THE MEDIEVAL CLIMATIC ANOMALY IN CENTRAL SIERRAN FOOTHILL PREHISTORY

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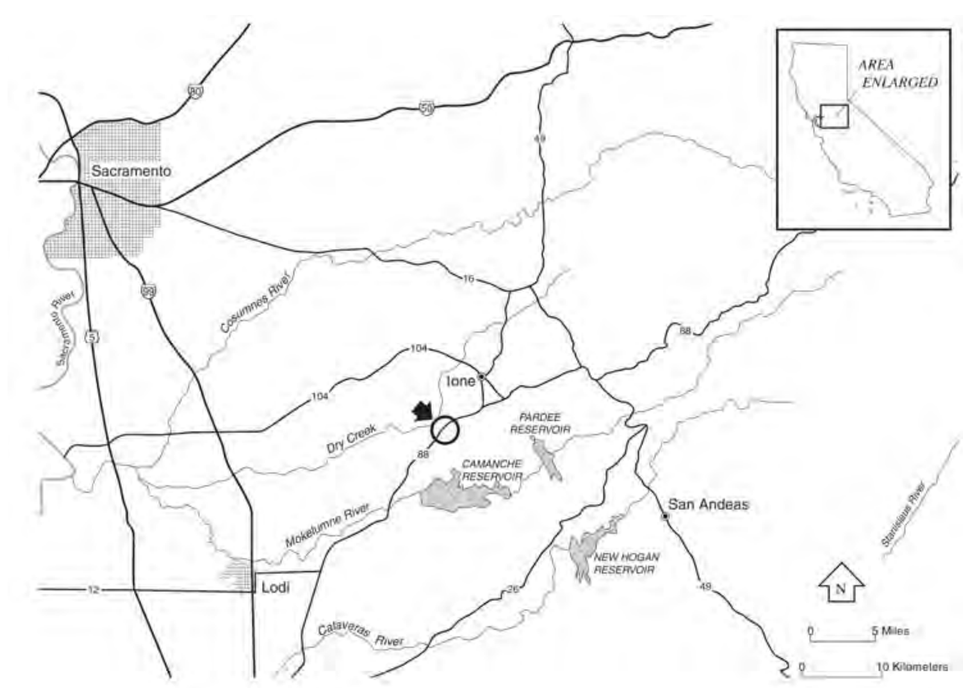
Excavations in 2000 for Caltrans bridge replacements at CA-AMA-56, the Applegate site, provided an opportunity to examine the role of the Medieval Climatic Anomaly (MCA) in the central Sierran foothills. A review of regional settlement data appears to show a widespread decline in occupation of the lower foothills during Late Period, Phase 1, which includes the duration of the MCA. Settlement shifts due to the drought may be corroborated by patterns in small samples of fine-grained faunal and floral remains collected from three radiocarbon-dated occupation surfaces at AMA-56, which span a 700-year period antedating and coeval with the MCA.

I will begin this paper by briefly summarizing the paleoclimatic interval known as the Medieval Climatic Anomaly (MCA), a period of prolonged drought spanning the 10th to the 14th centuries A.D. Space limitations preclude a detailed review of the MCA. The most compelling evidence summarized by Stine (1998) is the 70 radiocarbon dates on the outer rings of relict stumps in now-flooded Sierran lakes and rivers. These data indicate two "century-plus intervals..." during which "the amount and distribution of water on the land was reduced dramatically" (Stine 2000:627). Precise dating of these droughts is limited by the resolution of radiocarbon dates, but two periods of prolonged droughts appear to have occurred, between about 1050-850 and 775-600 B.P. The second, more recent drought appears to have been significantly hotter and drier than the earlier one. The prolonged span of each of the periods of drought had the cumulative effects of reducing available surface water far beyond the effects of one or a few extremely dry years due to "limits on annual rates of evapotranspiration and groundwater drawdown" (Stine 2000:628). This cumulative effect of prolonged droughts produces a far more pronounced impact on the landscape, and presumably human groups, than short-term ones (contra Bettinger 1999:158).

The timing of the MCA has provoked investigation into its effects on California prehistory. Of particular note are works by Terry Jones and his colleagues (1995; Jones et al. 1999), who have examined the effects of droughts for the Big Sur coast, the southern California coast, and the Mojave desert. They ascribe profound effects of the drought on prehistoric native Californians due to reduced food and water resources, which ultimately precipitated significant demographic stress. They point to shifts in settlement pattern, gaps in radiocarbon and obsidian hydration profiles, shifts in faunal assemblages, changes in the character of exchange, and skeletal evidence of declining health and increased violence during this period.

