attempts to clarify the Millingstone Horizon have been made. Johnson (1966: 19-20) proposed the addition of a late phase (Phase III; ca. 3,000 B.P. to A.D. 1) thus extending the terminal date of the Millingstone Horizon to about 2,000 years ago (at least along the southern California coast). An inland aspect of the Millingstone Horizon was described by Kowta (1969).

Warren (1968) defined several cultural traditions along the southern California coast as an augmentation to the temporal horizons proposed by Wallace (1955). Warren (1968:6) outlined the ecological adaptation of the Encinitas Tradition, which incorporated the Millingstone Horizon, as reflecting a well-developed collecting economy (focusing on plants, and along the coast, shellfish), with evidence of hunting (projectile points and vertebrate faunal remains) being rare.

Many archaeologists object to the use of the Millingstone Horizon concept due to the confusion regarding the use of the term to denote either a technological, temporal, or ecological pattern, or a combination of several such patterns. In this paper, "Millingstone Horizon" is meant to refer to archaeological cultures (or sites or assemblages) where the dominant food processing technology is the mano and metate and whose ecological adaptation is thought to be very heavily dependent on plant foods.

THE CURRENT VIEW OF MILLINGSTONE HORIZON SUBSISTENCE ECOLOGY

Primary to any definition of a Millingstone Horizon assemblage are: (1) the abundance of millingstones (manos and metates) in the assemblages; (2) the scarcity of projectile points; and (3) a decrease in vertebrate faunal remains from the previous "hunting" adaptation. The latter two criteria, coupled with the presumed association between millingstones and plant processing, has led to the interpretation that the Millingstone Horizon (particularly the inland aspects) represents a time when peoples intensified the exploitation of plant foods with a concurrent de-emphasis on the use of faunal resources. While this resource shift may not be as dramatic on the coast where shellfish and sea mammal remains are present (see the various papers in Erlandson and Colten [1991]), recent research into the subsistence facet of the inland aspect has supported the earlier interpretations (e.g., Kowta 1969; Allen 1982; Salls 1983; Basgall and True 1985; McCarthy 1986).

The prevailing ecological interpretation of inland sites is based on the abundance of millingstones and the general absence of vertebrate faunal remains. While the data are not herein disputed, their interpretation is subject to several

assumptions. First, it is widely assumed that millingstones were used only to process plant resources, an assumption now known to be false. Yohe et al. (1991) summarized the ethnographic evidence of small-animal processing on millingstones and reported the detection of small mammal proteins on milling equipment (manos and a hopper mortar) from two sites in southern California, one of which (CA-SDI-10246) dated to the "late Millingstone Horizon." The primary conclusion of Yohe et al. (1991) was that it cannot be assumed that millingstones were only used to process plants.

Second, one of the major lines of evidence regarding the relatively infrequent use of vertebrate faunal resources is the lack of bone recovered in the various sites. The recovery of bone (macro remains) is regulated by a variety of factors, including prehistoric processing techniques (e.g., schlepping, bone grinding, etc.), taphonomy, screen size, and analytical techniques. Micro remains (recovered through micro screening) rarely have been sought.

NEW SUBSISTENCE EVIDENCE

Excavations were recently undertaken at the Siphon Site (CA-SBR-6580), a large habitation site in the San Bernardino Mountains (Sutton et al. 1993) that is interpreted as representing the "Millingstone Horizon." A total of 3,162 artifacts was collected from the site, including a variety of milling tools, ornaments, flaked stone artifacts and tools (points, bifaces, cores, hammerstones, debitage), and bone tools. Few faunal or floral remains were recovered. The site was dated to between 3,925 and 3,375 B.P. (corrected radiocarbon assays, Sutton et al. 1993).

