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AVOCADOS TO MILLINGSTONES:

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CULTURE OR ADAPTATION: MILLING STONE RECONSIDERED

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Of interest to D. L. True throughout his career was the California Milling Stone Horizon, the artifact complex dominated by handstones, millingslabs, and crude core tools most frequently associated with the early Holocene in southern California. The basic Milling Stone pattern, identified in 1929 by David Banks Rogers in the Santa Barbara Channel and formally defined by Treganza (1950) and Wallace (1955), was brought to the attention of American archaeologists outside of California by Wallace (1954) and True (1958). Over the next 30 years, D. L. True authored a number of articles and reports on Milling Stone (Basgall and True 1985; True 1980; True and Baumhoff 1982, 1985; True and Beemer 1982; True et al. 1979) in which he described regional variants and refined the typological definitions of important artifacts. Also during this period, D. L. was not shy about bringing Milling Stone into the seminar room, often forcing theoretically-oriented archaeology students of the 1960s, 70s, and 80s to acknowledge their inability to distinguish artifacts from non-artifacts. Not surprisingly, nearly every significant synthetic treatment of Milling Stone in the last two decades was authored by either one of True's students (Basgall and True 1985; Hildebrandt 1983; McGuire and Hildebrandt 1994; Jones 1996) or a student of his students (Fitzgerald in Fitzgerald and Jones 1999; Fitzgerald 2000). As a result of these papers, and several by True's contemporaries (e.g., Wallace 1978; Warren 1967), Milling Stone has emerged as one the best known early complexes in western North America and it has been discussed in reference to a series of different issues raised by a succession of theoretical paradigms. One issue that developed with the emergence of processual archaeology concerns the basic organizational foundation underlying the Milling Stone complex. D. L. True (at least early in his career) and his contemporaries felt that Milling Stone represented an archaeological culture – a patterned imprint in the material record that might reflect a cultural system of beliefs, values and other ideas shared by members of a society or societies. This notion was all but buried by the ecological theories put forth by the new archaeology that grew and flourished concurrently with D. L. True's career. With the paradigm of the New Archaeology in place, Milling Stone became an adaptation- a rational, logical adjustment of technology and subsistence made by terminal Pleistocene/early Holocene peoples to the environment of southern California. As someone who has contributed to the notion of Milling Stone as adaptation (e.g., Jones 1991:435-436,1992, 1996), I'd like revisit this issue and argue, contrary to my earlier writings, there are compelling reasons to consider Milling Stone as an archaeological culture.

An ecological paradigm that has provided critical insights into many archaeological complexes has, in portraying Milling Stone as simply adaptation, overlooked important if not intriguing aspects of this archaeological pattern that might be more accurately recognized as antithetical to simple adaptive adjustment. The distinctiveness of the Milling Stone assemblage has been obscured if not lost by the adaptation paradigm of the New Archaeology. While this position will be developed primarily on theoretical grounds, recent empirical findings that expand the spatial and chronological limits of Milling Stone also speak to the value of conceptualizing Milling Stone as a culture and not merely as an adaptation. Of particular importance are new data from central and northern California that challenge longstanding notions of the distribution and chronology of the Milling Stone pattern (qv. Fitzgerald and Jones 1999).

Milling Stone: A Brief History and Definition

Excellent summaries of research on Milling Stone have been compiled previously by Basgall and True (1985) and Moratto (1984:124-165). Presented here is only the briefest of overviews. Regional variants of Milling Stone were discovered at basically the same time by David Banks Rogers (1929) in Santa Barbara and Malcolm Rogers (1939) in San Diego. In the latter area, Milling Stone (initially described as the Shell Midden Culture) was marked by accumulations of milling slabs, handstones, cobble tools, a few projectile points, perforated stones, and burials interred beneath cairns (Rogers 1939, 1945). Later redefined as the La Jolla Complex, these assemblages were commonly recovered from shell middens found along the shore of sloughs and estuaries that dominate the coastline of San Diego County. In Santa Barbara, D. B. Rogers described Oak Grove as the oldest of three prehistoric cultures marked by profuse deposits of milling slabs and handstones, few projectile points, and extended burials with red ochre (Rogers 1929). Oak Grove sites were found high on ridgetops away from the sea, a pattern which has contributed to a perception of some variation between Oak Grove and La Jolla as La Jollan subsistence was seen as heavily focused on marine invertebrates while Oak Grove site locations ostensibly suggested a terrestrial emphasis in subsistence. La Jolla also featured perforated stones, stone discoidals, and burial beneath cairns, while Oak Grove lacked stone discoidals and showed a different mortuary pattern. A terrestrial emphasis for Oak Grove was later supported by findings from CA-LAN-1, an inland Milling Stone site that produced a profusion of milling slabs, handstones, choppers, core hammers, and other core tools, including the more formalized scraper planes (Treganza 1950; Treganza and Bierman 1958; Treganza and Malamud 1950) but no shell remains. Perhaps nowhere in California was the Milling Stone pattern so well delineated as at CA-LAN-1, where milling and core tools numbered in the thousands — with only a handful of projectile points. A paucity of shell from other important Milling Stone components identified at nearly the same time (e.g., Little Sycamore [CA-VEN-1], Wallace 1954; Wallace et al. 1956) led Wallace to eventually conclude that Milling Stone represented people with very little interest in marine resources (Wallace 1978:28).

In 1958, True defined yet another Milling Stone variant in interior San Diego County, the Pauma Complex, marked by a combination of flaked stone crescents, leaf-shaped projectile points, milling slabs, core scrapers and stone discoidals. True subsequently (1977, 1980) linked Pauma more closely to La Jolla and distinguished it from San Dieguito by de-emphasizing points in the former and assigning crescents to the latter. Synthetic treatments of southern California prehistory have from the onset recognized strong similarities in the various regional Milling Stone complexes which are inevitably highlighted by profuse collections of milling slabs, handstones, core and cobble/core tools.

In the most comprehensive review of Milling Stone to date, Basgall and True (1985) described key southern California components, complexes, and regional variants, and further summarized extant interpretive issues. Not surprisingly, they concluded, as has virtually everyone who has examined the southern California material record in any detail, that a widespread Milling Stone pattern, evident across virtually all of coastal and cismontane southern California (excluding the Channel Islands), most certainly represents a subsistence regime focused on seeds, other vegetable products (e.g., agave and yucca), and shellfish. Their review culminated in an elegant consideration of the two alternative perspectives considered in the current paper. They recognized that these variables are by no means mutually exclusive, and that patterning in ideotechnic aspects of Milling Stone (e.g., preference for cairn burials) must be a product of a shared cultural tradition. They further pointed out that the similarities in tools that define the Milling Stone pattern are utilitarian in nature, and thereby must reflect a shared adaptation more than anything else (Basgall and True 1985:10.26). Few would be foolish enough to challenge such a logical conclusion, but the point I wish to make here is that aspects of this adaptation — gender division of labor, emphasis on gathering over hunting, and intensive processing — represent an unusual if not unique foraging lifeway that may reflect a distinctive cultural historical tradition developed in isolation from other early complexes in North America.