Figure 1: CA-AMA-56 vicinity.



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Critiques of this proposal by Robert Bettinger and Mark Basgall note that factors limiting populations were not elucidated. The relationship of population and food supply is not necessarily direct; in some cases, drought may actually provide new subsistence opportunities (Pate 1986). Jones et al. do not identify specific key components of the resource base that would be affected by drought, a necessary precondition to understanding the nature of the challenges facing prehistoric social groups in particular areas. Parenthetically, I think this gap is excusable given the broad geographic area considered in this article, as limiting factors must have differed for coastal and desert areas considered.

It is interesting that Jones et al. refer only in passing to the Sierran foothill sequence, as Moratto (et al. 1978; 1984; et al. 1988) has long argued that drought dramatically affected the use of the lower elevations, and these data broadly support Jones= thesis. Moratto noted substantial occupations during the Middle Period and Late Period, Phase 2 (Phase 2), but only a minimal representation of Late Period, Phase 1 (Phase 1). The MCA (ca. 1050-600 B.P.) spans most of Phase 1, comprising 450 years of the 600 year span (ca. 1050-450 B.P.) posited by Bennyhoff and Hughes (1987). While recent AMS dates on *Olivella* shell beads suggest that Phase 1 began later (ca. 850-450 B.P.; personal communication, Randall Milliken), the MCA still prevailed for 250 years of the 400-year span of Phase 1.

Data from New Melones Reservoir on the Stanislaus River show that Phase 1 materials are present at many sites. But Phase 1 components differ from Middle and Phase 2 components in that occupation was sufficiently robust to produce midden deposits at only three sites, in contrast to 12 Middle Period middens and 42 Phase 2 middens. The contrasts are even more dramatic from Buchanan Reservoir on the Chowchilla River. Few sites are found dating to either the Middle Period or Phase 1, and sites of both periods are limited to prime locations along the river. Middle Period deposits are large and deep, while Phase 1 components are represented by a thin overlay of materials. Grave offerings with Middle and Phase 2 burials are abundant, while Phase 1 burials have few, and skeletal remains show much evidence of violent death during Phase 1.

I recently reviewed similar data from the lower foothill reaches of the Mokelumne River and its tributaries, using information from Jerry Johnson's investigations at Camanche Reservoir and AMA-56 in the 1960s (Johnson 1967; 1970), supplemented by small samples recovered from year-2000 excavations at AMA-56 sponsored by Caltrans (Figure 1; see Wohlgemuth and Meyer 2002). As with Moratto's data from New Melones and Buchanan Reservoirs, a dearth of Phase 1 materials is apparent. The small sample of burials which can be ascribed to temporal periods I've limited to those with associated diagnostic artifacts. Of the 22 burials, none date to Phase 1. Of the ten robust component areas in the sample, none date to Phase 1. The frequency of temporally diagnostics artifacts is even more compelling. Of the 2,315 diagnostic beads, only four (0.2%) have been recovered dating to Phase 1. Similarly, of the 212 diagnostic projectile points, only nine (4.2%) are Gunther, Stockton Serrate, or Rosegate forms which date to Phase 1. These data are limited by small samples, and biased by large-scale excavations at two mostly older-component sites (AMA-56 and CAL-237), but it is still hard to escape the conclusion that Phase 1 is nearly invisible in the record of the lower Mokelumne drainage foothills, similar to findings from the Stanislaus and Chowchilla drainages.

In contrast to the dearth of Phase 1 occupations in the lower foothills of the Mokelumne, Stanislaus, and Chowchilla rivers, Schulz (1981) provides evidence of robust occupation in the Sacramento-San Joaquin Delta during this period. A sample of 169 site components shows that Phase 1 components, standardized per century of temporal phase, are more common than Middle Period components but less so than Phase 2. A sample of 903 burials (nearly all dated by association rather than direct radiocarbon assay) shows that burials dated to Phase 1 are nearly as common as those dated to Phase 2, and are more numerous than during Middle Period times. Of particular note is the sample of 82 radiocarbon dates, which peak in frequency during the 800-year span from 1400-600 B.P., largely corresponding to the MCA. While the Sierran foothills were very lightly inhabited or even abandoned during Phase 1, the Delta certainly was not, and may even have been subjected to a population influx at this time. It is tempting to attribute such an influx to the well-watered Delta by people from surrounding, formerly-productive but recently-desiccated foothill landscapes. One additional important point in this vein is the strong Phase 1 presence at sites at 3,000-4,000 feet in elevation in the Mokelumne drainage (Cleland 1987), which could reflect greater use of more well-watered, higher elevations during the MCA (Moratto et al. 1988).