Subsistence Technology and Remains

The subsistence technology identified at the site consists of projectile points (n = 6) and millingstones: manos (n = 113), metates (n = 56), and pestles (n = 9). The pollen data from the site (Cummings 1993) suggest an environment similar to that of today and offer a number of alternative suggestions regarding the materials available for use. Several seed genera were identified from the site, including amaranth (*Amaranthus*) and juniper (*Juniperus*). Juniper is plentiful at the site today as it apparently was at the time of the its occupation. Yucca (*Yucca* spp.) grows on the hillsides just north and west of the site. In addition, a riparian plant community (in the Mojave River) is present just to the east. A number of other food plants are available in the vicinity. Yucca processing has been suggested for other sites of this period in the San Bernardino Mountains (Kowta 1969; Basgall and True 1985). The roasting of yucca and agave (*Agave* spp.) leaves and hearts has been suggested (de Barros 1990) for the area and roasting pits are known in the nearby foothills (de Barros 1990).

The multi-functional character of many of the ground stone implements in the collection is visually evident. Metates probably were used as chopping platforms, bases for polishing, rubbing, scraping, and pulping certain materials, and as anvils for grinding and/or pulverizing. Manos were used as hammerstones for crushing, pounding, and pulverizing, as well as for grinding. They also may have been used as small anvils for removing hard outer coverings of nuts or for bipolar reduction of lithic cobbles.

The visible faunal remains are relatively meager. A relatively small number of unidentified large and medium mammal remains was discovered. The identified remains primarily are those of pond turtle (*Clemmys marmorata*). It is not clear whether the pond turtle was used as food, or the shells used as implements or musical instruments, or both.

Thus, the artifact and ecofact subassemblages from the Siphon Site are relatively typical of other Inland Millingstone Horizon sites. Based on the artifactual and visible ecofactual data recovered from the site, there would be no rea-

son to suspect that the currently held view regarding Millingstone Horizon ecology was incorrect.

The Nonvisible Floral/Faunal Data: Immunological Results

Both artifacts and soils from the Siphon Site were tested for protein residues using the crossover electrophoresis (CIEP) immunological technique in the hopes of identifying floral and faunal remains not evident in the visible assemblage. In addition, there was reason to suspect that animals may have been processed on millingstones in general, and on such artifacts dating from the Millingstone Horizon (e.g., Yohe at al. 1991). A total of 117 samples from artifacts was taken and processed (Table 1) from the site (see Newman 1993 for the complete report). As the results from immunological testing are *positive* data only (one cannot test for absence, only presence), one must remember that a negative immunological result (that might result from a variety of factors including available anti-sera, preservation, sampling error, etc.) is *not* evidence that a resource was not used. Soil testing was conducted to insure that positive results were not due to soil contamination but to cultural activities; all such soil samples were negative (see Newman 1993).

The Floral Data. The macrofloral remains recovered from the Siphon Site consisted of seeds of amaranth, juniper, water-hemlock (*Cicuta douglasii*), and prickly poppy (*Argemone*). Immunological antisera have so far been developed for only one plant (yucca) and yucca was identified on only one tool, a metate.

The yucca protein identification result is most interesting for several reasons. Kowta (1969:52-53) hypothesized that the Late Inland Millingstone Horizon economic focus was on plant resources, particularly agave and yucca. This was based on excavations at the Sayles Site where a large number of tools classified as "scraper planes" was recovered (see also Jackson 1977; Salls 1985). Kowta thought that the focus on agave and yucca was the result of a climatic shift to more xeric conditions (the Altithermal, ca. 7,000 B.P.) expanding the range of agave and yucca at the expense of other plants.

Irrespective of the arguments regarding the function of "scraper planes," either as yucca processing tools (Kowta 1969; Salls 1985) or as cores (Jackson 1977), no yucca proteins were identified on any such tools from the Siphon Site. As yucca can be detected immunologically, its total absence from the scraper planes casts some doubt as to: (1) whether these tools were used on yucca, and (2) whether yucca was utilized to any great degree (either for food or fiber).

The Faunal Data. While the macrofaunal data confirm the presence of turtle and some large and medium mammal, the immunological data are much more comprehensive. Deer (*Odocoileus*), pronghorn (*Antilocapra*), rabbit (lagomorph), rat, waterfowl, and fish were identified (there currently is no antisera for turtle). These results are important for two major reasons. First, the data indicate that the inhabitants of the Siphon Site exploited a fairly wide range of faunal resources, much more along the lines of what one might expect if not influenced by the Millingstone Horizon ecological "model." That is, the immunological data add significant breadth to the faunal assemblage.