Milling Stone as Culture

Virtually all interpretations of Milling Stone acknowledge strong inter-regional similarities in assemblages. Oak Grove, La Jolla, Little Sycamore, and Topanga were viewed by Wallace (1955) as regional variants of a proposed Milling Stone Horizon in southern California that was thought to post-date an Early Man Horizon — best represented by San Dieguito. Wallace (1955:219-220) described Milling Stone as a culture marked by the extensive use of milling stones and mullers, a general lack of well made projectile points, few bone or shell artifacts, and burial beneath rock cairns. Aside from the milling tools, the rest of the Milling Stone tool inventory was accurately described as "meager and crude" (Wallace 1955:228). Based on the assumption that it existed for a relatively discrete chronological interval, Wallace ultimately classified Milling Stone as a Horizon. Subsequent studies (e.g., Kowta 1969) demonstrated a long lifespan for Milling Stone in localities such as the Transverse Ranges and coastal and inland San Diego County. Warren (1968) applied the term, Encinitas Tradition, to describe related variants of the basic Milling Stone complex in southern California irrespective of ecological setting. Tradition, as opposed to Horizon, reflects a more long-lived pattern. Chartkoff and Chartkoff (1984), while interpreting Milling Stone largely as adaptation, embraced the concept of Encinitas as a southern California expression of their Archaic Period. Inter-regional variability notwithstanding, most serious treatments of Milling Stone acknowledge distinctively patterned assemblages dominated by milling slabs, handstones, and core tools found in abundance in southern California. In recent years, Milling Stone has also been clearly recognized in central and northern California (Fitzgerald 1993; Fitzgerald and Jones 1999; Hildebrandt 1983; McGuire and Hildebrandt 1994; True et al. 1979; True and Baumhoff 1985).

Interpretations of Milling Stone that rely on culture and/or history, of course, accompanied early definitions of the basic pattern. D. B. Rogers (1929) considered Oak Grove to be the first of three different cultures that migrated into and eventually disappeared from the Santa Barbara Channel. Wallace did not speculate on possible relationships between his Early Man Horizon I and Milling Stone Horizon II, but he did argue for a significant gap between Milling Stone and later cultures. He felt that the Horizon II/III transition reflected a cultural replacement (Wallace 1955:228). Warren et al. (1961:28) and later Warren (1964:131) suggested that Milling Stone represented simple gathering people who migrated to the coast from the interior around 7500 years ago. More recently Moratto (1984), following True (1966:294), argued that apparent cultural continuity from La Jolla to ethnohistoric Diegueño, suggests a Hokan-speaking correlation for the Milling Stone culture. Meighan (1989) distinguished Milling Stone as distinct from an early Holocene culture of simple coastal shellfish collectors.

Milling Stone as Adaptation

Nearly all treatments of Milling Stone have also included some consideration of the subsistence regime represented by these unusual assemblages and their likely relation to environmental and/or ecological variables. Such treatments vary in the degree to which they incorporate culture as a co-variable and in diachronic versus synchronic emphases, although most arguments for Milling Stone as adaptation are diachronic and focus on the hypothesized origins of the complex. The first theory of Milling Stone origins that incorporated significant ecological considerations was that of Warren et al. (1961) and Warren (1964:131) who suggested that the La Jolla Complex probably represented an adaptation that developed inland and then spread coastward after ca. 5500 B.C. This westward migration was envisioned as a response to mid-Holocene warming (i.e., the Altithermal) that rendered the interior deserts largely uninhabitable. Once on the coast, Milling Stone people incorporated shellfish into their diets. Kowta (1969) expanded on this model and argued that scraper planes, a common Milling Stone artifact, were used for processing agave, and that an agave-based adaptation moved westward into southern California from the interior when the range of agave expanded during the mid-Holocene warm period. While incorporating ideas of ecology, these models are more historical than ecological in that they pose a basic Milling Stone adaptation that developed elsewhere and then diffused into southern California. Moratto offered a comparable historical ecological model suggesting that climatic warming after 6000 B.C. stimulated movements to the coast by interior desert people who then "...borrowed littoral adaptations from older groups while sharing them with them their millingstone and scraper-plane technology..." (Moratto 1984:151). Wallace (1978:28) also argued in favor of a coastward migration caused by intolerable droughts in the interior during the Altithermal.

Stronger influences from environment and ecology are offered in models that argue for "*in situ*" development of Milling Stone from earlier hunting-based adaptations (e.g., San Dieguito). Theories of this type are hallmarks of the cultural ecological paradigm in that they attribute little if any causality to culture, history, or migration, but rather envision cultural developments as gradual responses to environmental and/or demographic stresses. In many cases, these arguments were posed as direct challenges to extant cultural historical/ migration models which was the case with Milling Stone. Moriarity (1966, 1967) and Kaldenberg (1976) argued that La Jolla represented an "*in situ*" emergence of a gathering complex from San Dieguito hunting. This notion was developed most fully by Chartkoff and Chartkoff (1984:70-109) who envisioned Milling Stone as a local expression of a broader Archaic outgrowth from Paleo-Indian. In the Chartkoffs' construct, Paleo-Indian is the period during which people adhering to the Paleo-Indian Tradition of big game hunting and fluted points initially colonized California. At the Paleo-Indian/Archaic transition (dated conjecturally and unrealistically early at 9000 B.C.) a narrow (or focal), hunting economy gradually gave way to a more broad-spectrum (diffuse) subsistence base. The transition was marked by both continuity — ongoing seasonal mobility, small group size, reliance on stone tools — and change — dwindling exploitation of big game, greater use of plant foods, longer occupation of individual camp sites, participation in trade, and new tool making technologies (Chartkoff and Chartkoff 1984:73). Underlying and partially fueling these changes were climatic warming associated with the end of the Pleistocene and beginning of the Holocene, disappearance of megafauna, and growth of human populations. In short, a new cultural pattern was seen as gradually emerging from the old one in response to environmental flux and population growth. This new adaptive mode was marked by a broader economy, increased social complexity, and exploitation of previously overlooked environmental niches (Chartkoff and Chartkoff 1984:78). Milling Stone was unabashedly portrayed as a New World version of Flannery's (1968) "Broad-Spectrum Revolution" (Chartkoff and Chartkoff 1984:97).

The notion of Milling Stone as a logical outgrowth from earlier Paleoindian has been more fully developed in recent considerations of coastal prehistory spawned by growing recognition of the unique character of marine habitats for hunter-gatherers (Wobst 1974; Yesner 1980; among others). Studies by Erlandson (1991, 1994), Erlandson and Colten (1991), Erlandson et al. (1996), Johnson et al. (2002), and Jones (1991) present growing evidence for human presence along the California coast much earlier than previously thought. The chronological dimension of these models has benefited from radiocarbon dating which was not widely available to the early students of Milling Stone. Radiocarbon has also not been very useful in many inland settings where poor preservation often limits the availability of dating samples. Dates obtained from shells have served to frame early California coastal prehistory in absolute time, albeit with some imprecision related to alternative corrections for the reservoir effect and local upwelling (see Ingram and Southon 1996; Stuiver and Braziunas 1993; Stuiver et al. 1986). Many of the earliest California coastal radiocarbon dates are associated with Milling Stone assemblages (see Erlandson 1994; Erlandson and Moss 1996), which have spawned some new ideas on the origins of the complex. While most models still consider Milling Stone as a derivation from classic Paleoindians who moved westward after colonizing the interior of North America, old shell dates have added an alternative view for Milling Stone origins, envisioning it as an outgrowth from an hypothesized Paleo-Coastal Tradition. The Paleo-Coastal theory, proposed by Davis et al. (1969) and more fully developed by Moratto (1984:162) suggests that California littoral environments may have been initially colonized by people with a hunting/shellfish collecting (non-milling) subsistence base, separate from Paleo-Indian (Erlandson and

