THE DESERT'S PAST

A NATURAL PREHISTORY OF THE GREAT BASIN

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The Early Holocene: 10,000 to 7,500 Years Ago

SHALLOW LAKES AND MARSHES

Although the pluvial lakes of the Great Basin were gone by 10,000 years ago, many Great Basin valleys that are today dry, or nearly so, supported shallow lakes and marshes during the early Holocene. In addition, many valleys that today contain lakes then contained lakes that were at least as high, and sometimes higher, than they are now.

THE MOJAVE DESERT

The late Pleistocene and early Holocene history of Las Vegas Valley provides an excellent example. This broad valley trends northwest and southeast, between the Sheep Range to the north and the Spring Range to the south (see Figure 6-12); the town of Las Vegas sits toward the southern end of the valley. Today, Las Vegas Valley is drained by Las Vegas Wash, which ultimately connects with the Virgin River, in turn a tributary of the Colorado. The area itself, however, is extremely arid, the wash routinely dry. Work by geologists Vance Haynes and Jay Quade has documented that this was decidedly not the case during the late Pleistocene and early Holocene.

Haynes's work focused primarily on the Tule Springs area, some 10 miles north of Las Vegas (see Figure 6-12). Quade's efforts, on the other hand, were directed toward the upper end of Las Vegas Valley, near Corn Creek Springs, approximately 20 miles northeast of Las Vegas. Although these studies were done some 20 years apart—Haynes's work was published in 1967, Quade's in 1986—and were directed toward different parts of the valley, the results they obtained are entirely consistent.

The picture painted by their research extends well beyond the range of radiocarbon dating, and perhaps to as early as 60,000 years ago. I will begin my discussion, however, with Haynes's geological Unit D, a 16′-thick pile of deposits that is widespread in the valley, and that dates to between about 30,000 and 15,000 years ago.

Near the margin of the valley, Unit D consists of fine-grained sediments, but these grade into "mudstones" (hardened deposits of clays and silts laid down in a moist environment) toward the valley floor. In many places, Unit D is riddled with the casts, or "pseudomorphs," of cicada burrows that were formed as a result of the deposition of carbonates in the original burrows themselves. These burrow casts are so common that, in some places where the deposits of Unit D are exposed, they cover the surface of the ground. The significance of these burrows seems clear: today, cicadas and their burrows are common in the far cooler and moister sagebrush environments of the floristic Great Basin to the north.

Equally clear is the more general environmental picture that can be extracted from Unit D and its contents. Peter Mehringer showed that the mudstones of this unit at Tule Springs contained both cattail and sagebrush pollen (see Chapter 6). This finding, combined with the nature of the sediments themselves, suggests that between about 30,000 and 15,000 years ago, Las Vegas Valley supported small, shallow bodies of water that were often fringed by cattails. Above the marshes and ponds, the alluvial flats supported sagebrush and cicadas. Neither is to be found here today.

In many areas, the top of Unit D is eroded, suggesting that at least some of the marshes and ponds dried up before the next depositional unit, E, began to be laid down some 14,000 years ago. Unit E is divided into two parts, with an erosional break separating the two: E_1 dates to between about 14,000 and 11,700 years ago, whereas E_2 falls between 11,000 and 7,200 years ago. The sediments that make up the two, however, are quite similar: greenish clays, black organic mats, and water-deposited sandy silts that fill depressions created by springs and stream channels.

The black mats here are much like that which overlies the Clovis level at the Lehner site in southeastern Arizona (see Chapter 4), and which dates to about 10,800 years ago. Like the Lehner black mat, those in Las Vegas Valley appear to represent the decay of organic material in a moist environment, but the Las Vegas Valley versions date to between 11,700 and 8,640 years ago.

Although cicada burrows are not as common in Unit E as they are in Unit D, they are nonetheless present. In addition, E_1 contains the bones of extinct Pleistocene mammals, including mammoth, horse, and camel. Unit E_2, on the other hand, does not, and the erosional break between these two depositional units may coincide with the time of extinction of those mammals here.

All of this information suggests that the water table during E_1 and E_2 times (roughly 14,000 to 7,000 years ago, excluding the erosional break that separates the two) was lower than it was when Unit D was deposited: the earlier complex of marshes and ponds had diminished considerably. But the green clays in Unit E show that there was at least some standing water in the valley, the cicadas imply that cool and moist conditions continued, molluscs from these deposits show that marshes continued to exist in the area, and the black mats suggest that these marshes were fairly widespread. Indeed, although Mehringer's work revealed only traces of cattail pollen in the sediments of Unit E, it was there, and his work also showed that other moisture-loving plants grew in the area at this time. Sagebrush, now absent on the valley floor, was also present throughout the deposits that make up Unit E.

