The Possibilities of Surface Survey

An example from the Mono Lake Basin, Western United States

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Abstract

Located on the western edge of the North American Great Basin, the Mono Lake basin is an area that has been studied both ethnographically and archaeologically. The basin consists of a varied environment that has not been evenly sampled by limited excavations. The excavated sites have identified distinct patterns of prehistoric and protohistoric lifeways. An environmentally stratified surface survey of lakeshore wetland habitats was conducted and identified differences in their prehistoric use. This surface study uses obsidian hydration for chronological control and distinguishes difference in prehistoric adaptations that are not apparent through the excavations alone.

In archaeological analysis, artifacts are often studied within the context of individual sites and site types. Through this analysis an understanding of past lifeways is constructed. By excavating sites, one can recover artifact assemblages that demonstrate diverse processes of work. This includes the production and consumption of raw material and tools, along with the acquisition, processing, and consumption of animal and plant resources. Nevertheless, the time and energy that is needed to investigate specific sites is also great and may preclude the ability to sample diverse environmental contexts. In areas with a varied environment it is possible that the places were used in distinct manners across space and through time.

If one has a sample from a single site only, it provides a picture of the activities undertaken at the given locality, but does not inform about use of the larger region. In places with good surface visibility, a surface survey that samples diverse environments can illustrate dynamic use of those habitats. A useful place to examine potential differences between excavated assemblages and those collected through surface survey is found in the Mono Lake basin at the western edge of the North American Great Basin (Figure 1).

Environment

The Mono Lake basin has a varied environment that results from differences in rainfall, the presence of streams or springs of freshwater, as well as geomorphology and surface topography. The elevation of the basin floor is 1945 m above sea level (asl.) and is surrounded by mountains, with the Sierra Nevada range rising beyond 2300m percent of freshwater that enters the basin annually does so through five streams that flow from the Sierra Nevada. Similar to the rest of the Great Basin, the Mono Lake basin is internally draining with no outlet to the ocean. Since water leaves the basin only through evaporation, Mono Lake has a salt content two times greater than the ocean. The alkaline waters of the lake do not support fish, but only fairy shrimp (*Artemia monica*), and the developing *pupae* of the brine fly (*Ephydra hians*) (National Academy of Sciences 1987; Jones and Stokes Associates 1993).