The final topic I want to address are patterns in faunal and floral remains recovered from three dated features (overlapping ash lenses interpreted as house floors) during 2000 excavations at AMA-56 in 2000. As shown in Figure 2, Feature C antedates the MCA, Feature B very likely was occupied during the first drought of the MCA, and Feature A was almost certainly used during the hotter, second drought of the MCA.

This is a rare opportunity to look at changes over a span extending from 1400-700 B.P. I expected faunal and floral remains from these features to conform to dramatic shifts during this period seen in the East San Francisco Bay Area and Sacramento Valley, which Broughton (1994; 1999) and I (Wohlgemuth 1996) have interpreted as reflecting intensification of lower-ranked resources. To my surprise, the data from AMA-56 markedly diverge from the predictions of intensification models. There are declines rather than increases in diversity and abundance of aquatic animals, fish, and small seeds through time (Table 1).

These data may indicate more restricted seasonal use of Feature A, and possibly Feature B as well, in contrast to use in a broader range of seasons in occupation of Feature C. A key seasonal indicator here is inedible seed-pod fragments of farewell to spring (*Clarkia* sp.), which were probably deposited primarily in the late spring gathering season during bulk processing and winnowing prior to grinding and consumption of the edible seeds, or seed storage for future use. This is in contrast to important nut and berry crops, which are stored inside nutshell or containing inedible berry pits; since residues of these foods were probably produced as they were consumed year round, they are comparatively poor seasonal indicators. Additionally, *Clarkia* seeds ripen later than other small seeds of the annual spring bloom. The absence of *Clarkia* seed pods and seeds in Feature A may mean occupation during a narrower range of seasons than in features B and C, where *Clarkia* remains were found.

More limited occupation of Feature A, and possibly Feature B, would accord with reduced flows in adjacent Jackson Creek that would have accompanied the MCA. Jackson Creek is a comparatively small drainage basin fed only by runoff, as its headwaters are at only 2,600 feet in elevation, well below the current range of winter snow pack. This drainage would be particularly vulnerable to the

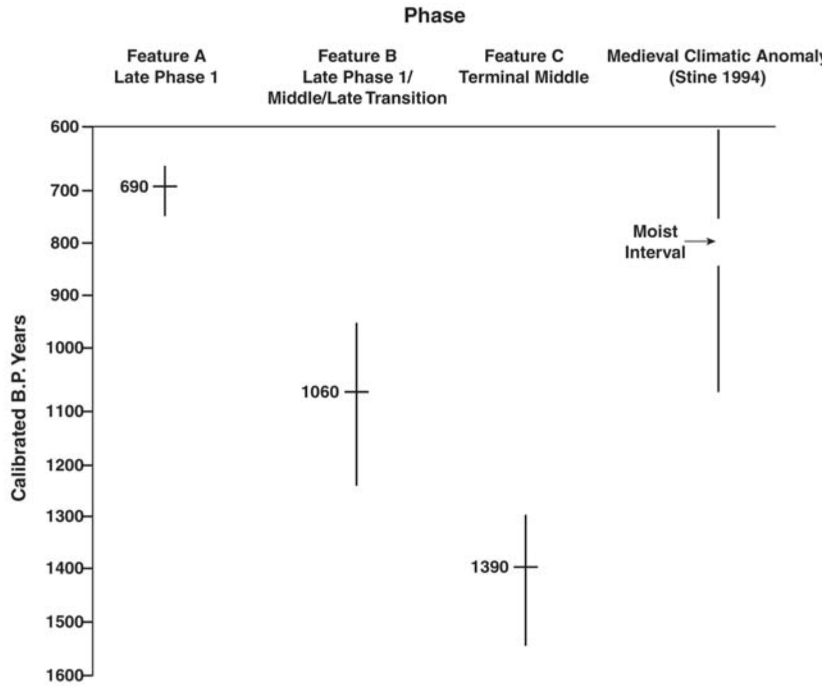

Figure 2: CA-AMA-56 feature radiocarbon dates and the Medieval drought (all dates calibrated B.P. and show 1-sigma range).