Much of E_2 (11,000 to 7,200 years ago) is Holocene in age. The complex of marshes and active springs that characterized Las Vegas Valley while E_1 was accumulating became increasingly smaller during E_2 times, but perennial streams with marshy edges persisted here until about 8,000 years ago. Then, sometime between 8,000 and 7,000 years ago, this cooler and moister regime disappeared. The water table, which was near the surface some 8,500 years ago, dropped dramatically; today, it is some 80′ lower than it was then. The cicadas became locally extinct, the sagebrush retreated, and the deposits of Unit E_1 began to be heavily eroded. Something closer to modern conditions had arrived.

A very similar sequence appears to have characterized the Mojave River drainage. In Chapter 6, I discussed the fact that Pleistocene Lake Mojave reached high levels between 18,000 and 16,000 years ago (the Lake Mojave I phase), and between 13,700 and 11,400 years ago (Lake Mojave II; see Figure 6-2). The end of the Lake Mojave II phase, however, did not see an end to Lake Mojave as a whole.

Today, water rarely travels the entire course of the Mojave River to reach the Lake Mojave Basin. It routinely did so, however, between 11,400 and 8,700 years ago. During that period, a series of shallow lakes formed, leaving behind as evidence blue to green clays (the lake sediments) that are interrupted by cracks caused by desiccation (the drying events that separated these intermittent lakes). Geologist William J. Brown and his colleagues refer to this final stage in the history of Lake Mojave as Intermittent Lake III, previous intermittent lakes having formed just before Lake Mojave I, and between Lake Mojave phases I and II. Although shallow lakes have formed in this basin since 8,700 years ago, none was of the magnitude and duration of those that formed during Intermittent Lake III.

THE FLORISTIC GREAT BASIN

No similarly detailed information exists for now-dry Great Basin valleys in the far northern reaches of the Great Basin. Nonetheless, the information that does exist shows that comparable events occurred here as well. Some of the more intriguing evidence comes from the Alkali Lake Basin of south-central Oregon, and has been developed in detail by archaeologist Judy Willig.

The Alkali Lake Basin is just northeast of the basin of Pleistocene Lake Chewaucan and just southeast of that of Pleistocene Lake Fort Rock (see Figure 8-1). Although no detailed studies have been done on the earlier Pleistocene history of this basin, a large pluvial lake did exist here, covering some 205 square miles to a maximum depth of 275′. Willig's work focused on the latest Pleistocene and early Holocene history of this area, and in particular on the relationship between lake and human history in the north-

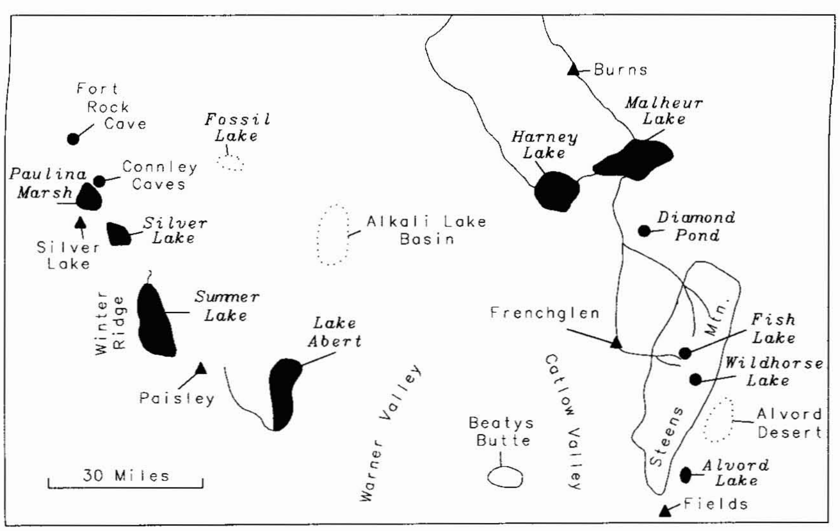

Figure 8-1. Northern Great Basin locations discussed in Chapter 8.

ern Alkali Lake Basin during this interval. I will discuss the archaeology of this area in the next chapter; here, I look only at what Willig discovered about the lakes and marshes of northern Alkali Lake Basin between about 11,500 and 8,000 years ago.