Second, and perhaps more revealing, is the pattern of the residues on the tools (Table 1). Of the total artifact samples processed (n = 117), positive results (not including the nonspecific results) were obtained on 11 tools (9.4%, a fairly low percentage). However, many (45.5%) of the positive results came from metates (five positive results on 21 samples, 23.8%). It appears that animals were being processed and/or served on millingstones (although not necessarily for food), presumably using a variety of cutting, pounding, and chop-

Table 1
RESULTS OF IMMUNOLOGICAL ANALYSIS, CA-SBR-6580

SAMPLE TYPE	NUMBER PROCESSED	RESULTS
metates	21	1 pronghorn/deer; 1 pronghorn; 1 yucca; 1 nonspecific; 1 rat; 1 waterfowl
manos	37[a]	1 rabbit
pestles	3	none
projectile points	6	1 rat
bifaces	13	1 deer; 1 waterfowl
core	1	none
core/unifaces	6	1 nonspecific
core/scraper planes	4	1 waterfowl/fish
core/hammerstones	4	none
choppers	8	1 pronghorn/deer
cobble hammerstones	3	none

[a] 37 samples were taken from 32 manos (see Newman 1993)

ping tools. However, the lower rate of positive results on the manos from CA-SBR-6580 (one positive on 37 samples) may suggest that the animals were not processed on the metates with manos.

DISCUSSION

The current ecological interpretation of the Millingstone Horizon in southern California is one of intensive utilization of plant resources with less emphasis (but certainly not absence) on vertebrate faunal resources. This is based on the functional interpretation of several artifact classes (millingstones and scraper planes) as being related to plant processing and on the paucity of vertebrate faunal remains from the various sites. The addition of the immunological technique as a method by which to test for the presence of nonvisible faunal remains has resulted in the delineation of a much greater breadth of faunal resources being identified at one Inland Millingstone Horizon site (the Siphon Site).

It may be that the perceived paucity of faunal remains from other such sites is the result of post-procurement processing. Indeed, the data from the Siphon Site suggest that some animals were being processed on millingstones, likely with the bones being crushed. Such processing could easily result in such remains being missed in conventional recovery methods and/or that the bones were consumed and deposited off-site in feces.

The ability of the immunological technique to test for the presence of yucca proteins on tools should serve as a test of the hypothesis that yucca was a major, if not a staple, plant resource of the period and was processed with stone tools (there are other possible explanations). The results (specifically the animal proteins on the milling stones) from the Siphon Site do not confirm that hypothesis but suggest the idea that plants are relatively overrated, but certainly important, in Millingstone Horizon ecological models (although only one plant, yucca, can currently be detected).

While the results from one site certainly are tentative, it should be clear that the traditional ecological model for Millingstone Horizon subsistence ecology (e.g., a focus on plants) should be critically reevaluated. This perceived focus on plant resources may be an artifact of the poor recovery of faunal remains related, at least to some degree, to the processing techniques of the Millingstone Horizon peoples. It is readily apparent, at least from the Siphon Site, that the breadth of utilized faunal resources is greater than the macrofaunal data would suggest. While such a model does not easily account for the paucity of projectile points (and therefore hunting in the conventional wisdom but the use of traps, clubs, etc., must be considered) in Millingstone sites, it is clear that a variety of terrestrial vertebrates were being exploited, perhaps by nonprojectile means (e.g., traps).

It may be that the "shift" from hunting to plant collecting marking the inception of the Millingstone Horizon actually reflects a modification in processing technology as an adaptation to more xeric conditions (extracting a greater number of calories from the same animal, particularly large animals, by processing it more completely). Perhaps no "shift" of focus occurred at all; perhaps the people just became more efficient processors (cf. Warren 1986). This change in view could be significant to our understanding of cultural development and evolution in southern California and elsewhere.

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