Colten 1991:134-135; Moratto 1984:162). This idea is consistent with theories of Meighan (1989) who hypothesized an early coastal adaptation of "simple coastal scrounging" distinct from Milling Stone. Following Moratto (1984) and Davis et al. (1969), Erlandson and Colten (1991:135) stated that a pre-Milling Stone adaptation, marked by shellfish, flaked stone tools and detritus was present on the California coast by 9500 years ago and that Milling Stone groups emerged later ca. 9000 CYBP. The notion of a Paleo-Coastal Tradition has been supported by several sites that produced molluscan remains, flaked stone, and no milling tools from their lowest levels, including CA-SLO-2 (Greenwood 1972), SDM-W-49 (Kaldenberg 1976), and CA-SBA-931 (Glassow 1991:116). No one, however, has discussed Paleo-Coastal without expressing some uncertainty about its chronology and/or relationships to other early complexes — particularly Paleo-Indian (see Moratto 1984:104, Erlandson and Colten 1991:134). Nonetheless, recognition of alternative models for the colonization of California has not altered perception of Milling Stone as logical adaptive outgrowth — either from interior big game hunters or coastal hunters/shellfish gatherers.

Optimization

Recent consideration of Milling Stone as a littoral adaptation has been explored with concepts of optimal foraging. Borrowed from sociobiology (MacArthur and Pianka 1966), optimal foraging has been applied to the California archaeological record by Beaton (1973, 1991), Broughton (1994), Erlandson (1991), Hildebrandt (1984), Hildebrandt and Jones (1992), and Jones (1991, 1992), among others. Applied diachronically, this theory suggests that the initial colonists of western North America or elsewhere (see Beaton 1985) should exploit the optimal set of available resources at either the micro- (diet choice) or macro-level (patch choice). Through time, diet should become sub-optimal as human populations grow, resources are depleted, and lower-ranked foods are added to the diet. Intrinsic in this application is a notion of adaptive and population continuity. This perspective is evident in my own (Jones 1991) application of optimal foraging to the earliest prehistory of coastal California in which I suggested that an optimal diet for coastal California would include large game animals (e.g., extinct megafauna, extant terrestrial species such as tule elk, and some marine animals when congregated on land) and easily gathered foods like shellfish. Milling Stone was seen as marking a shift to sub-optimal diet, as small seeds, processed with slabs and handstones, were added to the optimal mix of large animals and shellfish. An alternative view published the same year by Erlandson (1991:99) suggests that the shellfish/seed diet reflected at early Milling Stone sites in the Santa Barbara Channel was optimal, not sub-optimal. He argued that the carbohydrate value of seeds would compliment the high protein content of shellfish, and together these two foods would have readily satisfied the energy and protein requirements of early California coastal foragers. The absence of large game from the Milling Stone dietary regime was subsequently characterized as optimal by McGuire and Hildebrandt (1994) who suggested that trapping small and medium-sized animals may be more energetically efficient than hunting large ones. Their view is supported by Madsen and Schmitt (1998) who argue that under some conditions, small resources in dense concentrations can be highly ranked food sources. McGuire and Hildebrandt (2002) subsequently argued that extensive hunting of large animals was a later phenomenon in Native California that arose from earlier trapping/gathering economies as part of broader trends toward economic intensification that began ca. mid-Holocene.

Recent studies have sought to refine and/or expand knowledge of Milling Stone lifeways with intensified technological studies (Hale 2001) and other new analytical techniques (e.g., Kennett and Jones 2000; Sutton 1993). Hale's (2001) re-analysis of classic Milling Stone assemblages from the Tank (CA-LAN-1), Sayles (CA-SBR-421), and Glen Annie Canyon (CA-SBA-142) sites, among others, confirms many previous characterizations of Milling Stone with a stronger evidentiary basis. He argues that Milling Stone assemblages demonstrate the same technological underpinning across regions, and that the pattern reflects a non-sedentary, non-specialized foraging strategy that emerged during the early Holocene as an adjustment to the southern California environment. He emphasizes the apparent flexibility of the Milling Stone adaptation as represented by a decidedly informal ground stone assemblage used to exploit locally available resources. Kennett and Jones's isotope studies from the

Cross Creek site also suggest a non-sedentary adaptation, but with more limited mobility than is often attributed to Milling Stone. Sutton (1993) used protein residue studies to argue that animals may have been a larger component of Milling Stone diets than is commonly believed. Tools from CA-SBR-6580 produced residues indicating a broader diet than the site's faunal remains. Residues indicating use of pronghorn, deer, waterfowl, and rabbit were reported (Sutton 1993:138). Persistent questions about the reliability of blood residue studies (see Fiedel 1996) notwithstanding, the grinding of animal flesh seems to add an important and previously overlooked dimension to the Milling Stone adaptation. While it is possible that Milling Stone people indeed exploited more animals than faunal remains and projectile point frequencies suggest, it is important to recognize that this was accomplished with a tool kit dominated by core tools, choppers, milling slabs, and handstones.

Gender

While Milling Stone has long been recognized as a gathering adaptation, it was only in the 1990s when American archaeology embarked on broad considerations of gender in prehistory (Gero and Conkey 1991; Hays-Gilpin and Whitley 1998, among others) that the division of labor implied by the Milling Stone adaptation was explicitly articulated. Erlandson (1991:99), Jones (1992:22), McGuire and Hildebrandt (1994) all acknowledged that the Milling Stone lifeway must have involved more participation by men in gathering than is common among historic foraging societies. While all students of Milling Stone have recognized that the adaptation emphasized gathering (Basgall and True 1985; Wallace 1955; Warren 1964, 1968; Warren et al. 1961) previous estimations of its importance relative to hunting were often hampered by poor faunal preservation. When faunal materials were recovered from a Milling Stone component at CA-ORA-64 in the late 1970s, Koerper (1981) tried to minimize the apparent importance of gathered foods, instead emphasizing faunal evidence for hunting and fishing. He suggested that the importance of these activities to Milling Stone peoples may have been underestimated by earlier researchers. While his study preceded the 1990s focus on gender, his conclusions imply a more standard gender division of labor than that suggested by Erlandson, Jones, or McGuire and Hildebrandt. Erlandson (1991, 1994) based his conclusions on a series of well-sampled Milling Stone components with good faunal preservation that produced little besides shell and milling tools. Jones (1995, 1996) found the same pattern at CA-MNT-1232/H on the Big Sur coast, as did Fitzgerald (1998, 2000) at CA-SLO-1797. These and other sites support the traditional view of Milling Stone as a gathering culture. McGuire and Hildebrandt (1994) pointed out that Milling Stone gathering was accompanied by trapping of small and medium-sized animals. The extreme emphasis on gathered foods represented by Milling Stone, obscured by Koerper (1981), is supported by many sites with reasonable samples and good faunal preservation, indicating that this was an adaptation with an unusual emphasis on gathering in which men must have participated in gathering much more commonly than they do among historic foragers (see Lee and Devore 1968).

