Population Regression or Aggregation? Changing Settlement Patterns in the Western Mojave Desert during the Medieval Climatic Anomaly

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As part of a recent study to examine the potential effects of the Medieval Climatic Anomaly (MCA) on the prehistoric inhabitants of the western Mojave Desert (Gardner 2006), numerous archaeological assemblages were compared in order to attempt to determine what those effects may have been. One aspect of that comparison was the changing settlement patterns that are apparent in the archaeological record of the western Mojave Desert beginning about 1,200 years ago, at the onset of the MCA. This article represents a slightly revised version of that comparison. For more details regarding the history of research and potential impacts of the MCA in the western Mojave Desert, the reader is referred to Gardner (2006).

Climatologist Hubert H. Lamb was one of the first researchers to attempt to quantify the potential impacts of what he referred to as the Early Medieval Warm Epoch (Lamb 1965), also known as the Medieval Climatic Anomaly (MCA). How widespread this climatic event was and how it may have impacted human populations on a global scale have been the subjects of inquiry and debate ever since. Evidence for the MCA in western North America (Figure 1) has been derived from a variety of sources, including dendrochronological reconstructions, pollen studies, skeletal data, archaeological assemblages, and paleohydrologic data, among others. The proposed timing and intensity of the climatic changes during this time vary regionally, although the warmest phases appear to have transpired during the mid-twelfth century. While numerous scholars have proposed somewhat different time frames for the duration of the MCA (as well as slightly different names; e.g., Coltrain and Leavitt 2002; Jones et al. 1999; Li et al. 2000; Millar and Woolfenden 1999; Raab and Larson 1997; Stine 1994, 1998), it is generally considered to have taken place between roughly 1,200 and 650 years ago (ca. A.D. 800 and 1350). During this time, there were widespread and long-term periods of decreased precipitation, interspersed with periods of more favorable climatic conditions (e.g., Graumlich 1993:254).

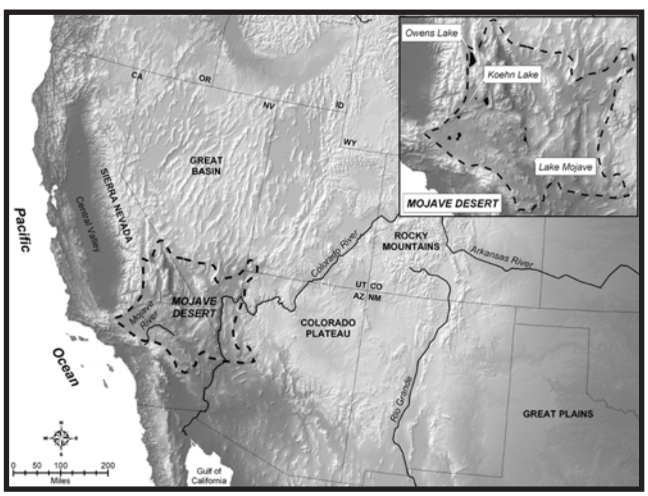

Figure 1. Map of western North America showing California, the Southwest, and the Great Basin, with the Mojave Desert boundary designated by the dashed line. Map is from Gardner (2006:31) and was produced by Hubert Switalski.

While there appears to be little doubt that the MCA was a significant climatic event in several regions of the world, evidence for how it may have influenced prehistoric human populations in the western Mojave Desert of the extreme southwestern Great Basin has remained largely inferential based primarily on observed changes in archaeological assemblages. Desert regions, such as the Mojave Desert (Figure 2), are of particular interest in examining issues of environmental stress, as they are frequently perceived to be somewhat marginal for human habitation even during more favorable climatic conditions. Therefore, during periods of environmental stress, such as a drought, the idea is that one would expect to see relatively dramatic differences in adaptation. In various parts of western North America, for example, there are striking correlations between drought and changes in settlement, subsistence, population demographics, exchange, health, and violence during the MCA (e.g., Jones et al. 1999). Whether the MCA was the cause of these changes is difficult to determine with any certainty, but the synchrony of the environmental and cultural changes suggests that it was a significant factor.

