UNDERSTANDING THE ROLE OF YELLOWSTONE LAKE IN THE PREHISTORY OF INTERIOR NORTHWESTERN NORTH AMERICA*

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ABSTRACT

As North America’s largest, high-elevation lake, Yellowstone Lake, Wyoming, played an important role in the lifeways of Great Plains, Great Basin, and Rocky Mountains Native Americans during prehistory. Various hypotheses suggest that the lake was important during the spring for fishing, during the winter for hunting, and/or during warm months for generalized foraging. Because the lake’s islands contain archaeological sites, some also have proposed that boats were utilized during prehistory at the lake. Using ethnohistoric, archaeological, and spatial data, we evaluate these suppositions about use of Yellowstone Lake. We suggest that annual use of the lake was initiated in early spring when the lake was frozen providing access to islands and continued through the summer. Lithic data and ethnohistoric research support the hypothesis that multiple ethnic groups used the lake in prehistory because it is a concentrated resource area.

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Yellowstone Lake, Wyoming, is North America’s largest, high-elevation lake. Because of the numerous sites that ring the lake’s 200 km circumference, archaeologists have long sought to understand the lake’s precise role in the seasonal subsistence and settlement patterns of the region’s many Native American ethnic groups. In this article, we present data from the University of Montana’s and other researchers’ prior work to evaluate several hypotheses regarding the settlement and subsistence patterns of prehistoric hunter-gatherers that used the lake during the last 10,000 years.

Using ethnohistoric, archaeological, and spatial data, we evaluate five key questions regarding use of Yellowstone Lake in prehistory: 1) What are the points-of-origin for Native American groups that used the lake; 2) How was subsistence organized at the lake, especially related to fishing, hunting, and gathering; 3) Were boats used by Native Americans at the lake or was mobility primarily by pedestrians; 4) How did people travel to the lake’s islands; and 5) Ultimately, why were Native Americans attracted to the lake? Our goal is to define the role of Yellowstone Lake among Native Americans who lived within the northwestern Great Plains, the northern Rocky Mountains, and the far northeastern edge of the Great Basin.

YELLOWSTONE LAKE ENVIRONMENT AND ECOLOGY

At an elevation of 2,360 m (7,750 ft.) amsl and measuring 30 × 25 km, Yellowstone Lake is the heart of the Greater Yellowstone Ecosystem (GYE) which encompasses nearly 80,000 km² within northwest Wyoming, south-central Montana, and northeast Idaho (Figure 1). Bordered by the Absaroka Mountains to the east and the Teton Range to the south, the lake is within the Wyoming portion of the Yellowstone Plateau physiographic province, a high-elevation, geologically-active uplift. Associated with active volcanism, thermal steam features are present on the northeast and southwest lake shores.

The Yellowstone River is the major lake tributary (Figure 2) and has two confluences on the lake, flowing into it on its southeast corner and out of it ca. 30 km to the northeast. Among 60 or so other smaller streams that flow into the lake, Clear Creek arrives on its northeastern shore and has its headwaters in the Absaroka Range, nearly meeting the Shoshone River which flows eastward to the Big Horn Basin. Each of these three major waterways—the southern and northern Yellowstone Rivers and Clear Creek—were active travel routes in prehistory, as discussed herein. Other major lake-feeder-streams include Pelican Creek on the north, Trail Creek on the southeast, Solution Creek on the southwest, and Arnica Creek on the west. The Madison River to the west of the lake was also a major regional route utilized in prehistory to gain access to the GYE.

Yellowstone Lake levels have fluctuated during the late Pleistocene and Holocene due to deglaciation and climate change, resulting in a series of old
terraces, or paleo-shorelines (Pierce et al., 2007). The paleo-shorelines have been well-dated by Pierce et al. (2007) and Locke and Meyer (1994), with recent work by the University of Montana refining some of these terrace formation chronologies on the east shore of the lake (Hoffman and Hendrix, 2012). The ages of the terraces provide minimum timelines for prehistoric occupation, with
the more-recent terraces closer to the lake shore (S0-S2) dating to the Holocene (< 9,000 uncalibrated years B.P.) and older terraces (S3-7) dating to the late Pleistocene-early Holocene (> 9,000 uncalibrated years B.P.). The more recent terraces are adjacent to the lake shore and within 0-2 m in elevation above it, whereas older terraces are inland 10-200 m from the shore and between 3-10 m above.

These paleo-shorelines provide a maximum age of occupation for an archaeological site at Yellowstone Lake. For example, Pierce et al. (2007:137-142) use radiocarbon dating to estimate that the S2 paleo-shoreline dates to no older than ca. 8,000 uncalibrated years ago; thus, any archaeological sites on that landform must be younger than that age. UM’s recent work at 48YE381 on the S2 terrace near the Yellowstone River outlet (MacDonald et al., 2011) confirmed this landform age by excavating the only radiocarbon-dated Early Archaic (ca. 6,800 B.P.) hearth in Yellowstone (but found no older materials).

Seasonality is important in understanding human use of the GYE. May through October are the only months with average temperatures around or above 10°C. November through March puts the lake area in snowfall zones averaging ca. 50 cm or more per month with accumulation of a meter or more from November through April. Yellowstone Lake is frozen up to 60 cm thick between approximately early December and mid-late May.

Yellowstone Lake’s shores contain several vegetative zones, including a mesic subalpine fir zone, forested riparian zone, graminoid riparian, and sagebrush or shrub and grass habitats (Despain, 1990). These vegetative zones are the result of several transitions occurring in the park after deglaciation. Lodgepole pine dominates the lake shore terraces and herbaceous plant communities comprise the principal understory growth. Lakeshore terraces support sagebrush communities including silver sage, big sagebrush, as well as a variety of grasses, while the stream banks and marshy areas produce stands of willows, sedges, and rushes.

Interspersed among the extensive pine forests that enclose the lake, these open meadows and riparian areas are extremely diverse, containing as many as 400 plant species (Elliot and Hektner, 2000). During 2009, UM identified ethnographically-recognized plant resources used for medicinal, spiritual, and subsistence-based purposes. Fifty-two different plant species were identified within a 20-acre meadow on the northwest shore of the lake, of which 15 species were recognized as food sources, 17 species as medicinal, and eight species as spiritually important (Kershaw, 1998). Wright et al. (1980:183) conducted a plant-use study for the nearby Jackson Hole region to the south of the lake, with similar findings.

Based upon pollen samples in the southern portion of YNP, the present ecozones (sage brush steppe, montane conifer forest, and alpine tundra) were established sometime during the Late Pleistocene to Holocene transition between
10,500 and 9,000 uncalibrated $^{14}$C yr B.P. (Whitlock, 1993). Associated with the warm, dry Altithermal, steppe-dominating grasses are prevalent between 7,000 and 5,000 B.P., suggesting maximum dryness in the area during this time (Gish, 2013). After 5,000 B.P., environmental conditions similar to today emerged across the northern Plains and Rockies, including Yellowstone.