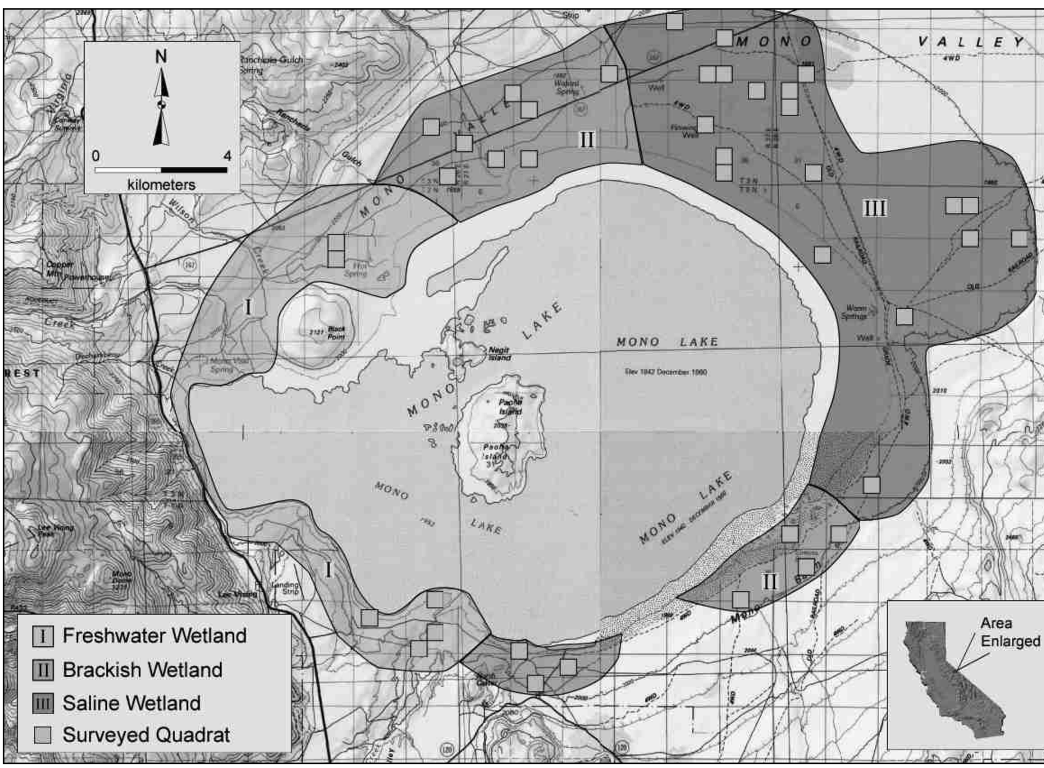

Figure 1. Map of the Mono Lake Basin with Wetland Classes and Surveyed Quadrats

above sea level in the west. The surface area covers more than 650 km^2 and the mean annual temperature is 9.2 °C. As a result of a rainshadow effect from the Sierra Nevada Mountains, rain does not fall evenly across the basin. In the west, 36.8 cm precipitates annually, while only 14.0 cm falls in the more arid east (Stine 1987). Eighty

Various animals and plants are found in the basin. Mammals include rodents (*Dipodomys* sp., *Neotoma* sp.), jackrabbits (*Lepus* sp.), cottontail (*Sylvilagus nuttallii*), antilope (*Antilocapra americana*), and mule deer (*Odocoileus hemiounus*). More than 290 species of birds visit the basin throughout the year, and the most common include Eared Grebe (*Podiceps nigricollis*), Wilson's Phalarope (*Phalaropus tricolor*), Red necked Phalarope (*Phalaropus lobatus*), and California Gull (*Larus californicus*). California Gulls lay eggs and nest on the lake's islands in the spring and summer, while the other birds mentioned remain there to put on weight during their annual migrations (National Academy of Sciences 1987). Plants present include various species of grasses such as foxtail barley (*Hordeum jubatum*) or salt grass (*Distichlis spicata*), and shrubs which are predominantly sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus nauseosa*), or greasewood (*Sarcobatus vermiculatus*), but there are fewer trees which include pinyon pine (*Pinus monophylla*) or Utah juniper (J*uniperous osteosporum*) (Constantine 1993). Plants and animals are distributed unequally around the basin, and their presence varies depending on the distribution of freshwater, soil alkalinity, sediment size, and surface topography (National Academy of Sciences 1987; Jones and Stokes Associates 1993; Stine 1993).

The paleoenvironment is understood through various proxy measures found throughout the Great Basin (Wigand and Rhode 2002). In the western Great Basin, these include plant macrofossils preserved and recovered from packrat (*Neotoma* sp.) middens (Jennings and Elliot-Fisk 1993; Koehler and Anderson 1993), prehistoric fluctuations in the treeline of bristlecone pines (Lamarche 1973), as well as the width of tree rings (Graumlich 1993). Within the Mono Lake basin, paleoenvironmental indicators include a pollen core taken from the lake (Davis 1999), along with a study of prehistoric lake elevation fluctuations (Stine 1987). Together, these data describe periods of change in moisture and temperature that occurred over both short and long duration throughout the Holocene and lead to development of the present vegetation mosaic by approximately 4000 years before present (B.P.) (Davis 1999).

Ethnography

Aboriginal inhabitants of the Mono Lake basin are the *Kutzadika'a* Paiute. Earliest European contact with the *Kutzadika'a* was in 1852 A.D. by a military expedition (Fletcher 1987). The original description of aboriginal activities is minimal, but shortly afterward there are historic documents reported by travelers, farmers, ranchers, and writers that describe certain *Kutzadika'a* activities. This information provides a picture of particular aspects of the aboriginal lifeway but they are still relatively short descriptions. More well-rounded information about their manner of living is found in the ethnographic works of Steward (1938) and Davis (1965). Steward's work includes discussions of the *Kutzadika'a*, the nearby Owens Valley Paiute, and other Great Basin aboriginal communities. The work of Emma Lou Davis (1965) focuses specifically on the Mono Basin. Based on interviews and travels around the basin with *Kutzadika'a* informants, Davis proposed a settlement and subsistence model that describes their traditional lifeway. It is characterized by seasonal mobility where people traveled to important resource patches throughout the year and populations would aggregate or disperse depending on resource productivity throughout the year.

In spring, people moved from winter camps to the western edge of the basin to collect roots and new growth from plants found near mountain streams. During the summer, people moved closer to the lakeshore to harvest plant seeds and hunt small game. At this time of year, some individuals would travel to the mountain uplands to hunt large game, such as mountain sheep and mule deer. By late summer, strong winds would often blow the brine fly *pupae* out of the lake's waters, causing them to accumulate along the northern shore in windrows. When this occurred people from areas further away would travel to the lakeshore to harvest and consume this resource that was easy to collect and process. In autumn, the people often organized communal rabbit or antelope drives. Groups from the surrounding areas would congregate, and their cooperation would often lead to the successful capture of large numbers of the animals. Communal activities served as times to share information about resource productivity in areas further away, to reinforce social relations, and to find opportunities for intermarriage and exchange. The exchange of food, minerals and other items was practiced on more of an individual level at other times of the year.