In an attempt to determine the potential effects of the MCA on the prehistoric inhabitants of the western Mojave Desert, Gardner (2006) compared archaeological assemblages from a large number of western (and a few central) Mojave Desert sites in an attempt to ascertain what those effects may have been and how they may have been manifested in the cultures that resided there. In order to make the study sites as comparable as possible, the data set presented in Gardner (2006) only included sites that were excavated, excluding those that were merely surveyed and/or surface collected. The study sites range in age from the

Jill K. Gardner, Statistical Research, Inc., San Diego, CA
Proceedings of the Society for California Archaeology, Volume 21, 2009, pp. 206-214

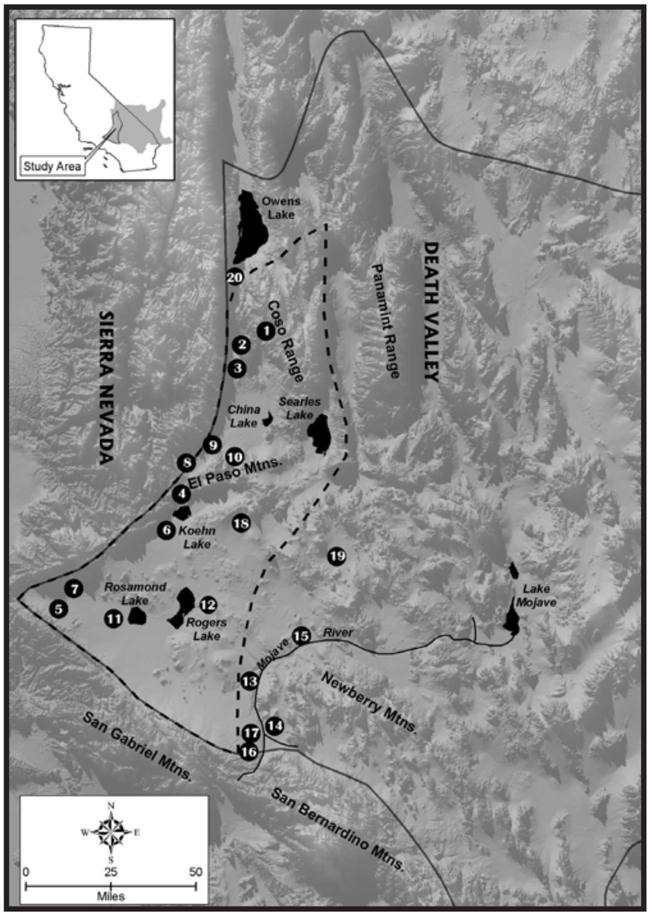

Figure 2. The western Mojave Desert (dashed lines), with approximate locations of sites and localities discussed in the text (and some that are not discussed herein but were part of the Gardner [2006] study).

(1) Coso Range (2) Rose Spring (INY-372); (3) Coso Junction Ranch (INY-2284); (4) Red Rock Canyon (includes KER-250, -261, and -5043); (5) KER-733; (6) Koehn Lake (KER-875) and Cantil sites; (7) Oak Creek Canyon (KER-1998); (8) Cross Mountain (KER-4619); (9) Freeman Spring (KER-6106); (10) Terese (KER-6188); (11) Rosamond; (12) Rogers Lake; (13) Oro Grande (SBR-72); (14) Deep Creek (SBR-176); (15) Hinkley (SBR-189); (16) Guapiabit (SBR-1913); (17) Siphon (SBR-6580); (18) Red Mountain Archaeological District; (19) Fort Irwin; (20) Owens Valley. Map is from Gardner (2006:108) and was produced by Hubert Switalski.