This diversity of plant resources support more than 60 mammal species, including bison, elk, moose, big horn sheep, deer, antelope, grizzly and black bear, mountain lions, coyotes, and wolves. A vast majority of Yellowstone’s bison and other medium and large ungulates are seasonally migratory, moving up in elevation in warm seasons and down in elevation in cold seasons (Cannon, 2001). Another seasonally migratory subsistence resource in Yellowstone Lake is cutthroat trout (*Oncorhynchus clarki bouvieri*), one of only two surviving original native cutthroat trout species left in North America. Cutthroat trout are abundant at the lake (and was in the past), especially in spring when it runs up the lake’s creeks to spawn.

**BACKGROUND AND CULTURE HISTORY**

**Prior Archaeological Research at Yellowstone Lake**

Our research questions originate from various hypotheses set forth during the last 50 years of archaeological studies at Yellowstone Lake, Wyoming. Since the first archaeological inventories of Yellowstone Lake’s West Thumb area during the late 1950s, many archaeological studies have been performed around Yellowstone Lake. Figure 2 shows the general locations of many of these sites. Seminal inventories conducted by Montana State University, Missoula (now the University of Montana), identified over 200 archaeological sites within Yellowstone National Park (Hoffman, 1961; Malouf, 1958; Taylor et al., 1964). Hoffman (1961:16-18) was the first to identify the high density of prehistoric sites at Yellowstone Lake. Taylor et al. (1964) performed the first systematic archaeological excavations at the lake at the Fishing Bridge Site (48YE1) on the north shore near the Yellowstone River outlet, while Cannon et al. (1993) and UM (Livers and MacDonald, 2011) conducted additional work there in the 1990s and 2000s, respectively.

In the 1980s, more-focused academic research was conducted by the Midwest Archaeological Research Center (MWAC) on the southwestern shore, results of which are discussed below (Reeve et al., 1981; Samuelson, 1983; Wright et al., 1978, 1980). In the 1990s, Cannon et al. (1996) of the MWAC conducted excavations at several sites on the west and north shores. Their work resulted in the identification of Intermountain Ware pottery at the First Blood Site (48YE449) on the western shore and the excavation of the lake’s only bison kill at the Windy Bison Site (48YE697) on the northeast shore. Finally, on
the south shore, Ann Johnson (Johnson et al., 2004; Shortt and Davis, 2002) led excavations at the Late Paleoindian Osprey Beach site (48YE409/410) with its extensive Cody Complex (ca. 14CyrB.P. 9,300 B.P.) occupation. More recently, Yellowstone National Park provided funding to complete survey and testing of archaeological sites on the northwest, eastern, and southern shores of Yellowstone Lake (MacDonald, 2012; MacDonald and Hale, 2013; Vivian et al., 2007, 2008).
Yellowstone Lake Culture History

These various studies have identified 285 archaeological sites along the shores of the lake, with 104 of those yielding 175 dateable occupations (McIntyre, 2012). Recent excavations by the University of Montana at dozens of lake-area sites confirm active use of the lake since the Paleoindian period (Figure 3) (Livers and MacDonald, 2012; MacDonald, 2013; MacDonald and Livers, 2011). Beginning in the Late Paleoindian period at sites like Osprey Beach, Native American hunter-gatherers visited Yellowstone Lake, escalating the intensity of use after 3,000 years ago (Johnson, 2002:82; Sanders, 2002:219). Of the 26 radiocarbon-dated features excavated by UM between 2009-2011 at 11 sites, only one (a \textsuperscript{14}CyrB.P. 6,800 B.P. hearth at 48YE381) predates 3,400 \textsuperscript{14}CyrB.P. (MacDonald et al., 2011), with Middle Archaic (n = 5), Late Archaic (n = 11), and Late Prehistoric (n = 9) features dominating the feature assemblage. As of 2011, the various archaeological studies conducted at the lake have identified 25 Paleoindian, 22 Early Archaic, 38 Middle Archaic, 54 Late Archaic, and 36 Late Prehistoric occupations (McIntyre, 2012).

PRIOR YELLOWSTONE LAKE ARCHAEOLOGICAL RESEARCH

While we know that the lake has been used extensively by Native Americans, we still do not fully understand the function of Yellowstone Lake within

![Figure 3. Prehistoric use of Yellowstone Lake: site and feature counts by time period.](image)
hunter-gatherer settlement and subsistence systems. Our five research questions introduced above largely stem from prior conclusions set forth by other researchers about lake use in the past (Hale, 2003). Recent studies by Scheiber and Finley (2011:375) suggest that the Shoshone were the dominant tribe within the GYE and other researchers (Johnson et al., 2004:143-144) suggest that Yellowstone Lake may have been at the center of a large territory used by a single group. Alternatively, Johnson et al. (2004:142-143) suggest that multiple groups from different regions used the lake, a supposition supported in recent research by Park (2010).

The 1980s MWAC researchers (Reeve et al., 1981; Samuelson, 1983; Wright et al., 1978, 1980) were the first to speculate as to the function of the lake in the prehistoric settlement and subsistence systems during prehistory. These researchers proposed that the lake was used during the winter to hunt ungulates at volcanic hot spots or, alternatively, during the spring to fish for cutthroat trout as they ran up the lake’s tributaries. However, MWAC’s limited data resulted in inconclusive results. Their studies found no faunal remains to indicate winter hunting, nor fish remains to indicate spring fishing. Regardless, the researchers indicate that the locations of the hunting sites near thermal features and the fishing sites near stream confluences confirm their interpretations. In addition, they cite the presence of “notched flakes” as indication that Native Americans produced wooden sticks to be used for fishing. No detailed descriptions or illustrations of the notched flakes were provided, nor were blood residue analyses performed to confirm or refute the wood working and fishing hypotheses.

More recently, Johnson (2002:83; Johnson et al., 2004:137-138) speculates that the lake was exclusively used during warm months due to the lack of available winter resources at the inhospitable lake. However, she also fails to provide information to support these ideas (Johnson, 2002:83), admitting that (as of 2002) “we have not found any seasonal indicators for sites around the lake.”

Johnson (2002; Johnson et al., 2004:139) also attempts to explain how the lake’s five islands contain archaeological sites, pushing forward the notion of boat use rather than winter access or swimming by stating that “although direct evidence is lacking, we suggest seasonally resident Cody bands at Yellowstone Lake . . . probably fished, fowled, and perhaps used skin-covered boats on Yellowstone Lake.” The speculation of boat use is further confirmed in illustrations (Figure 4) produced for the Late Paleoindian Osprey Beach site by Johnson for public presentations on that important site. She largely disregards access to the islands when the lake was frozen due to the frigid winter conditions (Johnson et al., 2004:137).