Another important autumn activity was the pinyon harvest, which occurred mainly in the mountains north and east of Mono Lake where pinyon groves were the densest. This resource was important for winter storage. During the winter, people subsisted mainly from foods stored throughout the year. If the pinyon harvest was productive, they would often make a winter camp near the pinyon caches. If not, they would move down to the area east of the lake where it was drier and closer to other stores of food.

Archaeology

There are several archaeological projects that have been undertaken in the Mono Lake basin over the years. The first that focused on the prehistory of the basin was done by Emma Lou Davis (1964) and was conducted in conjunction with the ethnographic project. She sought to study the temporal persistence of the identified ethnographic lifeway. Her work was achieved through surface survey and limited excavation. Davis (1964) identified eight classes of sites and proposed that together they demonstrate the persistence of the ethnographic lifeway through the Holocene. Although hunting is generally the most important activity, the exploitation of vegetal resources sees fluctuating intensity and is most important in the recent past.

Later, in the 1980's and into the new millennium other sites were excavated in the southwestern (Bettinger 1981; Carpenter 2001; Wickstrom and Jackson 1993) and central-eastern (Arkush 1995) parts of the basin. Those in the southwest are argued to demonstrate two distinct manners of living. The older pattern (3200-1350 B.P.) represents activities related to short-term hunting camps. Production and reduction of bifaces is an important activity during this time. The significance of bifaces is proposed to be related to an exchange network with people from the west side of the Sierra Nevada Mountains. The west slope of the Mountains generally contains less high quality stone material. Casa Diablo obsidian is often the most prevalent obsidian source in Yosemite Valley assemblages west of the Mono Lake basin (Hull 2002). It is not the closest obsidian source to the sites but has been argued to be a higher quality material than the more local source, Mono Craters. This proposition is supported by Casa Diablo obsidian being found in more distant contexts, such as near the California coast (Bouey and Basgall 1984). The more recent pattern (1350-protohistoric) includes plant processing as well as hunting activities, as seen through the presence of ground stone artifacts. There is less importance on flaked stone tool manufacture, less evidence of biface reduction, and an increased presence of core and flake tool-based technologies. Additionally, there is greater use of the local raw material, Mono Craters. Based on excavated sites, the archaeological record appears to represent a change in the use of the southwestern area. First, people went there for short periods of time to participate in activities related to hunting, tool manufacture, and possibly exchange. More recently, the pattern represents a diverse suite of activities that corresponds to those often undertaken by both sexes and signifies habitation by a complete family unit, rather than hunting parties. Also, the change identified in flaked stone technology is often found to correspond to a reduced mobility range among North American populations (Parry and Kelly 1987). One other project focused on the protohistoric lifeway (approximately 150 B.P.) of the *Kutzadika'a*. Arkush (1995) investigated a site east of Mono Lake where there are communal traps for hunting herds of antelope and wild horses as well as the remains of winter habitation structures. There is evidence of prehistoric use from approximately

3200 B.P., but this is scarce when compared to the protohistoric remains that represent communal activities and long-term occupation. Together, the evidence suggests less frequent and intensive use of the basin during the more ancient prehistoric era, while more recent times are represented by a greater diversity of activities and intensity of use.

Following this information, the current project focused on the wetland areas around Mono Lake to identify how they were used prehistorically and to see if this may have changed through time. The ethnographic record describes that the environment played an important role in the annual subsistence and settlement organization of the *Kutzadika'a*, while other works in the Great Basin highlight the importance of wetland habitats for many hunter-gatherer groups who lived within that arid environment (Janetski and Madsen 1990; Bettinger 1993). However, the role of wetland habitats varies by context (Madsen 2002).

Investigation of Mono Lake's Wetland Habitats

To study differences in the use of the wetlands surrounding Mono Lake, the habitat was separated into three different types: freshwater, brackish, and saline. Segregation of these types was done through analysis of the basin's physical characteristics and included the diversity and density of plants and animals as well as the presence of freshwater springs and streams, soil alkalinity, and sediment size. Size and productivity of a wetland is affected by elevation fluctuations of the lake, whether the shoreline is rising or falling (Jones and Stokes Associates 1993; Stine 1993). The freshwater group has the greatest diversity and density of vegetation and fauna, the most freshwater, and large grained sediments that can be leached of their alkalinity more rapidly once exposed during a lake recession. The brackish habitat has fewer such qualities as the freshwater, and the saline wetland has the least diversity and density of vegetation and fauna, freshwater, and the smallest sediment size of the three classes. Areas below 2020 m asl. and less than a kilometer from a source of permanent or seasonal freshwater comprise the present sample (Figure 1). This includes lands up to 40 m above a lake high stand that occurred approximately 3500 B.P (Stine 1987).