Gypsum to Late Prehistoric complexes[1] (Tables 1 through 4). The following is a discussion of one aspect of that comparison, that being the changing settlement patterns in the western Mojave Desert beginning about 1,200 years ago, and whether those changes may have been related, at least to some degree, to the MCA.

Changing Settlement Patterns

During the late 1980s and early 1990s, Sutton (1990, 1991a, 1991b) proposed a model for changing settlement and subsistence patterns in the western Mojave Desert, based primarily on the results of his excavations at the Koehn Lake site (KER-875; Figure 3) in the Fremont Valley. The model posits that environmental fluctuations over the last 4,000 years were potential causal mechanisms for culture change in this region. One of those fluctuations, the MCA, is of particular interest in understanding apparent shifts in settlement and subsistence patterns and population movements in the Mojave Desert during this time (e.g., Jones et al. 1999).

Based on the archaeological evidence at Koehn Lake and other sites in the Fremont Valley, Sutton (1996:235) argued that by about 2000 B.P., people had started living in villages, suggesting an increase in population size in the western Mojave Desert at about (or just prior to) this time. This proposal for population expansion is supported by the presence of large Rose Spring village sites at Rose Spring (INY-372; Yohe 1992) and Coso Junction Ranch (INY-2284; Whitley et al. 1988), as well as the increase in sites post-2300 B.P. in the Coso region (Gilreath and Hildebrandt 1991). This proposed village life and population expansion beginning at the terminal Gypsum Complex and continuing into the Rose Spring Complex strongly suggests an environmental amelioration at this time. It also supports the proposal by some scholars that the time span of the Rose Spring Complex should be extended back a few hundred years, to perhaps 2000 B.P. (e.g., Yohe and Sutton 2000).

The argument for this population increase and concomitant settlement change between Gypsum and Rose Spring times relies on the idea that Gypsum sites are scarce in the Mojave Desert. While this may be true in the western Mojave Desert (Table 1), it does not appear to be the case in other parts of the desert, such as Fort Irwin in the central Mojave Desert and Death Valley in the eastern Mojave Desert. In these two areas, a substantial number of Gypsum sites has been documented (e.g., Basgall and Hall 1992; Basgall et al. 1988; Hunt 1960; McGuire and Hall 1988; Wallace 1988), suggesting that a true paucity of such sites does not exist in other parts of the Mojave Desert. Moreover, it may not even be true for the western Mojave Desert, as suggested by the Gypsum Complex sites listed in Table 1, as well as the sites with Gypsum components listed in Table 4 (but see discussion of dating problems below and in Gardner [2006]).

These exceptions suggest that rather than an actual dearth of such sites, it may simply be a function of sample size, or perhaps some of the study sites that are undated or tenuously dated are, in fact, Gypsum Complex sites. As Sutton (1996:232-233) observed, the first half of the Gypsum