Sanders (2002:214) also explored the seasonality of use within the nearby Hayden Valley, just north of the lake along the Upper Yellowstone River Valley. Following Johnson, he suggests only warm-season use of the higher-elevation portions of the Yellowstone Plateau, including Yellowstone Lake, with movement downslope into lower-elevation river valleys in winter. Sanders (2002:217) also
Figure 4. Osprey Beach illustration. Courtesy of Yellowstone National Park (Johnson et al., 2004).
briefly refutes the earlier MWAC speculation for fishing, suggesting that “although preservation of fish bones is a problem, fishing-related artifacts (e.g., net weights or sinker) have not been clearly identified at any site in the lake area or Upper Yellowstone River” (Taylor et al., 1964).

**YELLOWSTONE LAKE ANALYSIS RESULTS**

In consort with ethnohistoric data (Nabakov and Loendorf, 2002, 2004), we provide archaeological and spatial data to evaluate these previously-proposed ideas regarding use of the lake. As reported herein and elsewhere (MacDonald and Hale, 2013; MacDonald et al., 2011), UM’s research on the northern, eastern, and southern lake shores supplements these prior studies discussed above. Lithic material, protein-residue, faunal, and ethnobotanical data allow us to assess prior concepts of Yellowstone Lake use. We have also compiled spatial data on site locations to better understand site distributions around the lake relative to habitat, stream confluences, and paleo-shorelines.

In the following, we attempt to answer our five research questions in light of three main forms of data:

1. ethnohistoric and ethnographic, largely summarized from Nabakov and Loendorf (2002, 2004);
2. archaeological site-specific data collected by UM and others; and
3. spatial data on site locations around the lake relative to habitat and to paleo-shoreline type.

We conclude with our overall interpretations regarding the functionality of the lake using each type of data as they lend insight into understanding when, how, and why hunter-gatherers used Yellowstone Lake during prehistory.

**Ethnohistoric and Ethnographic Data**

Our ethnohistoric and ethnographic data are largely, but not exclusively, compiled from Nabakov and Loendorf’s (2002, 2004) seminal studies of contemporary Native American use of the GYE and Yellowstone Lake. We feel these data are compelling in facilitating our interpretation of the role of Yellowstone Lake in the seasonal round of Native American hunter-gatherers.

**Native American Use of Yellowstone Lake**

Nabakov and Loendorf’s research is sufficient to answer Research Question 1: What were the points of origin for Native Americans that used the lake? While recent archaeological analysis by Scheiber and Finley (2011) largely focuses on use of the GYE by the Shoshone, the ethnographic literature suggests that a diverse suite of ethnic groups utilized the region. Among these groups include the Shoshone, Bannock, Crow, Blackfeet, Salish, Kiowa, Nez Perce, among many others. In particular, the Blackfeet and Crow are known to have used the northern
tier of the lake, while Nabakov and Loendorf suggest that the Wind River Shoshone were focused in the lake’s southern tier. The Bannock and Nez Perce mostly used the northern tier of the lake as well, with the latter apparently focused in the Pelican Creek Valley as a main warm-season bison hunting area. It is not reasonable to think that the Shoshone were the exclusive users of the Greater Yellowstone Ecosystem, even in later prehistory, especially in light of the ethnohistoric and archaeological data presented herein.

Subsistence at Yellowstone Lake

While the ethnohistoric data adequately account for the diverse tribal associations of Native Americans that used the lake, it is somewhat less sufficient in discussing research question 2: How was subsistence organized at the lake, especially related to fishing, hunting, and gathering? While Nabakov and Loendorf provide good information on the generalized hunting, fishing, and gathering patterns of Native Americans in the Greater Yellowstone Ecosystem, they are less adept at specifically addressing lake-use in prehistory related to subsistence patterns.

Certainly, the ethnographic studies completed for Nabakov and Loendorf’s work suggest that the various groups that used the lake incorporated a wide variety of subsistence strategies into their survival repertoire. Among the tribes, the Shoshone and Bannock are the only groups likely to have used the lake for fishing. Nabakov and Loendorf (2004:174) report that “[the Northern Shoshone] fished in Yellowstone Lake . . . ,” although details and specific ethnographic accounts of fishing at the lake are lacking. Ethnographic reports (Lowie, 1909, 1924; Murphy and Murphy, 1986; Steward, 1938) indicate that the Shoshone/Bannock fished extensively in the spring, mostly using brush dams and rock weirs. Shoshone/Bannock origin stories describe how coyote spilled mother earth’s basket of fish (interpreted to be Yellowstone Lake) forming the various inland northwest river systems (Nabakov and Loendorf, 2004:242-244), certainly supporting the notion that the Shoshone were well aware of fish in the lake.

Thus, given that the Shoshone fished and that they were aware that the lake contains fish, it is reasonable to assume that the Shoshone likely fished at Yellowstone Lake. This activity likely occurred in spring, sometime between May through July, depending on the timing of the lake thaw and the spring fish runs up creeks. Nabakov and Loendorf’s informants, including Dick Washakie and Ake Hultkrantz, confirm that both the Northern and Lemhi Shoshone fished a lot and that there were no magical restrictions or other social limitations on who could fish, as there were with hunting activities.

However, Nabakov and Loendorf do not provide specific ethnographic accounts of the Shoshone fishing at the lake, only that the Shoshone were known to have done so. Certainly, the ethnographic data rule out fishing by both the Blackfeet and Crow at the lake, the latter of which have stories about a monster in the lake, likely a deterrent to its use (McAllester, 1941). Thus, if the lake was
used for fishing, it was by the Shoshone/Bannock in the spring, at least in recent history and prehistory. Subsequent archaeological data will provide more information on this research question.

In addition to fishing, ecological data support the viability of hunting and gathering at the lake as well. Ethnographic accounts of use of the Yellowstone region include the collection of a wide variety of plants, including roots, seeds, and nuts. For the Shoshone, these account for 30-70% of their diet. Elliot and Hektner’s (2000) study of riparian areas of Yellowstone identified more than 1,200 species of plants, many of which are edible and/or medicinal. Blue camas was especially attractive for the Bannock and Shoshone, one of the key edible plant species identified by the University of Montana within the lake’s shoreline meadows. Wright et al. (1980) and Johnson et al. (2004:139) also speculate that camas (*Camassia* sp.) was likely the most important spring root crop for Native Americans at Yellowstone Lake and vicinity.

Mammal hunting was also vital to the lake-area subsistence regime during recent history. As noted above, more than 60 species of mammals inhabit the lake’s environs, including elk, bison, deer, bear, rabbits, and sheep, all of which were hunted. Bears are active at the lake, although Nabakov and Loendorf do not provide data by which to address Native American bear hunting in the Yellowstone uplands. Hallowell (1926) provides accounts of bear hunting among a host of northern-latitude hunter-gatherers, including the regionally-pertinent Cree. All of these hunter-gatherers, including those from Asia, Europe, and the Americas, hunted bears in the early spring. During the spring, with snow still on the ground, bears emerging from hibernation were easy targets as they lounged outside of their dens. Dens were typically marked by hunters in the fall/winter or were otherwise located by hunters who would then return in the early spring.

It is certainly reasonable to speculate that Native Americans would have been attracted to Yellowstone Lake and its surrounding environs to hunt bear. In our discussion of island access, the lake does not thaw completely until the end of May. Walking across the lake is tenable until early-mid-May in most years. Thus, bear hunters likely were at the lake at a time when ice was thick enough to walk to islands (all of which have archaeological sites).