Willig combined analyses of regional geomorphology with stratigraphic excavations to show that, during latest Pleistocene times, perhaps focusing on about 11,000 years ago, the northern Alkali Lake Basin held a shallow (perhaps 20″ deep) lake that covered slightly more than one square mile. This marsh-fringed lake, which appears to have been fairly long lived, she named Lake Koko. Both Willig and geologist Vance Haynes estimate that Lake Koko dried up shortly after 11,000 years ago. That it dried up seems clear: the uppermost deposits of the lake are heavily eroded, even when they are covered by sediments laid down during earliest Holocene times.

These earliest Holocene deposits are associated with the growth of another, larger lake in the northern Alkali Lake Basin. There is good evidence that Sand Ridge Lake, as Willig named it, was nearly 7′ deep, covered approximately 5.5 square miles, and was marsh fringed, permanent, and fresh. That evidence is provided not only by the geomorphological data amassed by Willig, but also by the snails she obtained from the deposits of this lake. Those snails require fresh and permanent water, and also attach themselves to the submerged portions of bulrush and cattail. Although Willig was unable to provide much radiocarbon control over the chronology of the late Pleistocene and early Holocene lakes she defined here, the one date she was able to obtain was for Sand Ridge Lake, and it falls at 9,610 years ago.

Some time after 9,500 years ago, Sand Ridge Lake retreated, forming a lake slightly over 4′ in depth that Willig estimates dates to about 8,500 years ago. Because the deposits of this lake lie beneath Mazama ash, it is clear that this second Holocene lake, which Willig named Lake Delaine, was gone by 6,800 years ago, though exactly when it dried up is not known. Since Mazama ash blanketed this area, only one other sizable lake has formed in the northern Alkali Lake Basin, filling it to a depth of about 4′; this lake was of very brief duration, and nothing secure is known of its age.

The Connley Caves sit on the southwestern slope of the Connley Hills in the western Fort Rock Basin, some 50 miles northwest of northern Alkali Lake Basin and about 10 miles southeast of Fort Rock Cave (see Figure 8-1). A mile to the southwest lies the fluctuating shoreline of Paulina Marsh, now the largest natural body of standing water in the basin as a whole, fed by the only perennial streams that exist in the Fort Rock Basin.

Excavated by archaeologist Stephen Bedwell in 1967, the Connley Caves provided an archaeological sequence that spans the period from 11,200 to 3,000 years ago, with one major exception: the interval between 7,200 and 4,400 years ago is not represented at these sites. Bedwell was primarily interested in the archaeological content of these caves, but, in addition to providing an important series of artifacts, the rockshelters also proved to be fairly rich in bone.

The nature of the fauna deposited in these sites changed dramatically through time. Nearly all the remains of birds that had been deposited here were deposited between 11,200 and 7,200 years ago (95% of them, to be precise). In addition, most of those birds are tightly associated with water—grebes, ducks, shorebirds, and, to a lesser extent, Sage Grouse (*Centrocercus urophasianus;* within their general habitat, these birds are most common in areas with abundant surface water). The steep decline in such birds after 7,200 years ago strongly suggests that the levels of Paulina Marsh were dramatically reduced after that time. Such a reduction is, of course, fully consistent with Willig's evidence for the desiccation of shallow lakes and marshes some time between 8,500 and 6,800 years ago in the northern Alkali Lake Basin, not far to the southeast.

Similar evidence for early Holocene lakes and marshes exists elsewhere in the northern Great Basin. Archaeologist Keith Gehr, for instance, has shown that a series of at least four Holocene lake terraces exists along the southern edge of the Harney Lake Basin within the Malheur National Wildlife Refuge in south-central Oregon, about 40 miles northeast of the northern Alkali Lake Basin (see Figure 8-1). Dates on the earliest, and on the next-to-latest, of these terraces fall at 9,620 and 8,680 years ago, respectively. Although these dates are on snails (which are prone to contamination), the 9,620-year date is virtually identical to that obtained by Willig for Sand Ridge Lake to the southwest.

Although detailed sequences comparable to those from the Mojave River drainage and Las Vegas Valley do not exist for more northerly parts of the Great Basin, the evidence that does exist is convincing. From about 10,000 to between 8,000 and 7,000 years ago, many northern Great Basin valleys supported a series of often substantial lakes and marshes. In some cases (for instance, the northern Alkali Lake Basin), those valleys are now dry. Elsewhere, the lakes and marshes that now exist in these valleys (for instance, Paulina Marsh and Harney Lake) are far smaller than those that existed during the early Holocene.