Expanded Chronological and Spatial Dimensions

Data from recently discovered Milling Stone components in central and northern California represent challenges to longstanding notions about the chronology and distribution of the complex. These new data push the antiquity of Milling Stone back to the terminal Pleistocene, and broaden the range of environments where the complex has been identified – without demonstrating any significant inter-regional variation in the basic assemblage pattern. While a Milling Stone presence in northern and central California had long been suspected (Curtice 1961; Edwards 1968; Wallace 1978), findings from Lake Berryessa (True et al. 1979) were the first to unequivocally demonstrate presence of the complex north of southern California. This finding was later supported by additional discoveries in central and northern California (Fitzgerald and Jones 1999; Hildebrandt 1983; True and Baumhoff 1985). Of particular importance were Fitzgerald's findings from CA-SCL-65 in the San Francisco Bay area. This site, situated at an elevation of 156 m in rolling hills southwest of the bay (Figure 1), produced a classic Milling Stone assemblage complete with four human interments found beneath cairns of milling tools. Radiocarbon dates from samples of human bone collagen from two of these interments were between 5440 and 4950 cal. B.C. (Fitzgerald 1993; Fitzgerald and Jones

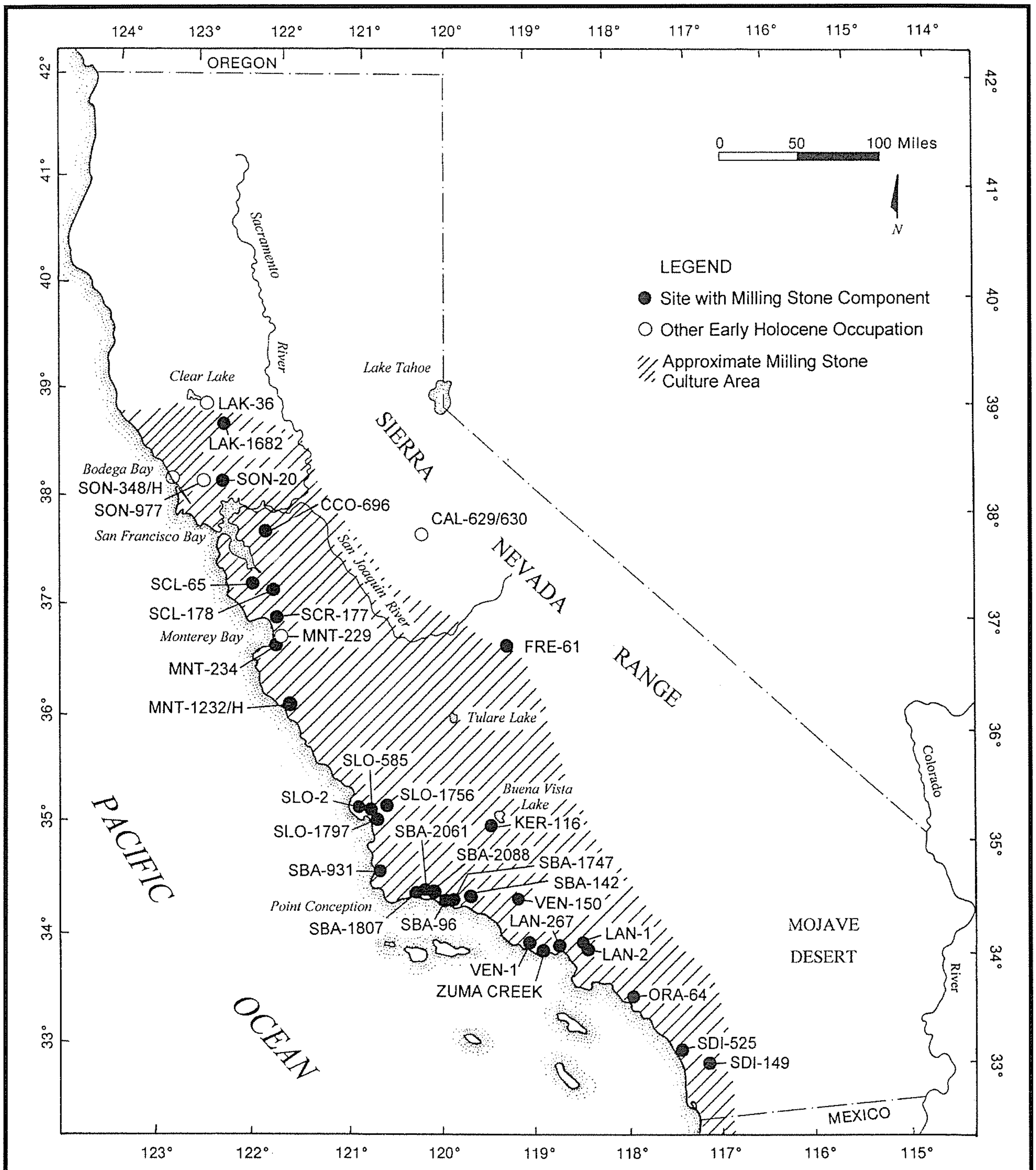

Figure 1. Key Milling Stone Components and the Milling Stone Culture Area.

1999:75). These findings show co-occurrence of both the technological and ideotechnic components of Milling Stone in a setting somewhat different from that of the classic contexts of southern California. Subsequently, Rosenthal et al. (1995) reported yet another unmistakable Milling Stone assemblage from CA-LAK-1682, 20 km southeast of Clear Lake at an elevation of 288 m in the North Coast Range (Figure 1). A feature of burned rock and ground stone artifacts from this deposit produced a radiocarbon date of ca. cal. 6100 B.C. (Rosenthal et al. 1995). This is the northernmost Milling Stone component yet identified, and while authors of the site report argue for affiliation with Fredrickson's (1974) Borax Lake Pattern, the site produced only a single Borax Lake projectile point (one of a total of five points), along with 42 handstones, 35 milling slabs/slab fragments, and 21 core tools — a typical Milling Stone manifestation. Ignoring this assemblage, and relying instead on obsidian hydration results, the authors argue that the site was used repeatedly over thousands of years as a gathering and processing station for Borax Lake and later peoples. Over-reliance on obsidian hydration dating in this instance has obscured a well-dated and discrete component that is remarkable in its similarity to the classic Milling Stone expressions of southern California. A less robust but well-dated Milling Stone component was also reported from a buried paleosol at CA-CCO-696, where Meyer and Rosenthal (1997) recovered a cairn burial dated 5400 cal. B.C. The component also yielded a typical compliment of milling slabs, handstones and cobble-core tools (Meyer and Rosenthal 1997). In conjunction with findings from CA-FRE-61 (McGuire 1993; McGuire and Hildebrandt 1994), these components establish a Milling Stone presence in the San Francisco Bay area, the southern North Coast Ranges, and southern San Joaquin Valley.

The chronological dimension of Milling Stone has been extended by findings from CA-SLO-1797, the Cross Creek site, recently reported by Fitzgerald (1998, 2000) and Jones et al. (2002). This deposit is situated in a peri-coastal valley, 9 km from the present shoreline of San Luis Obispo County in central California (Figure 1). Discovered during trenching for a State water pipeline in the summer of 1996, the site was subjected to salvage excavations the following winter. These revealed a dark gray shell midden, 30-150 cm below the surface, overlain by one, and in some places, two largely sterile strata. Sixteen radiocarbon dates were obtained from the Cross Creek site: eleven from the primary cultural strata (strata 3 and 4), and five from overlying strata and stratigraphic interfaces. Twelve dates from strata 3 and 4 were tightly clustered between 8350 and 7570 cal. B.C. Samples yielding these dates were spread throughout the midden along with handstones, milling slabs, anvils, and core tools. No burials were recovered and, as a consequence, no direct dating associations were recorded. Nonetheless, there is little reason to believe that the suite of dates between ca. 7500 and 8300 cal. B.C. does not relate to the assemblage of milling implements and core tools intermingled among the dating samples. All of the Cross Creek dates were obtained from samples of shell. Dates of nearly identical age were obtained from samples of human bone collagen and shell from the Milling Stone levels at nearby CA-SLO-2 (Fitzgerald and Jones 1999:75; Greenwood 1972). Considering the slender chronological evidence upon which much of early California prehistory has been constructed, the San Luis Obispo findings represent a substantial contribution to Milling Stone chronology — one that suggests strongly that the complex dates back to ca. 10,000 years ago.