In support of this supposition, Yellowstone National Park’s current bear management officer (Kerry Gunther, personal communication, March 19, 2012) notes that he has observed bears on three islands and recorded one (Stevenson Island) with a bear hibernation den. Hibernating bears on the islands certainly would have encouraged human hunters to walk across early-spring ice, especially if the hunter had pre-scouted the presence of den in the late-fall or early-winter.

**Native American Boats at the Lake**

The ethnohistoric record provides little information by which to address research questions 3 and 4: Were boats used by Native Americans at the lake or
were the lake’s shores and islands accessed only by pedestrian hunter-gatherers? Boats would have provided easy access to the lake’s islands and would have facilitated transport of people and their goods around the lake’s shores. Nevertheless, the ethnographic and ethnohistoric literature is deficient of any accounts of Native American boat use at Yellowstone Lake. Norris’ 1880 superintendent report (Norris, 1881) indicate the casual observation of a dug-out canoe downriver on the Yellowstone and another near Beaverdam Creek on the southern lake shore, although these are just as likely to have been historic as prehistoric. Nabakov and Loendorf’s studies fail to address Native American boat use in their research, nor do any other ethnographers or ethnohistorians address boat use within Yellowstone. Nevertheless, among the tribes that used the lake, the Shoshone are known to have utilized skin boats in their collection of riparian resources in lower-elevation lakes and in the Great Basin (Steward, 1938). Discussed below, the archaeological data will be crucial in better understanding boat use at the lake.

The ethnohistoric, ethnographic, and ecological research summarized above provides clues regarding the answers to research question 5: Why were Native Americans attracted to the lake? Following others (Johnson et al., 2004:138-139), we propose that the lake served as a concentrated resource area in which a host of seasonally-available resources were procured by mobile hunter-gatherer populations. In terms of seasonality, we propose that the use-cycle was initiated in early spring with snow still on the ground and ice still on the lake, thus explaining island access.

This early seasonal use contrasts most recent interpretations set forth by Johnson et al. (2004) and Sanders (2002), as discussed above, which posit a later start of the season use cycle in perhaps June, only during warm months. We propose that individuals visiting the lake earlier in the seasonal cycle (perhaps March/April) were likely bear hunters who also were scouting lake conditions to estimate the timing of plant availability and even perhaps cutthroat trout runs up creeks. Certainly, summer to fall were the prime hunting and gathering seasons and account for the majority of ethnohistoric and archaeological use episodes, however we support an earlier initiation of that seasonal cycle for bear hunting and information collection. We discuss how archaeology can contribute to our understanding of these interpretations below.

Archaeological Data

Lithic Material Studies and Point of Origin

As with the ethnohistoric discussion above, we target the five research questions using archaeological data from sites excavated around the shores of Yellowstone Lake. Figure 2 above shows the 28 key archaeological sites and two important pollen core study locations used in this study. These sites have

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yielded more than 24,000 lithic, faunal, and ethnobotanical artifacts from the excavation of more than 240 sq. m. around the entire circumference of the lake. As shown in Figure 2, we focus our discussion on sites within four areas of the lake—northwest, northeast, southeast, and southwest—with excellent comparative data to evaluate our research questions.

As depicted in Figure 1 above, lithic source data are useful in determining the point of origin for hunter-gatherers that used the lake in prehistory. In this analysis, we focus on the overall lithic material trends on the respective shores of the lake, regardless of period of occupation. Chronologically, there is some variation in material use over time, as discussed elsewhere (MacDonald et al., 2011), but in general the material use-trends discussed below hold true for most of the prehistory of the various shorelines of the lake.

We use two sets of lithic material data in our current analysis. First, we compare the use of obsidian and chert at sites on the northwestern, northeastern, southeastern, and southwestern lake shores. To simplify our comparison of the data, we include all extrusive volcanic materials within the obsidian category, including dacite, while in the chert category we include all sedimentary silicate rocks, including chert, chaledony, silicified/petrified wood, and orthoquartzite. Sources for these various materials are identified in Figure 1.

Second, we use energy-dispersive x-ray fluorescence (EDXRF) analysis results of volcanic lithic artifacts at the lake, collected during our own and other’s research, with all analyses completed by Richard Hughes (2010). In our presentation of the EDXRF data, we distinguish four major volcanic-material source areas, including:

1. Obsidian Cliff, located 35 km northwest of the lake (Davis et al., 1995);
2. western sources, including Bear Gulch and Cougar Creek obsidians, and southwest Montana dacites;
3. eastern sources, including only Park Point obsidian from the eastern shore of Yellowstone Lake; and
4. southern sources, including obsidians from near Jackson, Wyoming (Teton Pass, Conant Creek, Packsaddle Creek, Crescent H, Warm Springs, Huckleberry Ridge, and Lava Creek).

Both of these sets of information—the obsidian vs. chert and the EDXRF data—help resolve the points of origin for Native Americans that used Yellowstone Lake.

In total, our lithic material study encompasses more than 24,000 artifacts from 28 well-studied sites at the lake (see Figure 2), including 23 by UM and five by others. On the northwest shore, we use our data from seven sites near the Yellowstone River outlet (48YE380, 48YE381, 48YE1556, 48YE1558, 48YE1553, 48YE549, and 48YE2111; Livers and MacDonald 2011; MacDonald and Livers, 2011). On the northeast shore, we combine our data from seven sites
along Cub and Clear Creeks (48YE2075, 48YE678, 48YE2080, 48YE2082, 48YE2083, 48YE2084, and 48YE2085; Livers and MacDonald, 2012) with those collected by Cannon et al. (1997) at three sites near Steamboat Point (48YE696, 48YE697, and 48YE701). On the southeast shore, we combine our data (Livers and MacDonald, 2012) from sites 48YE1499 and 48YE2107 near the Yellowstone River inlet with those collected by Lifeways (Vivian, 2009) at the nearby Donner Site (48YE252). On the south-central and southwest lake shore, we combine our data (MacDonald, 2012a) from seven excavated sites on the south-central lake shore (48YE1660, 48YE1664, 48YE1670, 48YE2190, 48YE1384, 48YE1383, and 48YE1601) with those collected by Lifeways (Johnson et al., 2004) at Osprey Beach (48YE409/410) on the southwest lake shore (West Thumb area). Numerous additional data are available from other studies and other areas of the lake, but for the purposes of this article, these four areas—Northwest, Northeast, Southeast, and Southwest—provide adequate samples to evaluate points of origin and the function of the lake in prehistory.