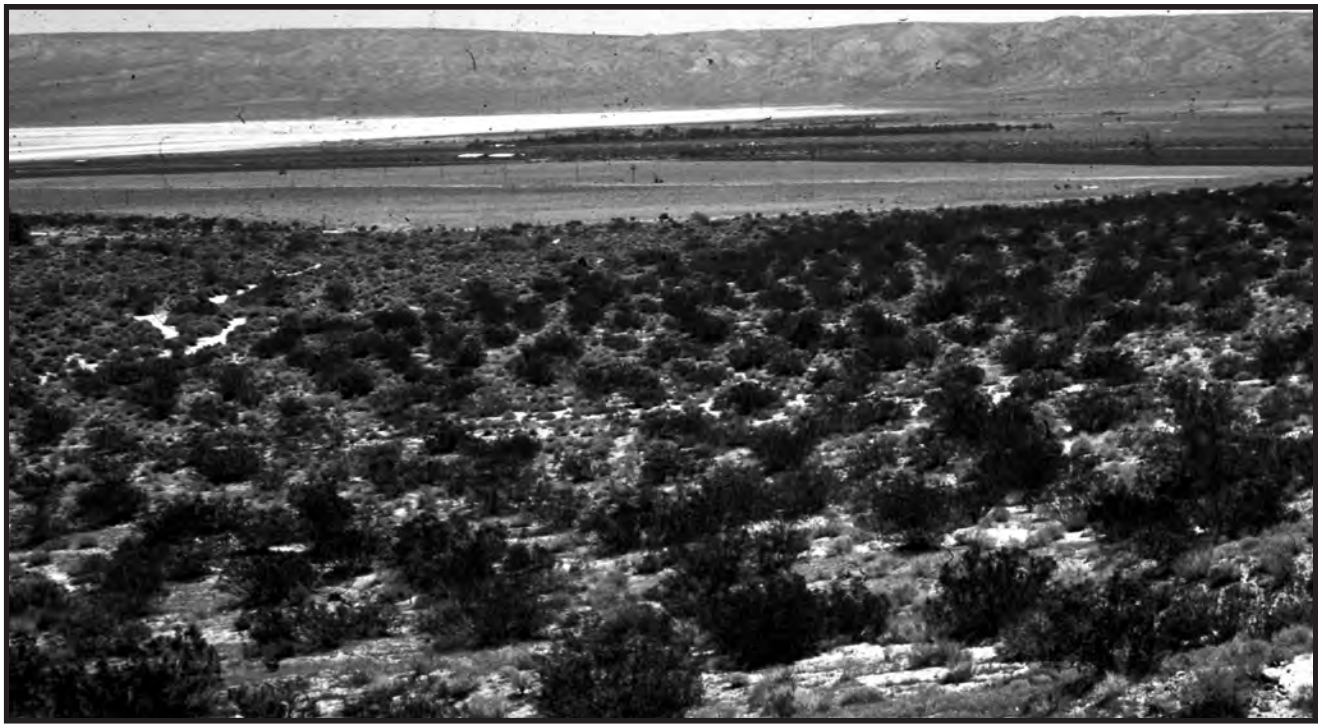

Figure 3. View of Koehn Lake (top left), taken ca. 1986 (photograph courtesy of Mark Q. Sutton).

Complex represented a time of relatively cooler and wetter conditions than those of the immediately preceding Pinto Complex, a situation that would likely have influenced cultures in terms of increased population, trade, and sociopolitical complexity. The identification of additional Gypsum Complex sites is essential for future archaeological research in the western Mojave Desert in order to clarify this issue.

As the Rose Spring Complex came to a close, there is some evidence of population recession in much of the western Mojave Desert, continuing into the Late Prehistoric Complex (Sutton 1990:6; Tables 2 and 3). This does not seem to be the case, however, at the Red Mountain sites in the west-central Mojave Desert, where Allen (2004:9) reported that use of Red Mountain Spring continued from Rose Spring to Late Prehistoric times, although the spring was never considered to be as productive as those to the west and south of Red Mountain. It is also not the case in the Fort Irwin region in the central Mojave Desert, where a significant number of sites have been dated to the Late Prehistoric Complex (e.g., Basgall et al. 1988; McGuire and Hall 1988).

Sites in this study with only Late Prehistoric components (Table 3) include KER-733 in the Antelope Valley (Sutton 1984), KER-520 in the Rosamond site complex (Everson and Sutton 1993), KER-2210 at Cantil (Sutton 1991b), two of the Rogers Lake sites (KER-1180 and -3377; Byrd et al. 1994), and a few in the Coso Volcanic Field (Gilreath and Hildebrandt 1997). All of these sites had low artifact densities consisting mostly of debitage, the largest of which was KER-1180 (28,000 m^2), although the rest of the sites were much smaller. While 10 of the 12 multiple component sites had Late Prehistoric components (Table 4), the majority of these sites was considered to be primarily Rose Spring in age, with more ephemeral Late Prehistoric occupations. This site size and distribution pattern suggests at least three possibilities: a population recession, a population shift to a different settlement pattern, or a combination of both.