Discussion

Based on recent and previous findings, it is not unreasonable to conclude that the Milling Stone complex is no less than 10,000 years old and that it was present throughout western California from the southern North Coast Ranges to what is today the Mexican border (Figure 1). While it persisted to as recently as 1000 years ago in selected portions of southern California (Kowta 1969), it was replaced in most areas by other cultural adaptations 5000-4000 years ago. It is bounded on all sides by complexes that show greater emphasis on hunting reflected by assemblages with significantly higher frequencies of projectile points: the Borax Lake Pattern in northern California, San Dieguito and Lake Mojave complexes in the south, and Paleo-Indian in the San Joaquin Valley. The antiquity of Milling Stone as represented at the Cross Creek site suggests it is the oldest complex on the California mainland. Assemblages associated with older coastal occupations on the Channel Islands dating 11,500-12,000 years ago (e.g., Daisy Cave [Erlandson et al. 1996] and Arlington Springs [Johnson et al. 2000]), are not yet robust enough to allow for general characterization although recent studies have revealed a 9500-year old non-Milling Stone, biface-oriented assemblage at CA-SMI-608 on San Miguel Island (Erlandson et al. 2005) and possible microblades on San Clemente Island (Cassidy et al. 2004) dating ca. 9000-8000 years ago. While the islands may prove to be different, the Paleo-Coastal Tradition on the mainland seems to be marked by Milling Stone assemblages.

That Milling Stone is not better represented in northern California must be a product of poor preservation and site visibility, caused by denser vegetative cover, higher rainfall, greater rates of alluvial deposition, and erosion. Arguments to the contrary (Hildebrandt and Levulett 1997), problems of site visibility in northern California create false impressions of only a very recent prehistory (True et al. 1979). As investigators have slowly overcome this problem in identifying a greater antiquity for littoral adaptations on the southern Northwest coast (Minor 1995, 1997; Moss and Erlandson 1998), so have incrementally more compelling findings of the last decade eliminated lingering doubts about the existence of the Milling Stone complex in central and northern California. It is reasonable to expect more and older evidence for Milling Stone in this region in the future.

This new perception of Milling Stone antiquity undermines previous theories about the organizational basis and origins of the complex. The presence of Milling Stone components 10,000 years ago on the central coast raises serious doubts about a desert origin inasmuch as no Milling Stone site or assemblage of comparable or greater antiquity has been found in the interior. Furthermore, the findings from San Luis Obispo raise questions about relationships between Milling Stone and mid-Holocene warming, as these coastal sites clearly predate even the earliest estimates for the onset of the Altithermal. If people did retreat from the interior during mid-Holocene warming (see Mikkelson et al. 1999), they did not carry a Milling Stone tool kit with them, and certainly would have encountered coastal people with a well-established, gathering economy already in place. It is also important to realize that while Milling Stone was established 10,000 years ago, it persisted in some areas for 9,000 more years.

The expanded spatial distribution of Milling Stone also presents a challenge to adaptive perspectives on the complex, as the latest findings clearly show that the pattern was not restricted to southern California, and has in fact been identified in a bewildering range of settings including the shorelines of lagoons in San Diego County, the exposed coast of south central California, the San Joaquin Valley, and the South and North Coast Ranges. While the complex is largely absent from the higher elevations, it seems to be associated with prairie/grasslands, coastal sage, and certain chaparral associations, but it is difficult to draw further environmental generalizations for the whole of the Milling Stone culture area as it is presently defined (Figure 1). Milling Stone may be partially explicable as an adaptation to California grasslands and chaparral that represent the basic Mediterranean complex that expanded in California with the close of the Pleistocene. Still, the latitudinal gulf that separates the San Diego coast from Clear Lake would always be associated with a significant amount of environmental variation.

Indeed, what establishes Milling Stone as an unmistakable archaeological pattern is its technology — the over-representation of milling slabs, handstones, and crude core tools that generations of archaeologists have recognized as distinctive. Co-occurring with this assemblage is an equally unique mortuary practice of burial beneath rock cairns, often constructed of milling tools. That these tools represent a lifeway dependent more on gathering than hunting is almost universally accepted, but what is sometimes overlooked is the fact that these implements directly represent processing, not gathering. While slabs and handstones may have also been used to grind small animals, they certainly must have been used primarily to process seeds. Furthermore, if Kowta's (1969) theories (supported experimentally by Salls 1983) are correct, many of the core tools in Milling Stone assemblages were used to process agave and yucca. Others (e.g., core hammers) were probably used to manufacture or sharpen milling tools (King 1967). While slabs and handstones may not reflect the highly intensified processing commonly associated with the mortar and pestle (Basgall 1987; Jones 1996), Milling Stone inventories nonetheless represent a subsistence regime focused on labor-intensive processing of plant foods and small animals, with little if any pursuit of large or medium-sized game. Arguments to the contrary (e.g., Erlandson 1991; McGuire and Hildebrandt 1994), this labor-intensive lifeway should be recognized as suboptimal, since experimental processing has shown that small seeds are not efficient sources of calories (Simms 1985:121).

If Milling Stone marks adaptation only, this suboptimal dietary focus should reflect a logical progression from earlier less labor-intensive subsistence regimes (i.e., the dietary broadening described by Chartkoff and Chartkoff 1984 and predicted by optimal foraging theory). An optimal diet in the Milling Stone culture area (Figure 1) should include large and medium-sized game animals like deer and/or tule elk. If Milling Stone was historically derived from Paleo-Indian or Paleo-Coastal hunters this expectation should certainly be met. While Milling Stone shows some correlation with prairie and chaparral ecosystems, these habitats were probably not devoid of large and medium-sized game animals. An adaptive adjustment by hunting populations should be reflected by continuation of hunting with the addition of more gathered resources and processing. In 1991, I tried to portray Milling Stone as a match for such expectations, concurring with the Chartkoffs' portrait of Milling Stone as logical adaptive outgrowth. In truth, the empirical record from sites such as Cross Creek (CA-SLO-1797; Fitzgerald 2000; Jones et al. 2002) and CA-SBA-1807 (Erlandson 1994) suggests that Milling Stone was a gathering/processing (and possibly trapping) adaptation in which men pursued gathering with unusual regularity, and large-medium sized game animals were insignificant (McGuire and Hildebrandt 1994, 2002). This lifeway is not a logical adaptive outgrowth from Paleoindian hunting or hypothesized Paleo-Coastal hunting/shellfish gathering. With respect to the economic logic of food acquisition, Milling Stone is not rationally derived from big game hunting, and is inadequately characterized as a simple adaptive adjustment to the environmental parameters of central and southern California. The apparent processing specialization marked by Milling Stone might be reasonably deduced from a broad-spectrum coastal hunting/shellfish gathering adaptation, but the apparent lack of larger animals in the subsistence regime is contrary to the expectations of simple diet broadening. Milling Stone seems to reflect culturally-based selection of certain foods and resource patches over others *contra* optimal dietary considerations. Optimal foraging theory in this instance provides a frame of reference that exposes irrational cultural behavior.