Between these northern and southern geographic extremes, the data we have come from basins that still contain lakes, and come primarily from the analysis of lake sediments themselves, not from dated shorelines.

Robert Thompson's analysis of sediment cores from the Ruby Marshes, for instance, provided information not only on the late Pleistocene history of Lake Franklin (see Chapter 6), but also on the lakes and marshes that have existed in this area during the last 10,000 years. Basing his arguments primarily on the ostracodes and green algae preserved in the sediments provided by his cores, Thompson showed that, while the lake that occupied this basin had reached fairly low levels by 10,400 years ago, that lake was still deeper than it is today, and that it lasted well into the Holocene. In fact, between about 8,800 and 8,700 years ago, the lake rose briefly, but then began to decline, becoming a sedge-rich marsh by 8,700 years ago. By 6,800 years ago, when Mazama ash fell in Ruby Valley, the basin was nearly dry.

The other information that is available on lake history in the more central part of the Great Basin is less compelling, since it is far less detailed and based on far fewer radiocarbon dates. Geologist Stephen Born has argued that Pyramid Lake was at fairly high levels during the earliest Holocene, but that it had dropped substantially by 8,000 years ago. To the south and west, a series of radiocarbon dates suggest that Mono Lake was far higher between 10,000 and 7,000 years ago than it has been during the last 3,000 years. The only known exception to all this is Walker Lake: it appears to have been dry between about 14,000 and 4,700 years ago (see Chapter 5). The desiccation of Walker Lake, however, seems to have been due to the behavior of Walker River, which, during this 9,000-year interval, apparently flowed north, into Carson Sink, rather than south, into Walker Lake. Unfortunately, there is virtually no direct information available on the early Holocene history of lakes and marshes in the Carson Sink.

What we know about early Holocene lakes and marshes in the Great Basin is remarkably consistent. These bodies of water were widespread in the Great Basin between at least 10,000 and 8,500 years ago, securely documented from the Mojave River drainage and Las Vegas Valley on the south to the northern Alkali Lake Basin on the north. When these shallow lakes and marshes desiccated is somewhat less clear. Although there are suggestions that desiccation occurred at around 8,500 years ago in some areas—the Mojave River drainage, for instance—in other areas, shallow lakes and marshes seem to have existed until after 8,000 years ago, as in Las Vegas Valley and in Ruby Valley. Nowhere, however, is there convincing evidence that valleys that today lack substantial bodies of water maintained these lakes and marshes beyond 7,000 years ago. When Mazama ash fell in such valleys, it routinely fell on ground that was dry or nearly so.

SUBALPINE CONIFERS, SHADSCALE, AND CREOSOTE BUSH

THE FLORISTIC GREAT BASIN

The widespread existence of marshes and shallow lakes in the Great Basin during the early Holocene suggests climates that were cooler or moister, or both, than those of today. What we know of the vegetation of the Great Basin during this interval suggests no different.

Peter Wigand and Peter Mehringer have shown that the pollen from the late Pleistocene sediments of Hidden Cave, western Nevada, is dominated by pine and sagebrush (see Chapter 6 and Figure 6-5). That dominance ended fairly abruptly at around 10,000 years ago, as pine pollen declined to levels no greater than those that characterized the uppermost, latest Holocene, deposits in the site. Pines may have become less abundant on the local landscape at about this time, though this conclusion is clouded by the fact that the pine pollen in the Pleistocene sediments of Hidden Cave may have come from the waters of Lake Lahontan. Sagebrush pollen also declined in the deposits of Hidden Cave at about 10,000 years ago, but the decline it underwent was not nearly as dramatic as that suffered by pine. Sagebrush pollen becomes less abundant at this time than it had been during the late Pleistocene, yet it was still far more abundant between 10,000 and 6,800 years ago or so than it was to be after this interval.

As the amount of pine pollen in the sediments of Hidden Cave dropped substantially and sagebrush pollen declined, cheno-am pollen increased. As I have discussed, much of the cheno-am pollen in Hidden Cave is probably from shadscale (*Atriplex*), and pollen of this sort is not at all abundant in the late Pleistocene deposits of the site. Soon after 10,000 years ago, however, it became so, rising to form some 40% of all Holocene pollen samples.