A Model of Aggregation

Based on the current available information from the archaeological record of the western Mojave Desert, sites appear to have been relatively spread out across the landscape for much, if not most, of prehistory. Under the model of a population shift initiated toward the end of the Rose Spring era, people would have begun to aggregate into more compact settlement units, as a way of "joining forces," so to speak, to make better use of diminishing resources as a result of environmental deterioration. If this scenario is accurate, it should be evident in the archaeological record of the study area in the form of site clusters, rather than scattered settlements.

This may be the case at the Cantil site complex in the Fremont Valley less than 2 mi south of Koehn Lake (Sutton 1991b), as one of the seven sites (KER-2210) was interpreted as a Late Prehistoric site, and another (KER-2211) as a multiple component Rose Spring/Late Prehistoric site. A third site (KER-2215) was tenuously dated (through

Table 1. Gypsum Complex Sites

Site	Basic Description	Evidence for Age Assignment [a]
KER-246 (Red Rock Canyon)	lithic reduction site	point typology (1 EL); 3,140 ± 40 RCYBP; OH = 5.9 to 16.4µ
KER-526 (Rogers Lake)[b]	large base camp	3,670 ± 70 and 3,770 ± 70 RCYBP; OH = 7.4 to 13.5µ
KER-2209 (Cantil)b	short-term habitation site, possible hare focus	point typology (1 CT); OH = 2.7µ
KER-2214 (Cantil)	small multifunctional camp	point typology (1 GC, 1 EE)
KER-2218 (Cantil)[b]	small, temporary special-	
purpose camp	2,490 ± 300 RCYBP	

[a] Projectile point designations: EL = Elko; CT = Cottonwood; GC = Gypsum Cave; EE = Elko Eared. OH = obsidian hydration rim values; ranges reflect the means of the rim values.

[b] These sites are problematic regarding their age assignment (see text for details).

Table 2. Rose Spring Complex Sites

Site	Basic Description	Evidence for Age Assignment [a]
KER-250 (Bickel)	small rabbit (hare) drive site	point typology (11 RG, 1 each of DSN, CT, EC); four dates between 650 ± 65 and 1,255 ± 110 RCYBP; OH = 3.5 to 8.1µ
KER-533 (Rogers Lake)	temporary encampment; forager residential base or field camp	1,890 ± 80 RCYBP
KER-875 (Koehn Lake)	large village	point typology (vast majority are RS); eight dates between 970 ± 70 and 1,430 ± 60 RCYBP; OH = 4.0 to 6.4µ
KER-2215 (Cantil)	small, temporary camp	OH = 4.5, 5.6µ
KER-2450 (Rosamond)	temporary camp for processing hares	point typology (1 RS); 1,110 ± 50 RCYBP; OH = 3.4, 3.6, 4.4µ
KER-2567 (Rosamond)	small habitation site or temporary camp	point typology (5 RS); OH = 2.9 (on a RS point), 2.9, 4.1, 9.2µ
KER-2768/H (Rosamond)	lithic quarry/reduction site	point typology (1 RS)
KER-2769 (Rosamond)	lithic quarry/reduction site	point typology (11 RS), OH = 3.3 to 8.9µ
KER-6106 (Freeman Spring)	seasonal habitation site; focus on hares	point typology (14 RS); 1,110 ± 40, 1,110 ± 50, 1,130 ± 60 RCYBP; OH = 3.0 to 11.0µ

[a] Projectile point designations: RG = Rosegate; DSN = Desert Side-notched; CT = Cottonwood; EC = Elko Corner-notched; RS = Rose Spring. OH = obsidian hydration rim values; ranges reflect the means of the rim values.