One additional phenomenon that may have influenced the emergence of Milling Stone is the Younger-Dryas event. Growing evidence suggests extremely dry conditions in parts of the New World during the Younger Dryas ca. 10,750 radiocarbon years ago. Haynes (1991, 1993:233) reported evidence for a spike extremely dry conditions in North America and Europe at the terminal Pleistocene. The oldest Milling Stone manifestation at Cross Creek still post-dates this event by more than a millennium, but the exigencies of an interval of extreme aridity could help explain the marked variation between Milling Stone and earlier interior hunting adaptations. Such an event, however, would not explain the persistence of this adaptation for thousands of years after the close of the Pleistocene.

While Milling Stone must be recognized as both adaptation and culture (as others [e.g., Basgall and True 1985; Warren 1964] have so elegantly argued in the past), the latter may be more important than is generally presumed. Milling Stone represents a distinctive cultural historical tradition marked by a heavy reliance on processing of small, sub-optimal resources, unusual gender division of labor, and a consistent mortuary pattern. Furthermore, the core-tool dominated flaked stone assemblage contrasts markedly with the sophisticated fluted projectile points and biface industries of classic Paleoindian. In technology and subsistence, the Milling Stone tradition shows no similarity to Paleoindian and cannot be easily portrayed as an adaptive outgrowth from it. These distinctive features suggest a tradition that developed in isolation from Paleoindian and which may reflect a separate migration route into the New World (Jones et al. 2002). The distribution of the earliest Milling Stone manifestations (Figure 1) suggests this may have been a coastal migration corridor. Supporting this possibility are similarities between Milling Stone and the Pebble Tool Tradition of the Northwest Coast, which, dating to 10,000 years ago, is marked by heavy reliance on crude core and cobble-core tools (Carlson 1990, 1996). Milling Stone seems to represent, above all else, a processing specialization more logically derived from a broad-spectrum adaptation than from specialized Paleoindian hunting. A logical precursor to Milling Stone would be a more broad-spectrum adaptation with less exaggerated emphasis on processing. Such a precursor may have some connection to the broad-spectrum economies that are increasingly evident at considerable time depths in South America (Dillehay 1997, 2000; Dixon 2001; Keefer et al. 1998; Meltzer et al. 1997; Roosevelt 2000; Roosevelt et al. 1996; Sandweiss et al. 1998). It should further be kept in mind that D. L. True occasionally alluded to such a possibility when discussing his research in Chile where he noted the presence of crude cobble core tools similar to those of the California Milling Stone.

References

Basgall, M. E.

1987 Resource Intensification among Hunter-Gatherers: Acorn Economies in Prehistoric California. *Research in Economic Anthropology* 9: 21-52.

Basgall, M. E., and D. L. True
1985 *Archaeological Investigations in Crowder Canyon, 1973-1984: Excavations at sites SBR-421B, SBR-421C, SBR-421D, and SBR-713, San Bernardino County California.* Report on file, California Department of Transportation, District 8, San Bernardino, California.

Beaton, J.
1973 *The Nature of Aboriginal Exploitation of Mollusc Populations in Southern California.* Unpublished Master's thesis, Department of Anthropology, University of California, Los Angeles.

1985 Evidence for Coastal Occupation Time-Lag at Princess Charlotte Bay (North Queensland) and Implications for Coastal Colonization and Population Growth Theories for Aboriginal Australia. *Archaeology in Oceania* 20:1-20.

1991 Extensification and Intensification in Central California Prehistory. *Antiquity* 65(249):946-952.

Broughton, J. M.
1994 Declines in Mammalian Foraging Efficiency during the Late Holocene, San Francisco Bay, California. *Journal of Anthropological Archaeology* 13:371-401.

Carlson, R.
1990 Cultural Antecedents. In *Northwest Coast,* edited by W. Suttles, pp. 60-69. Handbook of North American Indians, vol. 7, W. C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

1996 Introduction to Early Human Occupation in British Columbia. In *Early Human Occupation in British Columbia*, edited by R. Carlson and L. Dalla Bona, pp. 1-10. University of British Columbia Press, Vancouver.

Cassidy, J., L. M. Raab, and N. Kononenko
2004 Boats, Bones, and Biface Bias: The Early Holocene Mariners of Eel Point, San Clemente Island, California. *American Antiquity* 69(1):109-130.

Chartkoff, J. L., and K. K. Chartkoff
1984 *The Archaeology of California.* Stanford University Press, Palo Alto.

Curtice, C. G.
1961 *Cultural and Physical Evidence of Prehistoric Peoples of Sacramento County.* Unpublished Master's thesis, Department of Anthropology, California State University, Sacramento.

Davis, E. L., C. W. Brott, and D. L. Weide
1969 *The Western Lithic Co-Tradition.* San Diego Museum Papers 6.

Dillehay, T. D.
1997 *Monte Verde, A Late Pleistocene Settlement in Chile, Volume 2, The Archaeological Context and Interpretation.* Smithsonian Institution Press, Washington, D. C.

2000 *The Settlement of the Americas: A New Prehistory.* Basic Books, New York.

Dixon, E. J.
2001 Human Colonization of the Americas: Timing, Technology and Process. *Quaternary Science Reviews* 20(1):277-299.

Edwards, R. L.
1968 *A Descriptive Report on the Salvage Archaeology of Three Sites on Thomes Creek, Tehama County.* Manuscript on file, Department of Anthropology, University of California, Davis.

Erlandson, J. M.
1991 Shellfish and Seeds as Optimal Resources: Early Holocene Subsistence on the Santa Barbara Coast. In *Hunter-Gatherers of Early Holocene Coastal California*, edited by J. M. Erlandson and R. H. Colten pp. 89-100. University of California, Los Angeles Institute of Archaeology, Perspectives in California Archaeology Vol. 1.

1994 *Early Holocene Hunter-Gatherers of the California Coast.* Plenum Press, New York.

Erlandson, J. M., T. J. Braje, T. C. Rick, and J. Peterson
2005 Beads, Bifaces, and Boats: An Early Maritime Adaptation on the South Coast of San Miguel Island, California. *American Anthropologist* 107(4): 677-683.

Erlandson, J. M., and R. Colten
1991 Perspectives on Early Hunter-Gatherers of the California Coast. In *Hunter-Gatherers of Early Holocene Coastal California*, edited by J. M. Erlandson and R. H. Colten, pp. 133-139. University of California, Los Angeles Institute of Archaeology, Perspectives in California Archaeology Vol. 1.

Erlandson J. M., D. J. Kennett, B. L. Ingram, D. A. Guthrie, D. P. Morris, M. A. Tveskov, G. J. West, and P. L. Walker
1996 An Archaeological and Paleontological Chronology for Daisy Cave (CA-SMI-261), San Miguel Island, California. *Radiocarbon* 38(2):361-373.

Erlandson, J. M., and M. L. Moss
1996 The Pleistocene-Holocene Transition along the Pacific Coast of North America. In *Humans at the End of the Ice Age*, edited by L. G. Strauss, B. V. Eriksen, J. M. Erlandson, and D. R. Yesner, pp. 277-302. Plenum Press, New York.

Fiedel, S.
1996 Blood from Stones? Some Methodological and Interpretive Problems in Blood Residue Analysis. *Journal of Archaeological Science* 23(1):139-147.

Fitzgerald, R. T.
1993 Archaic Milling Cultures of the Southern San Francisco Bay Region. *Coyote Press Archives of California Prehistory* No. 35. Salinas, California.