Overall, obsidian accounts for 88% of all lithics at the northwest shore sites. Chert (8%) is a minority and largely derives from the Crescent Hill chert source to the north along the Yellowstone River. EDXRF data ($n = 234$ total sourced lithics) suggest mobility to the west-northwest as well. As shown in Figure 5, sites on the northwest shore of the lake are heavily dominated by Obsidian Cliff obsidian (79.5% of XRF-sourced lithics) with sources 30 km northwest. In addition to the high percentage of Obsidian Cliff obsidian, southwest Montana dacites and Bear Gulch obsidian account for 11.7% of sourced lithics, while the Park Point source on the eastern lake shore accounts for 6.8% of sourced lithics. EDXRF data do not support active travel or even trade to the south, with only 1% ($n = 2/234$) of obsidians at northwest shore sites deriving from Jackson area obsidian sources.

The focus for north shore Native Americans was squarely to the north and northwest, with those areas comprising 91.2% of sourced EDXRF lithics. Together with the dominance of Crescent Hill chert among microcrystalline silica materials, the volcanic material data indicate that people living near the mouth of the Yellowstone River on the northwest shore likely originated from the north and northwest, likely using the Gardiner, Madison, and Yellowstone River Valleys as the main travel corridors to access the lake.

There are significant differences in obsidian and chert use between northeastern and northwestern lake users ($\chi^2 = 44.103; df = 1; p = .000$), with more obsidian on the northwest shore (88%) compared to the northeast shore (69%) due to the northwest shore’s proximity to Obsidian Cliff. Increased amounts of chert on the northeast shore (31%) compared to the northwest shore (8%) is due to the northeast shore’s proximity to Absaroka cherts. Northeastern shore hunter-gatherers also used significant amounts of Park Point obsidian (30%) from the eastern lake shore. They also apparently targeted Obsidian Cliff, given that it represents nearly 67% of the obsidian at northeastern shore sites. Other sources
Figure 5. Comparison of lithic raw material use at Yellowstone Lake.
represented in northeast lake shore EDXRF data include Teton Pass \((n = 2)\) and Conant Creek \((n = 1)\), indicating minimal use of southern sources.

As reflected in Figure 6, eastern-sourced materials—including Absaroka cherts and Park Point obsidian—account for 66% of the total lithic assemblage from UM’s northeastern shore sites, with west-northwest sources comprising 34%. At northwest lake shore sites, eastern sources comprise only 7% of lithics, with northern and western sources accounting for more than 91%. These differences in lithic raw material use are significant between the northwest and northeast lake shores and point us in the direction of origin for people that used the respective areas of the lake \((\chi^2 = 198.00; df = 1; p = .000)\). These significant differences in chert and obsidian use probably reflect different points of origin, with northwestern lake users deriving from the north-northwest and northeastern lake users deriving from the east along the Clear Creek Valley and the Big Horn Basin.

Considering that these lake shores are only seven miles apart, the variation in lithic raw material use between them is striking. These data may indicate segregation of populations that visited the lake based on their points of origin, with people arriving to the lake and not venturing much beyond. For example, people travelling from the east to the lake along the Clear Creek Valley apparently focused their time along the lake’s east shore, with occasional travel to Obsidian Cliff to collect obsidian, which they curated with them as they traveled back eastward to their winter camps along the Shoshone River (e.g., Mummy Cave; Husted and Edgar, 2002) and onward to the Big Horn Basin.

![Figure 6. Comparison of lithic raw material use on the northeast and northwest lake shores.](image-url)
On the southeast shore of the lake, we see much more diverse use of obsidians and cherts than on either the northwest or northeast shores, the majority of which have sources to the south. It is important to note that the closest sources of materials to the southeast shore are Absaroka cherts, with sources along the lower (southern) Yellowstone River, ca. 15-30 km south. The most proximate obsidian sources are the southern (Jackson-area) sources at a distance of ca. 50 km. Obsidian Cliff would be directly accessed from the southeast lake shore only by walking around the entire lake perimeter (40 km) with another 35 km to the cliff.

As might be expected given their source-proximity, Absaroka cherts ($n = 2,709$) comprise more than 80% of stone artifacts at sites on the southeast lake shore ($N = 3,383$), with obsidian ($n = 675$) comprising the remainder of the southeast shore lithic assemblage. The lithic material data collected in the Southeast Arm by UM and Lifeways are not significantly different ($\chi^2 = 0.466; df = 2; p = .495$), suggesting continuity in material use between the three different sites used in our studies.

Sourced obsidian artifacts from the southeastern lake shore sites ($n = 17$) derive from five different sources, with 32% Obsidian Cliff and 37% southern sources. Western sources comprise 21%, with eastern shore Park Point obsidian accounting for only 11% of southeast shore obsidian artifacts.

It is important to remember, however, that only approximately 20% of the entire lithic assemblages at southeastern lake shore sites are obsidian. Thus, in terms of the total lithic assemblage from the Donner Site ($n = 3,329$), for example, Obsidian Cliff obsidian represents only ca. 9% (ca. 300 lithics), compared to 89% (ca. 3,029 lithics) originating from southern/eastern sources (including Absaroka cherts and southern/eastern obsidians).

In order to more realistically compare Obsidian Cliff use between the four lake-shore areas, we calculated the percentage of Obsidian Cliff artifacts: total obsidian artifacts × Obsidian Cliff %) ÷ total lithics. Obsidian Cliff comprises only 6.3% of the southeastern shore sites’ lithic collections, compared to 70% on the northwest shore (Figure 7). These data support a southern origin for southern lake shore users. The overall low densities of Obsidian Cliff obsidian—in terms of the entire lithic assemblages at southeastern sites—likely indicates procurement via trade with other lake users to the north, rather than direct procurement. In other words, southeastern lake users traveled from the south northward up the Snake and Yellowstone Rivers to the mouth of the river on the southern lake shore. There, they hunted and gathered and occasionally socialized with other people visiting the lake, at which time they probably acquired Obsidian Cliff obsidian via trade.

Interestingly, lithic material trends on the southwest shore are not quite as clear as the other three areas discussed above. Here, at eight sites, obsidian (61%; $n = 1,401$) and chert (39%; $n = 901$) percentages are nearly equally represented. These trends are distinct from both the northwest and southeast lake shores, the former of which had 90% obsidian and the latter only 20%.
In terms of the EDXRF data, the southwest shore generally appears to be a mix of northern, western, and southern sources. Fourteen different sources of obsidian are present in the southwest shore site assemblages. However, given its closer proximity, Obsidian Cliff obsidian occurs in high percentages (56.3%; \( n = 98 \)). Bear Gulch obsidian occurs somewhat frequently as well (18%; \( n = 32 \)), perhaps indicating a western origin using the Madison River. Southern sources comprise 19% (\( n = 33 \)) of the southwest shore lithic assemblages. These data suggest use of southern, western, and northern sources by people living on the southwest shore, possibly indicating that these were mixing areas used by many different groups moving back and forth to the Yellowstone River and Obsidian Cliff.