Table 3. Late Prehistoric Complex Sites

Site	Basic Description	Evidence for Age Assignment [a]
KER-261 (Last Chance)	small rabbit (hare) drive site	640 ± 75 RCYBP
KER-520 (Rosamond)	temporary camp with focus on lithic reduction	point typology (1 CT); OH = 5.0µ
KER-733	special activity site for processing hares	point typology (3 CT); 460 ± 75 RCYBP; OH = 2.8 to 4.3µ
KER-1180 (Rogers Lake)	short-term encampment; forager residential base or field camp	point typology (1 DSN); 690 ± 50 and 180 ± 130 RCYBP
KER-2210 (Cantil)	two small camps, possible hare focus	point typology (1 DSN); OH = 3.3, 3.3, 5.2µ
KER-3377 (Rogers Lake)	short-term encampment; forager residential base or field camp	OH = 3.6 to 4.9µ

[a] Projectile point designations: CT = Cottonwood Triangular; DSN = Desert Side-notched. OH = obsidian hydration rim measurements; ranges reflect the means of the rim values.

Table 4: Multiple Component Sites

Site	Basic Description [a]	Evidence for Age Assignment [b]
INY-372 (Rose Spring)	large village (or large, long-term habitation site) (GY, RS, LP)	point typology (predominantly RS); multiple radiocarbon dates; OH range = 2.8 to 10.6µ
INY-444 (Ray Cave)	rockshelter (GY, RS, LP)	point typology [c]; 1,500 ± 95 and 3,390 ± 50 RCYBP; OH = 3.0 to 5.0µ
INY-1534A (Chapman 1)	rockshelter (GY, RS, LP)	point typology [c]; 320 ± 60, 580 ± 70, and 760 ± 60 RCYBP; OH = 1.5 to 14.1
INY-1534B (Chapman 2)	rockshelter (GY, RS, LP)	point typology [c]; 230 ± 60 and 470 ± 80 RCYBP; OH = 1.1 to 12.9µ
INY-1535 (Junction Ranch)	seasonal site; cluster of house rings (GY, RS, LP)	point typology [c]; OH = 1.6 to 10.7µ
INY-2284 (Coso Junction)	large village (GY, RS, LP)	point typology (unknown number, but mostly RG); OH = 2.9 to 11.3µ
KER-1998 (Oak Creek Canyon)	large site with focus on hare exploitation (RS, LP)	point typology (1 RS, 2 DS); OH = 2.2 to 5.2µ
KER-2211 (Cantil)	large site with a focus on hare exploitation (RS, LP)	point typology (8 CT, 7 DSN, 15 RS, 1 HU); 940 ± 80, 940 ± 100; and 1,300 ± 100 RCYBP; OH = 1.1 to 6.3µ
KER-4619 (Cross Mountain)	large habitation site with cemetery (RS, LP)	point typology (RS, DS), 460 ± 60 and 370 ± 60 RCYBP
KER-5043 (Coffee Break)	small, seasonal habitation site	(GY, RS) point typology (4 RS, 1 HU); 880 ± 50, 2,490 ± 60, 2,430 ± 80 RCYBP; OH = 3.1 to 11.6µ
KER-6188 (Terese)	relatively small habitation site, possibly short-term (GY, RS)	OH = 4.0 to 10.9µ

[a] GY = Gypsum Complex; RS = Rose Spring Complex; LP = Late Prehistoric Complex.

[b] Projectile point designations: DS = Desert series; DSN = Desert Side-notched; CT = Cottonwood Triangular; RS = Rose Spring; RG = Rosegate; EE = Elko Eared; HU = Humboldt. OH = obsidian hydration rim measurements; ranges reflect the means of the rim values.