1998 *Archaeological Data Recovery at CA-SLO-1797, the Cross Creek Site, San Luis Obispo County, California, Coastal Branch Phase II Project.* Report on file, California Department of Water Resources, Sacramento.

2000 *Cross Creek: An Early Holocene Millingstone Site.* The California State Water Project, Coastal Branch Series Paper No. 12. San Luis Obispo County Archaeological Society, San Luis Obispo, California.

Fitzgerald, R. T., and T. L. Jones
1999 The Milling Stone Horizon Revisited: New Perspectives from Northern and Central California. *Journal of California and Great Basin Anthropology* 21(1):65-93.

Flannery, K. V.
1968 Archaeological Systems Theory and Early Mesoamerica. In *Anthropological Archaeology in the Americas*, edited by B. J. Meggers, pp. 67-87. Anthropological Society of Washington, Washington D.C.

Fredrickson, D. A.
1974 Cultural Diversity in Early Central California: A View from the North Coast Ranges. *Journal of California Anthropology* 1(1):41-54.

Gero, J. M., and M. W. Conkey (editors)
1991 *Engendering Archaeology: Women and Prehistory.* Blackwell, Cambridge.

Glassow, M. A.
1991 Early Holocene Adaptations on the Northern Channel Islands. In *Hunter-Gatherers of Early Holocene Coastal California*, edited by J. M. Erlandson and R. H. Colten, pp. 113-124. University of California, Los Angeles Institute of Archaeology, Perspectives in California Archaeology Vol. 1.

Greenwood, R. S.
1972 *9000 Years of Prehistory at Diablo Canyon, San Luis Obispo County, California.* Occasional Paper No. 7, San Luis Obispo County Archaeological Society, San Luis Obispo, California.

Hale, M. J.
2001 *Technological Organization of the Millingstone Pattern in Southern California.* Unpublished Master's thesis, Department of Anthropology, California State University, Sacramento.

Haynes, C. V., Jr.
1991 Geoarchaeological and Paleohydrological Evidence for a Clovis-Age Drought in North America and its Bearing on Extinction. *Quaternary Research* 35:438-450.

1993 Clovis-Folsom Geochronology and Climatic Change. In *From Kostenski to Clovis*, edited by O. Soffer and N. D. Praslov, pp. 219-236. Plenum Press, New York.

Hays-Gilpin, K., and D. S. Whitley (editors)
1998 *Reader in Gender Archaeology.* Routledge, New York.

Hildebrandt, W. R.
1983 *Archaeological Research of the Southern Santa Clara Valley Project.* Report on file, California Department of Transportation, Sacramento.

1984 Late Period Hunting Adaptations on the North Coast of California. *Journal of California and Great Basin Anthropology* 6(2):189-206.

Hildebrandt, W. R., and T. L. Jones
1992 Evolution of Marine Mammal Hunting: A View from the California and Oregon Coasts. *Journal of Anthropological Archaeology* 11(4): 360-401.

Hildebrandt, W. R., and V. A. Levulett
1997 Middle Holocene Adaptations on the Northern California Coast: Terrestrial Resource Productivity and its Influence on the Use of Marine Foods. In *Archaeology of the California Coast during the Middle Holocene*, edited by J. M. Erlandson and M. A. Glassow, pp.143-150. University of California, Los Angeles Institute of Archaeology, Perspectives in California Archaeology Vol. 4.

Ingram, B. L., and J. R. Southon
1996 Reservoir Ages in Eastern Pacific Coastal and Estuarine Waters. *Radiocarbon* 38(3):573-582.

Johnson, J., T. W. Stafford, Jr., H. O. Ajie, and D. P. Morris
2002 Arlington Springs Revisited. In *Proceedings of the Fifth California Islands Symposium*, edited by D. R. Brown, K. C. Mitchell, and H. W. Chaney, pp. 541-545. Santa Barbara Museum of Natural History, Santa Barbara.

Jones, T. L.
1991 Marine Resource Value and the Priority of Coastal Settlement: A California Perspective. *American Antiquity* 56(3):419-443.

1992 Settlement Trends along the California Coast. In *Essays on the Prehistory of Maritime California,* edited by T. L. Jones, pp. 1-37. Center for Archaeological Research at Davis, Publication 10. University of California, Davis.

1995 *Transitions in Prehistoric Diet, Mobility, Exchange, and Social Organization along California's Big Sur Coast.* Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Davis.

1996 Mortars, Pestles, and Division of Labor in Prehistoric California: A View From Big Sur. *American Antiquity* 61(2):243-264.

Jones, T. L., R. T. Fitzgerald, D. J. Kennett, C. H. Miksicek, J. L. Fagan, J. Sharp, and J. M. Erlandson
2002 The Cross Creek Site (CA-SLO-1797) and its Implications for New World Colonization. *American Antiquity* 67(2):213-230.

Kaldenberg, R.
1976 *Paleo-technological Change at Rancho Park North, San Diego County, California.* Unpublished Master's thesis, Department of Anthropology, San Diego State University.

Keefer, D. K., S. D. deFrance, M. E. Moseley, J. B. Richardson III, D. R. Satterlee, and A. Day-Lewis
1998 Early Maritime Economy and El Niño: Events at Quebrada Tacahuay, Peru. *Science* 281(5384):1833-1835.

Kennett, D. J., and T. L. Jones
2000 Appendix C: Oxygen Isotope Analysis of *Saxidomus nuttallii* Shells from CA-SLO-1797. In *Cross Creek: An Early Holocene Millingstone Site,* edited by R. T. Fitzgerald, pp. 167-174. The California State Water Project, Coastal Branch Series Paper No. 12. San Luis Obispo County Archaeological Society, San Luis Obispo, California.

King, C. D.
1967 The Sweetwater Mesa Site (Lan-267) and its Place in Southern California Prehistory. *University of California Archaeological Survey Annual Reports. 1966-1967*:25-76.

Koerper, H. C.
1981 *Prehistoric Subsistence and Settlement in the Newport Bay Area and Environs, Orange County, California.* Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Riverside.

Kowta, M.
1969 *The Sayles Complex: A Late Milling Stone Assemblage from Cajon Pass and the Ecological Implications of its Scraper Planes.* University of California Publications in Anthropology No. 6. Berkeley.

Lee, R. B., and I. Devore (editors)
1966 *Man the Hunter.* Aldine, Chicago.

MacArthur, R. H., and E. R. Pianka
1966 On Optimal Use of a Patchy Environment. *American Naturalist* 100(916):603-609.

Madsen, D.B., and D. N. Schmitt
1998 Mass Collecting and the Diet Breadth Model: A Great Basin Example. *Journal of Archaeological Science* 25(5):445-455.

McGuire, K. R.
1993 *Test Excavations at CA-FRE-61, Fresno County, California.* California State University, Bakersfield Museum of Anthropology, Occasional Papers in Anthropology 5.

McGuire, K. R., and W. R. Hildebrandt
1994 The Possibilities of Women and Men: Gender and the California Milling Stone Horizon. *Journal of California and Great Basin Anthropology* 16(1):41-59.

2002 The Ascendance of Hunting during the California Middle Archaic: An Evolutionary Perspective. *American Antiquity* 67(2):231-256.

Meighan, C.
1989 Early Shell Mound Dwellers of the Pacific Coast of North America. Paper presented at the Conference for Circum-Pacific Prehistory, Seattle.

Meltzer, D. J., D. K. Grayson, G. Ardila, A. W. Barker, D. F. Dincauze, C. V. Haynes, F. Mena, L. Nunez, and D. J. Stanford
1997 On the Pleistocene Antiquity of Monte Verde, Southern Chile. *American Antiquity* 62(4):659-663.