The archaeological data collected by UM and others at these 28 lake-area sites support the hypothesis of use by multiple hunter-gatherer groups from multiple regions. On the northwest lake shore, individuals were oriented northward toward Obsidian Cliff and the Yellowstone, Madison, and Gardiner River Valleys. On the northeast shore, individuals were focused eastward up the Clear Creek and Shoshone River Valleys. On the southeast shore, the southern Yellowstone River was the likely origin route, while the southwestern shore appears to have been somewhat of a multi-use area for multiple groups from the south, west, and north. Overall, Native Americans actively traveled to the lake from multiple regions, likely representing diverse ethnic groups and/or bands, rather than a single group with a massive territory. Our data, thus, corroborate the multi-users model proposed by Johnson et al. (2004) and Park (2010), rather than the single-group (e.g.,
Shoshone-centered) model proposed by Scheiber and Finley (2011) and Johnson et al. (2004). Future research should investigate variation in these settlement patterns over time, with our initial research showing differences between Paleoindian and Early Archaic patterns (MacDonald et al., 2011).

Archaeological Data on Subsistence

Faunal, ethnobotanical, and protein-residue analysis data provide insight into the nature of fishing, hunting, and gathering at Yellowstone Lake. As listed in Table 1, we present subsistence data from excavations at 20 sites at Yellowstone Lake (see Figure 2 for general site locations), including 11 excavated by UM and 9 excavated by others. The sites derive from the northwest \( (n = 8) \), northeast \( (n = 2) \), eastern \( (n = 1) \), south \( (n = 5) \), and southwest \( (n = 4) \) areas of the lake (see Figure 2). The sites date to all time periods, including Paleoindian \( (n = 2) \), Early Archaic \( (n = 1) \), Middle Archaic \( (n = 3) \), Late Archaic \( (n = 6) \), and Late Prehistoric \( (n = 7) \).

Faunal remains are rare at Yellowstone Lake sites, with only two sites yielding identifiable bone fragments. This low number is likely due to the highly acidic soils which deteriorate organic material. The Late Prehistoric Windy Bison site (48YE697) yielded bison, elk, and sheep. Sucker found at the site is interpreted by Cannon et al. (1996) to be intrusive/ modern, since that fish is not native to the lake. Unidentifiable bone fragments (possible bison) were also found at the Donner Site (48YE252) in a Middle Archaic occupation on the southeast arm of the lake.

Thirteen lake-area sites have yielded lithic artifacts with positive blood protein signatures, as revealed in Table 1. Three sites on the northern West Thumb are not shown on Figure 2, including 48YE449, Solution Creek, and 48YE652 (Cannon et al., 1996). We also add data from 48YE1 on the northwest lake shore (Cannon et al., 1993).

Fish was identified on a flake from an unknown north shore site (Cannon et al., 1993). The species was identified as rainbow trout, not native to the lake. As such, we interpret this to mean that someone used the flake to process rainbow trout somewhere else and carried the tool to the lake during prehistory, or that the flake was contaminated by one of the site excavators who fished for rainbow trout recently and touched the flake. Of the dozens of lake-area tools, thus, that have been analyzed for proteins, none have yielded positive signatures for fish.

As shown in Table 1 and Figure 8, deer protein was identified on tools at six lake-area sites, with bear identified at five sites. Rabbit was identified at four sites, with three each of bovine (bison), cat, and sheep. Dog was identified at two sites, with rat (cf. squirrel) and guinea pig (cf. skunk/beaver) also identified at single sites each. These protein identifications suggest a diverse hunting strategy at the lake, with the lithics dating from Paleoindian to the Late Prehistoric. The presence of bear protein on lithics from five lake-area sites supports the
<table>
<thead>
<tr>
<th>Lake area</th>
<th>Site</th>
<th>Faunal remains</th>
<th>Protein residue</th>
<th>Plant remains</th>
<th>Period of use</th>
<th>Reference</th>
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<tr>
<td>Northwest</td>
<td>48YE1</td>
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<td>Not defined</td>
<td>Cannon et al., 1993</td>
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<td>Livers &amp; MacDonald, 2011</td>
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<tr>
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<td>None</td>
<td>Sagebrush, cheno-am, sedge, grass, asteraceae</td>
<td>Late archaic</td>
<td>MacDonald &amp; Livers, 2011</td>
</tr>
<tr>
<td>Northwest</td>
<td>48YE381</td>
<td>None</td>
<td>Bovine, bear, deer, dog</td>
<td>Grass, cheno-am, sagebrush, asteraceae, lily, bitterroot</td>
<td>Early-middle archaic</td>
<td>MacDonald &amp; Livers, 2011</td>
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<tr>
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<td>Cannon et al., 1997</td>
</tr>
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<td>Species</td>
<td>Plant</td>
<td>Time Period</td>
<td>Reference</td>
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<td>Pine</td>
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<td>MacDonald, 2012b</td>
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<tr>
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<td>Paleo</td>
<td>Johnson et al., 2004</td>
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<tr>
<td>Southwest</td>
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<td>Sheep</td>
<td>None</td>
<td>Middle archaic, Late prehistoric</td>
<td>Cannon et al., 1996</td>
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<tr>
<td>Southwest</td>
<td>Solution Crk site</td>
<td>Bison</td>
<td>None</td>
<td>Paleo</td>
<td>Cannon et al., 1996</td>
<td></td>
</tr>
<tr>
<td>Southwest</td>
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<td>Rabbit</td>
<td>None</td>
<td>Late archaic</td>
<td>Cannon et al., 1996</td>
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<td>Southeast</td>
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<td>Bison</td>
<td>Bison</td>
<td>Middle archaic</td>
<td>Vivian, 2009</td>
<td></td>
</tr>
</tbody>
</table>

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*Both are interpreted as intrusive; neither fish is native to Yellowstone Lake.

*FTIR analysis by PaleoResearch on FCR.
hypothesis of active bear hunting in prehistory. As we discussed in the ethno-
historic section, early spring was the most common season to hunt bears among
northern-latitude hunter-gatherers.

Ethnobotanical remains and fossil pollen were identified at seven sites, all
excavated by UM (see Table 1; Gish, 2013). These plants include buckwheat,
chено-am, sagebrush, jacob’s ladder, sedge, grass, sunflower, lily, and bitterroot.
All of these species contain edible and/or medicinal qualities and support the
warm-season model of lake use due to their availability between May-September.
Features in which these plants were found date variably to the Early Archaic,
Middle Archaic, Late Archaic, and Late Prehistoric, suggesting long and con-
sistent use of plants by lake-area hunter-gatherers during prehistory.

In summary, these subsistence data from lake-area archaeological sites pro-
vide an excellent window into the hunting and gathering activities conducted
by Native Americans in prehistory at Yellowstone Lake. Hunters took a variety
of animals, including deer, bear, bison, sheep, and rabbit, among others, while a vast
array of plants, including lily, sunflower, grasses, and bitterroot, were collected
by lake-area residents during prehistory. Most significant in the subsistence
data is the lack of any positive identification of fish remains or proteins on any
of the tested materials at the dozens of sites studied at the lake. In this regard,
UM excavated a total of 26 features at sites around the lake between 2009-2011,
falling to find fish remains from any of the flotation-processed soil samples
(MacDonald, 2013).
Archaeological Data on Boat-Use

As described herein and elsewhere (Johnson et al., 2004), boats certainly would have facilitated travel around Yellowstone Lake’s shores and to the lake’s islands, as well as facilitated the transport of lithic raw material to the various lake areas. However, in all of UM’s excavations at the lake, only one wood-working tool has been recovered—an adze from the northwest lake-shore site 48YE1553 (MacDonald and Livers, 2011)—while only two were recovered in the Osprey Beach excavations (Johnson et al., 2004:214). We are unaware of any other lake-area sites yielding adzes or heavy-duty wood-working tools. Thus, if boats were utilized, it does not appear that they were of the dug-out canoe variety, but could have possibly been of the skin-boat (umiak) variety, as discussed in the ethnohistoric section above.