[c] Together, these sites included Desert Side-notched (n = 15), Cottonwood Triangular (n = 12), Cottonwood Leaf-shaped (n = 5), Rose Spring (n = 63), Eastgate (n = 2), Elko Corner-notched (n = 2), and Pinto (n = 1).

obsidian hydration only) to the Rose Spring Complex but may, in fact, date to Late Prehistoric times. An additional site (KER-2209) dated to the Gypsum Complex may actually be Late Prehistoric in age (see Gardner 2006:168-169; also see Table 1). Thus, it is plausible to suggest that these four sites in the Cantil complex—and perhaps the undated site (KER-2212)—may have been contemporaneous Late Prehistoric sites, only one of which (KER-2211) contained evidence of extensive habitation (16 features, including hearths, an obsidian cache, and at least one structure; Sutton 1991b).

It is possible, then, that if populations were aggregating in the Cantil area during the Late Prehistoric Complex, perhaps KER-2211 was the major center of activity, and the other sites were subsidiary or special-purpose satellite sites to that center. The Koehn Lake site might fit somewhere in this scenario, as it is within an easy day's walk from the Cantil sites and is at least double the size of KER-2211. While the Koehn Lake site is overwhelmingly Rose Spring in age, it has a thin veneer of Late Prehistoric material; thus, even during times of resource stress, it could have been occupied (or reoccupied) on a much smaller scale and may have acted as the core of activity for the Cantil sites during this time of proposed population aggregation. In the absence of chronological control of some of the Cantil sites, however, this suggestion must remain speculative.

A similar pattern may also be true for the Rogers Lake site complex a few miles southeast of Koehn Lake (Byrd et al. 1994), as two of the sites (KER-1180 and KER-3377) date to Late Prehistoric times, and two others (KER-1765 and KER-3379) were undated but may be Late Prehistoric in age. In addition, although KER-526 was identified as a Gypsum site (Byrd et al. 1994:156; but see Gardner 2006:197), the shell beads from the site provide meager evidence of a Late Prehistoric component (as well as a potential Rose Spring component), possibly of much smaller size and scope than earlier occupations. Again, without better chronological control, the relationship between these sites continues to be unclear.

Conversely, of the 15 sites in the Rosamond complex in the Antelope Valley south of Cantil, only one (KER-520) was interpreted as Late Prehistoric in age, while four had Rose Spring components, two had Pinto components, and eight were undated (Sutton 1993). Thus, the Rosamond sites do not support the idea of population aggregation during the Late Prehistoric Complex, although in the absence of chronometric data at more than half the sites, it is difficult to deny the possibility. On the other hand, 12 of the 15 Rosamond sites (including the eight undated sites and KER-520) were identified as lithic reduction sites, with rhyolite as the almost exclusive material being reduced. As the

Rosamond site complex is less than 40 mi south of the Cantil complex, it is conceivable that the undated Rosamond sites were also satellite locations to KER-2211 for the express purpose of acquiring and processing rhyolite. This is not an unreasonable distance in terms of transportation costs, as ethnographic accounts in the Great Basin have demonstrated that resources were transported to residential bases from distances up to about 100 km. (roughly 60 mi) (Rhode 1990:414; also see Bettinger 1977; Thomas 1973, 1988). For the Rosamond complex, however, this suggestion must be tempered, given the absence of adequate chronometric data.

Alternatively, the Rosamond site complex may have more of a connection to KER-303 than to the Cantil complex or Koehn Lake. KER-303 is closer to the Rosamond sites than to Cantil, as it is situated approximately 20 mi west of Rosamond Lake. Although there is no site report available, in an overview of western Mojave Desert archaeology, Sutton (1988:58) noted that radiocarbon assays and projectile point typology dated KER-303 between 2400 and 300 B.P. The site contained a large cemetery, three structures, and numerous trade items, including an enormous quantity of shell beads and ornaments (>100,000) and a number of glass beads.