Table 1: Subsistence remains from radiocarbon-dated AMA-56 Features.

Class	Taxon		Feature C	Feature B	Feature A
		14C intercept (cal BP)	1390	1060	690
Faunal	Aquatic non-fish	count	25	44	8
		% of faunal ID=s	41.7	37.6	20.5
		richness	7	8	2
	Fish	count	20	40	6
		anadromous count	1	1	B
		richness	5	6	1
		Freshwater shellfish (mg/liter)	20	9	8
Floral	Nuts and berries	mg	35.6	17.3	11.7
		richness	5	5	4
	Small seeds	count	4.1	0.7	1.5
	Farewell To Spring	fruit capsule	.43	.03	B

effects of drought. Under current conditions it runs dry from July through September. During the MCA, in most years the creek would run dry for longer periods, and substantially limit aquatic resources. Further, the lack of fresh water itself, as much as effects of drought on food resources, would have narrowed the seasonal window of productive occupation of AMA-56 during the MCA.

The data presented here from AMA-56 are clearly preliminary and need to be corroborated; it is very possible that they are isolated and not terribly meaningful. But their presentation is warranted if only to draw attention to factors, here stream flows, which might be limiting occupation at AMA-56, in response to the critiques of Bettinger (1999) and Basgall (1999) of the thesis of Jones et al. (1999).

Two final points need to be made. First, although a case can be made that the effects of the MCA can be seen in subsistence residues at AMA-56, there are still aquatic taxa in features used during this period. While the effects of the MCA were probably pronounced, the Sierran foothills did not become the Mojave Desert. At least during some years there was sufficient water in Jackson Creek not only to support occupation at AMA-56, but to support turtles, fish, shellfish, etc. at levels that could be used as resources. Second, it is easy to see why the MCA would have depressed use of the small, low-elevation, runoff-fed Jackson Creek drainage. But it is another thing to consider the effects of the MCA on the lower foothills of the Stanislaus and Mokelumne rivers, with their much larger, high-elevation, snow-fed drainage basins. These rivers do not run dry in summer today. The dearth of Phase 1 occupation, so apparent in the lower foothill reaches of the Stanislaus and Mokelumne, suggests that major rivers may also have gone dry in summer of at least some years, and possibly for many consecutive years. Schulz's (1981) data from the Delta, and Cleland's (1987) from the 3,000-4,000-foot range along the Mokelumne, show that the low visibility of Phase 1 in the lower foothills is not the product of some widespread pattern of reduced visibility of Phase 1 artifacts and occupation traces throughout central California.

In conclusion, data from the Sierran foothills and adjacent Delta seem very much in accord with arguments about the effects of the MCA made by Jones et al. (1999). Settlement data show minimal occupations during Phase 1 in the foothills. In contrast, the Delta was well-populated, and may have been a refugium from the desiccated foothills. Data also suggest greater use of higher elevations during Phase 1. Skeletal data from Buchanan Reservoir point to increased evidence of violence, and regional exchange appears to have been disrupted there as well, during Phase 1. Subsistence data from dated features at AMA-56 do not show the dramatic shifts pointing to intensification of aquatic fauna and small seeds seen in the Sacramento Valley and East Bay during this period, but instead declines in the frequency of remains of these foods. In sum, all of these data appear to accord very well with the conclusions and even predictions of Jones et al. (1999). The effects of the MCA on native peoples of the Sierran foothills, and probably the Delta as well, appear to have been profound indeed.

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Note

This paper was prepared without consideration of a review of dendroclimatological evidence in the Sacramento River watershed by Meko et al. (2001). That investigation incorporated data from Blue Oak and montane-conifer tree rings in the Sacramento, Feather, Yuba, and American river drainages, and reconstructed annual precipitation from 869 A.D. to the present. No evidence could be found of extended droughts that would correspond to the timing of the MCA. Since there is only a limited geographical overlap between the studies of Stine (2000) and Meko et al. (2001), it is conceivable that the central and southern Sierra Nevada may have been subjected to the MCA as proposed by Stine (2000), while the northern portion of the range may have been less adversely affected. Still, the contradictory findings of these two studies suggests that the MCA should not be regarded so much as a definitive and established fact as an hypothesis needing additional confirmation.

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