Following information provided from ethnographic and archaeological data, predictions were that the freshwater wetlands would exhibit the greatest use through time. Intensity of use in this area would gradually increase until the most recent prehistoric times, while exploitation of the other wetlands would eventually be included as use areas. The first new area to be exploited would be the brackish wetlands, followed by the saline habitats as people began using the greater area more intensively and for longer periods of time. In general, the predictions follow expectations of the Diet Breadth and Patch Choice models (Bettinger 1991), where the resources that are most easily collected and processed for the energy received are generally exploited first. According to these schemes, the freshwater habitats would be the first selected due to the types of plants and animals present, while the saline habitats would generally be chosen last due to the relative lack of important resources that result from greater aridity. Other research in the southwestern Great Basin has suggested a pattern of greater sedentism along with an expansion of the diet breadth as plant and animal resources are exploited with greater intensity in more recent times (Bettinger 1999).

Results

Information recovered suggests that prehistoric landuse patterns were contrary to the predictions. The density of artifacts encountered in each wetland initially supported the predictions about intensity of use with the freshwater wetlands containing the greatest density of artifacts (20/ km^2), the saline contained the least (7/ km^2), with the brackish falling in between the two (11/ km^2). Dissimilar to the density of artifacts, the distribution of tools and debitage did not meet expectations in that only one freshwater quadrat contained a full array of flaked and ground stone artifacts (Table 1). One assumption was that quadrats with a greater number of tool classes suggest greater residential activity, while those with isolated flakes and few tool classes signify short term activity where the tasks undertaken did not often end an artifact's use-life, although it may have been retouched or fabricated there. Instead of the freshwater habitat, the brackish wetlands demonstrated the most quadrats with flaked and ground stone tools along with debitage. This, coupled with the lower artifact densities suggests that the remains represent short-term camps for hunting and plant collection/processing. The saline habitat contained mostly debitage, suggesting that the area was predominantly used for short-term activities that likely focused on hunting. If one studies the distribution of artifact classes across the wetland habitats, it appears that different activities were undertaken in the wetlands (Table 2). Of note is the distribution of flaked stone tools and assayed cobbles in the brackish wetland, projectile points and bifaces in the saline area, and cores, flake tools, and bedrock mortars in the freshwater habitat. Analysis of these distributions is more fully developed in my Master's thesis (Brady 2007), but some of the conclusions reached will be discussed here. The chronology, which is dependant upon obsidian hydration, is summarized by focusing on the most prevalent obsidian source. Six distinct obsidian sources were present in the collected sample. The source of each collected artifact and piece of debitage was determined through a combination of visual sourcing methods, along with samples tested through x-ray fluorescence (XRF) analysis. There are

Table 1. Quadrat constituents by wetland class

	Empty	DBTG Only	GSTN Only	DBTG & FTL	DBTG & FSTN	DBTG & GRNSTN	All Tool Classes	MGS
Freshwater	-	2	-	2	-	1	1	6
Brackish	2	2	-	2	2	2	6	15
Saline	-	11	1	2	-	2	3	19
Total	2	15	1	5	2	5	10	40

DBTG: debitage; **GSTN**: ground stone tool; **FTL**: flake tool; **FSTN**: flaked stone tool

Table 2. Artifact distribution across wetland class

	PPT	COR	BIF	FTL	HND	MIL	PST	MGS	BRM	ASC	CRTL	Total
Freshwater	0	5	2	14	2	1	1	0	4	5	0	34
Brackish	4	2	3	16	5	5	0	2	0	25	1	63
Saline	3	0	5	10	5	5	0	3	0	0	1	32
Total	7	7	10	40	10	11	1	5	4	30	2	129

PPT: projectile point; **COR**: core; **BIF**: biface; **FTL**: flake tool; **HND**: handstone; **MIL**: millingstone; **PST**: pestle; **MGS**: miscellaneous ground stone; **BRM**: bedrock mortar; **ASC**: assayed cobble; **CRTL**: core tool differences in hydration rates among the individual sources present, so the discussion focuses only on Mono Craters hydration readings which comprise the bulk (n=212; 82.8%) of the overall sample (Figure 2). The measurements were converted to years before present (B.P.) using an obsidian hydration rate that was derived for the source (yBP=x^2/14.7) (Onken 1991) and applied with relative success in an earlier archaeological project (Carpenter 2001).