Although KER-303 is a relatively small site (ca. 3,500 m^2), it is extremely dense in terms of its artifactual remains and quite deep for its size, with a site deposit over 2 m deep in some areas (Sutton 1988:56). The small size but extreme complexity of this site, along with the presence of numerous trade items, led Sutton (personal communication 2005) to suggest that KER-303 was part of a system of regional interaction spheres in the Mojave Desert and may represent a trading center near the intersection of three spheres that included the Kitanemuk, the Serrano, and the Kawaiisu (also see Sutton 1989:111). If so (and assuming at least some of the sites are contemporaneous), perhaps the inhabitants at the Rosamond complex were involved in trading activities at KER-303, possibly to trade rhyolite for some other resource. It remains conceivable that the inhabitants of the Rosamond site complex had their primary residence at Cantil or Koehn Lake, traveling from there to Rosamond and then to KER-303 prior to returning home.

Ethnographic and Archaeological Correlates

Looking at ethnographic correlates of population aggregation and dispersal in other regions of the world, it is possible that the proposed aggregation in the western Mojave Desert may have been rooted in kinship affiliations, as seen among the !Kung San of the Kalahari Desert of southern Africa. A !Kung San camp typically includes relatives and other people referred to as kin regardless of their actual relatedness (Lee 1979:55). These would be individuals who "can live and work well together" (Lee 1979:55). In another example, for the Mardu of western Australia, the "rhythm of desert life is one of alternating aggregation and dispersal of social groups" (Tonkinson 1991:37). Their adaptation and group size varies according to local environmental conditions and the availability of food. Tonkinson (1991:37) also observed that for the Mardu, as for any human population, "it is important to distinguish between long-term climatic variations caused by droughts and short-term variations that occur within a yearly cycle and relate to seasonal changes in climate."

Archaeological correlates can be seen in North America, particularly in the Southwest. For example, using a selectionist model consisting of a number of variables, including aggregation, population size, specialized agricultural strategies and tactics, labor organization, and environment, Leonard and Reed (1993:656) argued that their model "clearly predicts aggregation during times of climatic deterioration (holding the size and productivity of the land base constant) . . ." (but see Kohler and Sebastian 1996). Applying their model to Zuni and Chaco, Leonard and Reed (1993:654, 656) maintained that the Zuni shifted from dispersed to aggregated occupations by the early A.D. 1300s, while the Chaco area demonstrated "evidence of aggregation from A.D. 900 to at least A.D. 1130, considerably earlier than aggregation at Zuni." Similar patterns have been observed in other areas of the Southwest as well.

Conclusion

It is only through future archaeological investigations that we may be enlightened about the influence of the MCA on human populations in the western Mojave Desert. Specifically, additional Gypsum and Late Prehistoric complex sites must be identified to be able to clarify what was happening just before, during, and just after the MCA. Moreover, the identification of sites from various time periods is crucial not just for illuminating how environmental episodes like the MCA may have impacted prehistoric cultures in this desert region, but for other causes of culture change as well. Regardless of whether there was a population recession or a settlement system shift (or both) in the western Mojave Desert commencing toward the end of the Rose Spring Complex, it seems obvious that the environment played a role in whatever occurred at this time.

Acknowledgements

Over the last four decades, Mark Sutton has conducted seminal work in the western Mojave Desert. Along with his colleagues and students, he has provided invaluable (and voluminous) information to illuminate what we know about the prehistoric inhabitants of the western Mojave. Without the backdrop of his previous (and ongoing) investigations in this desert region, this paper (which was derived from my dissertation) would have suffered from a

true paucity of data for answering questions of culture change, or any other questions that are of interest to archaeologists who study arid environments. For that, and for all the time he has spent encouraging me and discussing his work with me, I thank him more than he can know.

NOTES

1. In Gardner (2006), I employed the more traditional "period" designation for these time frames. Since that time, Sutton et al. *(2007) have suggested a new way of looking at the terms "period" and "complex." In that publication, "period" is used to designate broad climatic time frames (such as early Holocene, middle Holocene, etc.), while "complex" designates specific archaeological manifestations (such as Lake Mojave, Gypsum, etc.) during and across those broader time frames. As I am a co-author on that publication, it seemed appropriate to incorporate that change in this revised portion of my dissertation.*

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