Meyer, J., and J. S. Rosenthal
1997 *Archaeological and Geoarchaeological Investigations at Eight Prehistoric Sites in the Los Vaqueros Reservoir Area, Contra Costa County, California.* Report on file, Northwest Information Center of the Historic Resources Information System, Sonoma State University, Rohnert Park.

Mikkelson, P., W. R. Hildebrandt, and D. A. Jones
1999 *Prehistoric Adaptations on the Shores of Morro Bay Estuary.* San Luis Obispo County Archaeological Society Occasional Paper 14. San Luis Obispo.

Minor, R.
1995 A Reassessment of Early "Pre-Littoral" Radiocarbon Dates from the Southern Northwest Coast. *Journal of California and Great Basin Anthropology* 17(2):267-273.

1997 Pre-Littoral or Early Archaic? Conceptualizing Early Adaptations on the Southern Northwest Coast. *Journal of California and Great Basin Anthropology* 19(2):269-280.

Moratto, M. J.
1984 *California Archaeology.* Academic Press, San Francisco.

Moriarity, J. R. III
1966 Cultural Phase Divisions Suggested by Typological Change Coordinated with Stratigraphically Controlled Radiocarbon Dating in San Diego. *The Anthropological Journal of Canada* 4:20-30.

1967 Transitional Pre-Desert Phase in San Diego County, California. *Science* 155(3762):553-556.

Moss, M., and J. M. Erlandson
1998 Early Holocene Adaptations on the Southern Northwest Coast. *Journal of California and Great Basin Anthropology* 20(1):13-25.

Rogers, D. B.
1929 *Prehistoric Man of the Santa Barbara Coast.* Santa Barbara Museum of Natural History, Santa Barbara.

Rogers, M. J.
1939 Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. *San Diego Museum of Man Papers* 3.

1945 An Outline of Yuman Prehistory. *Southwestern Journal of Anthropology* 1(2):167-198.

Roosevelt, A. C.
2000 Who's on First? *Natural History* July/August:76-79

Roosevelt A. C., M. Lima da Costa, C. Lopes Machado, M. Michab, N. Mercier, H. Vallada, J. Feathers, W. Barnet, M. Imazio da Silveira, A. Henderson, J. Sliva, B. Chernoff, D. S. Reese, J. A. Holman, N. Toth, and K. Schick
1995 Paleoindian Cave Dwellers in the Amazon: The Peopling of the Americas. *Science* 272(5260):373-384.

Rosenthal, J. S., J. Meyer, and G. White
1995 *Archaeological Investigations at the Crazy Creek Site, CA-LAK-1682 and CA-LAK-1683, Lake County, California.* Report on file, Northwest Information Center of the Historic Resources Information System, Sonoma State University, Rohnert Park.

Salls, R.
1983 The Scraper Plane: A Functional Interpretation. *Journal of Field Archaeology* 12(1):99-106.

Sandweiss D. H., H. McInnis, R. L. Burger, A. Cano, B. Ojeda, R. Paredes, M. del Carmen Sandweiss, and M. D. Glascock
1998 Quebrada Jaguay: Early South American Maritime Adaptations. *Science* 281(5384):1830-1832.

Simms, S.
1985 Acquisition Costs and Nutritional Data on Great Basin Resources. *Journal of California and Great Basin Anthropology* 7(1):117-125.

Stuiver, M., and T. F. Braziunas
1993 Modeling Atmospheric ^{14}C Influences and ^{14}C Ages of Marine Samples to 10,000 BC. *Radiocarbon* 35:137-189.

Stuiver, M., G. W. Pearson, and T. F. Braziunas
1986 Radiocarbon Age Calibrations of Marine Samples back to 9000 CAL YR BP. *Radiocarbon* 28:980-1021.

Sutton, M. Q.
1993 On the Subsistence Ecology of the "Late Inland Millingstone Horizon" in Southern California. *Journal of California and Great Basin Anthropology* 15(1):134-140.

Treganza, A. E.
1950 *The Topanga Culture and Southern California Prehistory.* Ph.D. dissertation, University of California, Berkeley. University Microfilms, Ann Arbor.

Treganza, A. E., and A. Bierman
1958 The Topanga Culture, Final Report on Excavations, 1948. *University of California Anthropological Records* 20(2).

Treganza, A. E., and C. G. Malamud
1950 The Topanga Culture, First Season's Excavation of the Tank Site, 1948. *University of California Anthropological Records* 12:129-170.

True, D. L.
1958 An Early Gathering Complex in San Diego County, California. *American Antiquity* 23(3):2455-263.

1966 *Archaeological Differentiation of Shoshonean and Yuman Speaking Groups in Southern California.* Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

1977 *Archaeological Investigations in San Diego County, California: Preliminary Report on sites SDI-4558, -4562, and -4562A.* Report on file, California Department of Transportation, San Diego.

1980 The Pauma Complex in Northern San Diego County: 1978. *Journal of New World Archaeology* III(iv):1-39.

True, D. L., and M. A. Baumhoff
1982 *Archaeological Investigations at Lake Berryessa, California.* Report on file, U. S. Bureau of Reclamation, Sacramento.

1985 Archaeological Investigations at Lake Berryessa, California: Berryessa II. *Journal of California and Great Basin Anthropology* 7(1):21-45.

True, D. L., M. A. Baumhoff, and J. E. Hellen
1979 Milling Stone Cultures in Northern California: Berryessa I. *Journal of California and Great Basin Anthropology* 1(1):124-154.

True, D. L., and E. Beemer
1982 Two Millingstone Inventories from Northern San Diego County, California. *Journal of California and Great Basin Anthropology* 4(2):233-261.

Wallace, W. J.
1954 The Little Sycamore Site and Early Milling Stone Cultures in Southern California. *American Antiquity* 20(2): 112-123.

1955 A Suggested Chronology for Southern California Coastal Archaeology. *Southwestern Journal of Anthropology* 11(3):214-230.

1978 Post-Pleistocene Archaeology, 9,000-2,000 B.C. In *California,* edited by R. F. Heizer, pp. 25-36. Handbook of North American Indians, vol. 8, W. C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Wallace, W. J., E. S. Taylor, R. J. Desautels, H. R. Hammond, H. Gonzales, J. Bogart, and J. P. Redwine
1956 *The Little Sycamore Shellmound, Ventura County.* Contributions to California Archaeology 2. Archaeological Research Associates, Los Angeles.

Warren, C. N.
1964 *Cultural Change and Continuity on the San Diego Coast.* Unpublished Ph.D. dissertation. Department of Anthropology, University of California, Los Angeles.

1967 The Southern California Milling Stone Horizon: Some Comments. *American Antiquity* 32(2):233-236.

1968 Cultural Tradition and Ecological Adaptation on the Southern California Coast. In Archaic Prehistory in the Western United States. *Eastern New Mexico University Contributions in Anthropology* 1(3):1-14.

Warren, C. N., D. L. True, and A. A. Eudey
1961 Early Gathering Complexes of Western San Diego County, California. *University of California, Los Angeles, Archaeological Survey Annual Report 1960-1961*:1-106.

Wobst, M. H.
1974 Boundary Conditions for Paleolithic Social Systems: A Simulation Approach. *American Antiquity* 39(2): 147-178.

Yesner, D. R.
1980 Maritime Hunter-Gatherers: Ecology and Prehistory. *Current Anthropology* 21(6):727-750.