Most ancient use of the basin is found in the saline wetland. Debitage produced through biface reduction dominates the archaeological record in that habitat. Corresponding with the debitage, bifaces are also important tools recovered there. The importance of bifaces, together with the large amount of bifacially reduced debitage and minimal number of other tools suggests a mobile settlement strategy during this time period (before 3200 B.P.). By around 3800-3500 B.P., the lake had risen to a high stand, making the eastern, saline wetlands more expansive and productive for both waterfowl and plants.

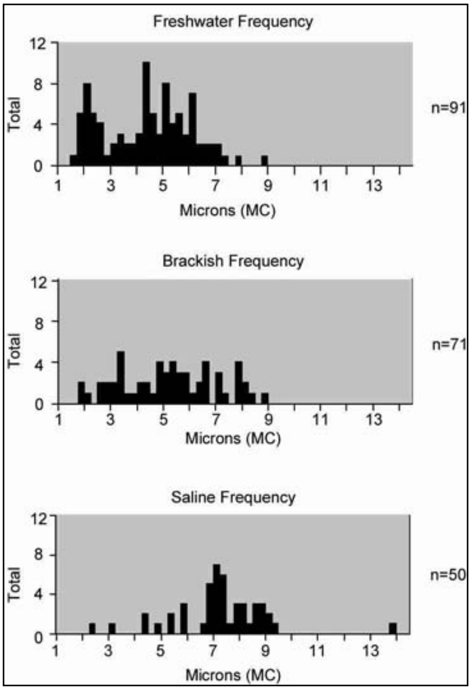

Figure 2. Histogram of Mono Crater Obsidian Hydration Measurements

After the lake had risen to its high stand, it began a large recession from 1980-1941 m asl. between ca. 3400-1850 B.P. At this time greater intensity of use is found in the brackish wetlands. In the north, a diversity of activities is represented that include hunting, and plant collection and processing. In the southern brackish area the most important activity represented is obsidian raw material acquisition from the Mono Crater's obsidian source. Two of the surveyed quadrats contained unmodified and assayed cobbles pertaining to this source. As the lake's shoreline declined, the saline wetlands dried up while those in the north and west remained productive due to greater availability of freshwater and larger sediment size. These allow lake-deposited minerals to be leached from the soil and for vegetation to expand to the newly exposed lakebed.

From around 1350 B.P. until historic times (ca. 150 B.P.), occupation intensity becomes more focused in the southwestern freshwater area. During this time period the lake underwent rapid elevation fluctuations. In the western area, the greater permanence of freshwater and larger sediments easily allowed vegetation migrations during changes in the lake's shoreline. These characteristics made the locality more productive for hunter-gatherers than other portions of the lakeshore because they promoted more robust vegetation growth that did not simply dry up as the lake elevation lowered. This, in turn, also made it an important habitat for a variety of animals. The greater intensity of use found in the southwestern freshwater area is observed by the greatest density of artifacts discarded, and the use of specialized bedrock mortar technology. Also observed in this portion of the basin is a prevalence of core and flake technology rather than the biface-oriented one that is common in other parts of the basin. Together, these lines of evidence suggest a different manner of living than found during earlier times in the basin and is seen through the use of distinct technologies and greater occupation intensity proven by the greater numbers of discarded tools.

Conclusions

The archaeological data collected during surface survey suggest that the strategies of prehistoric landuse within the Mono Lake basin changed across space and through time. This project highlights the varied importance of the different lakeshore wetlands through time, something not addressed from the information provided through individually excavated sites. A dynamic distribution of activities undertaken at different locations and points in time is represented in the surface archaeological record. This begins with short-term use of the saline wetlands for mainly hunting activities. As time progressed, the nature of the wetlands shifted, and so did peoples' activities. Landuse changed to focus on small occupations represented by plant and animal processing gear in the northern brackish habitats, and toolstone procurement in the southwest. Finally, in the most recent prehistoric times occupation intensity became focused in the southwestern freshwater habitat. It appears that populations were larger and more residentially stable than they had been previously. New information from the Mono Lake basin demonstrates that the surface archaeological record can be used to answer questions of prehistoric landuse that may be overlooked when focusing on isolated excavated assemblages. It also demonstrates that the importance of a particular wetland within an arid context may change through time depending on how people adapt to changing environmental and demographic constraints through technology and mobility, among other variables.

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