Lithic artifact data can be used to evaluate boat-use as well. We hypothesize that lithic densities should be similar around the lake’s shores if boats were used for mobility. Boats would have facilitated mobility around the lake shore and facilitated lithic material transport. Lithics would also have been suitable for use as ballast. This discussion takes into consideration lithic raw material source locations, which are more proximate to the northwest and northeast lake shores than on the south shore. In general, the south shore lacks material sources of any quantity and quality, with only occasional natural obsidian and chert pebbles available for casual, embedded collection at the lake. As discussed above, the nearest sources are Absaroka cherts on the southern Yellowstone River at the far southeast corner of the lake. Thus, boats would have provided one means to ameliorate lithic material shortage for lake users on the south shore.

Our lithic density data do not support the hypothesis that boats were used to facilitate material transport (Figure 9). We first compare two fairly proximate areas of the lake, northwest and southwest, separated by 15 km across the lake, but 50 pedestrian km due to the presence of the West Thumb (see Figure 2). If boats were utilized for movement between these two areas of the lake, we should see similar amounts of stone artifacts in the two areas, with the distance fall-off curve flat; however, as reflected in Figure 9, our data show significant differences in lithic density. Therefore, there is no evidence for use of boats to transport stone. It is important to note that we focused our excavations in the highest lithic density areas in all lake areas, making the data amenable for comparison.

On the northwest lake shore, UM excavated 70 1 × 1 m test units at seven sites, yielding 13,995 tools and flakes from test units for a mean of 199.9 per sq. m. On the southwest shore, combining UM and Lifeways excavations at sites in that area, archaeologists excavated 94 sq. m. at eight sites, revealing 2,178 tools and flakes from test units for a mean of 23.2 per sq. m. Both of these areas yielded high percentages of Obsidian Cliff and/or cherts from northern lithic sources. People, thus, moved regularly between the northwest and southwest shores, but
Figure 9. Comparison of lithic densities and mean flake weights, north and south shore sites, Yellowstone Lake.

the conservation of material supports the hypothesis that they travelled on foot, rather than by boat.

These lithic density trends are not restricted to the northwest and southwest shores (Figure 9). The overall character of all sites along the entire north shore is of lithic abundance, whereas on the south shore it is one of lithic scarcity. In
addition to the northwest shore data (199/sq. m.), excavations at UM’s six Clear
Creek sites on the northeastern lake shore yielded 107 lithics per sq. m. Only
27.5 lithics per sq. m. were recovered at the Osprey Beach site on the southwest
shore’s West Thumb, while only 14 lithics per sq.m. were recovered at seven
sites excavated by UM on the south-central lake shore. UM recovered only
17 lithics per sq. m. at two sites on the southeast arm of the lake. Excavations at
the Donner Site on the southeast arm revealed 97 lithics per sq. m., comprised
largely of southern-oriented cherts.

Overall, the lithic density at southern lake shore sites is 42 lithics per sq. m.
\( (n = 5,557 \text{ lithics}; 131 \times 1 \text{ m test units; 11 sites}) \) compared to 164 lithics per
sq.m. at sites on the north shore \( (n = 18,809 \text{ lithics}; 115 \times 1 \text{ m test units; 13 sites}) \).
The sheer volume of lithics from test units on the north shore—18,809 lithics—
compared to the south shore—5,557 lithics—is even more striking considering
that 16 additional sq. m. of excavation were conducted on the south shore
compared to the north.

Mean flake weights for the northwest shore and southwest shore sites
excavated by UM between 2009-2011 are also significantly different, with
southwest shore flakes \( (n = 403; 470.4g) \) weighing 0.86 g on average compared
to 1.89 g for northwest shore flakes \( (n = 14,361; 7,582.7 \text{ g}) \). These flake data
support the hypothesis that south shore hunter-gatherers used and produced
fewer lithics of smaller sizes, likely to conserve material in the face of the
toolstone-depleted environment.

Material was also transported to south shore sites in finished or nearly-finished
state, reflecting the low availability of lithic raw material sources in this region.
Biface-reduction and shaping flakes account for 77.1% of typed flakes at
south shore sites, compared to 78.0% at northwest shore sites. These data are
comparable on both shores and suggest that the late-stages of biface manufacture
were a focus in both locations, not just on the south shore.

The major difference between the northwest and southwest shores in this regard
is the greater numbers of final-stage shaping/pressure flakes on the southwest
shore (51.7%) compared to biface-reduction flakes (48.3%) compared to the
northwest shore (44.9% vs. 55.1%). Whereas this difference is not significant
at the .05 level \((\chi^2 = 2.145; df = 1; p = .143)\), the overall ratio of biface-reduction
flakes to shaping flakes is 0.93 on the southwest shore (61 shaping flakes;
57 biface-reduction flakes) compared to 1.23 on the northwest shore (2,084
biface-reduction flakes; 1,697 shaping flakes). These flaking debris data suggest
that bifaces and projectile points were in a more finished state by the time
they reached the southwest shore compared to the northwest shore.

Also, it is clear that significantly greater numbers of late-stage flaking debris
were produced at northwest shore sites \( (n = 3,781) \) versus southwest shore sites \( (n
= 118) \) (with similar amounts of excavation). These data support those discussed
above that tool production was a focus on the northwest shore, but not on the
southwest shore in which tools were curated and carried beyond sites.
In support of this curation mode on the south shore, an interesting and somewhat unique type of lithic artifact—freehand cores—were recovered in significant quantities \((n = 8)\) at UM’s southwest shore sites. These cores are small \(< 3\text{cm in diameter}\) with multiple flake removals from all faces and are produced from both obsidian \((n = 4)\) and chert \((n = 4)\). Given their small size, flakes removed from the cores were likely used as expedient tools, rather than as preforms for bifaces or projectile points. These cores are rare to non-existent on the northwest shore, with only two identified at the seven UM-excavated sites around Fishing Bridge and Lake Lodge (MacDonald and Livers, 2011).

The use of these small cores on the south shore suggests that they functioned as portable lithic material for mobile hunter-gatherers in the material-depleted south shore. These cores were not used abundantly on the north shore of the lake, likely due to the proximity of the Obsidian Cliff material source and chert sources to the east in the Clear Creek Valley and to the north in the Yellowstone Valley. Material was abundant in this region, but not so on the south shore.

Overall, these lithic data suggest a significant fall-off in lithic use in locations further away from sources, suggesting the curation of lithics on the south shore which lacks adequate replacement stone (Andrefsky, 1994; Bamforth, 1986; Binford, 1979, 1980). This is a pattern exemplified by pedestrian hunter-gatherers minimizing risk in the face of possible stone shortage while traveling in toolstone-deficient areas. We propose that this pattern of lithic resource use supports our supposition that boats were not used by hunter-gatherers at the lake. If they were, such significant fall-offs in lithic material use would not be evident (cf. Blair, 2010). Our lithic data from more than two dozen lake-area sites suggest that pedestrian hunter-gatherers carried bifaces and small cores to the south shore of the lake where they were heavily curated, as evidenced by the low numbers of lithics, their comparatively small sizes, the high density of late-stage reduction debris, and small, portable freehand cores. Hunter-gatherers ensured subsistence success by preserving lithic material in a south shore environment lacking proximate lithic sources. Boats were not used as a means to transport material and minimize risk on the lithic-deficient south shore.

**SPATIAL DATA AND DISCUSSION**

**Spatial Data**

Using geographic information systems (GIS), we also studied the distribution of sites at Yellowstone Lake based on their relative location to current and past habitats, paleo-shorelines, and proximity to stream confluences. Analysis of paleo-shorelines as defined by Pierce at al. (2007), in particular, was excellent at predicting locations of Paleoindian occupations; these shorelines were exposed during the late Pleistocene to early Holocene and, thus, were used by Native Americans more than 9,000 uncalibrated years ago. However, these high terraces
were also used during all other time periods. Our conclusions are that while Paleoindian sites are restricted to the higher landforms and shorelines as defined by Pierce et al. (2007), sites dating to the last 8,000 years were distributed largely evenly among all terraces. Therefore, we conclude that people occupied any and all available shorelines throughout prehistory. These data do not help us understand the function of the lake in prehistory, other than to support the fact that people lived on flat terraces near the lake as their preferred camp locations.

Site Locations and Habitat Type

Analysis of site locations relative to modern and past ecological zones and habitats is helpful in understanding the function of the lake in settlement and subsistence systems. Here, we compare site locations relative to modern forest and open/riparian habitats. We also compare site locations by time period relative to pollen types attributable to open/riparian habitats for those periods. Pollen data were compiled for the south end of the lake from Buckbean Fenn by Baker (1976) and for the northern lake shore at Cub Creek Pond by Waddington and Wright (1974) (see Figure 2). We compare the frequency of riparian/open grassland pollen types with site locations from those periods of use on the respective portions of the lake.

Our hypothesis in the GIS study is that sites will correlate better with habitat types comprised of open/riparian compared to forest species. To determine the accuracy of the model, the digitized archaeological site locations were overlaid on the vegetative model in ArcGIS (Figure 10). Using the conversion tool, the vegetative model was converted from a vector shape file into a raster file. This enabled the utilization of another tool function (extract by attributes tool) to extract cell values directly from the rasterized model that corresponded with any overlying point features (i.e., digitized site locations). These values were then automatically recorded into a site locations geodatabase where each site record was assigned to a specific patch type (i.e., riparian/grassland, forest, etc.). Following this, the records were consolidated into data tables that reflected information regarding a site’s relative age and association with a particular patch-type (McIntyre, 2012).

Figure 10 shows the site locations at the lake compared to modern/open habitat (green hues) and forest (brown hues). The figure clearly shows that open/riparian habitats differentially account for site locations. Statistical evaluation of those site location data confirm that open/riparian habitats predict prehistoric archaeological site locations for a minimum of 83% (Late Archaic period) to a maximum of 94% (Late Prehistoric period), with a mean prediction rate of 86%. This is a very high success rate that suggests that Native Americans in prehistory differentially selected open/riparian habitats.

We also compared riparian/open grassland pollen types with site counts on the north and south shores of the lake from Paleoindian, Early Archaic, Middle
Archaic, Late Archaic, and Late Prehistoric periods (Figure 11). On the south shore of the lake, we found a significant and very strong correlation between site counts and open/riparian pollen types from Buckbean Fenn for those periods ($r^2 = 0.86$; ANOVA: $df = 4; F = 18.49; p = .023$). On the north shore of the lake, the correlation was moderately strong, but was not significant ($r^2 = 0.54$;
Figure 11. Regression correlation between site counts by period and riparian/grassland pollen types for the northeast and southeast areas of Yellowstone Lake.

ANOVA: $df = 4; F = 3.548; p = .156$). We also combined the data from the north and south shore to examine the cumulative correlation and found the regression to be strong and significant as well ($r^2 = 0.78$; ANOVA: $df = 4; F = 10.57; p = .047$). These data strongly support the hypothesis that Native Americans preferred to live
in open/riparian habitats compared to forested settings over time on both the northeast and southeast shores of the lake.

Site Location and Proximity to Streams

Our next question was to evaluate whether site locations also correlate well with proximity to streams. If so, it suggests that fishing was a key factor in site placement. Our data do not show a strong correlation between stream proximity and site count, as shown in Figure 12. Only at the 400 m distance to streams do we observe more sites close to streams than we do away from streams (> 400 m). Even then, stream proximity predicts only a bit more than 50% of the sites. At a distance of 50 m, stream proximity only accounts for the locations of 11 of 175 site components (6%). These data do not support the hypothesis that stream confluences with the lake were preferred camping locations. These data also fail to support the hypothesis that fishing was the prime-mover in site locations; if it were, we’d see a high density of sites close to streams for fishing of cutthroat trout in spring. Rather, our data show that open/riparian settings far and away explain the archaeological site location data, predicting site locations an average of 86% of the time.

FISHING AT THE LAKE?

The GIS and archaeological data contrast the ethnohistoric suggestion that fishing was a common subsistence strategy at the lake in prehistory. While it is
clear that the Shoshone and Bannock knew that the lake contained fish, it is not clear from ethnographic accounts that these tribes fished specifically at Yellowstone Lake. The archaeological data also fail to support the role of fishing at the lake.

The presence of sites at stream confluences was used by Samuelson (1983) as support for the hypothesis that these sites were fishing camps. However, our comprehensive lake data do not support her hypothesis. Stream confluence is not a good predictor of site location at Yellowstone Lake. Rather, open/riparian habitats are a much better predictor of site location.

In addition, only one of the lake-area sites yielded fish bones and those fish remains are modern (non-native sucker at Windy Bison Site). Only one stone artifact from the lake yielded fish protein and that was also non-native (rainbow trout), likely indicating that the tool was used on rainbow trout somewhere else and transported to the lake or that the tool was recently contaminated (e.g., a site excavator who fished for rainbow trout recently).

Samuelson’s (1983) notched flakes are not sufficient for defining a subsistence regime and no additional tools have been identified at well-studied lake sites to support pre-contact fishing as an important piece of the subsistence puzzle. Lakeshore studies by UM, MWAC, and Lifeways have found no net sinkers or fish hooks or other similar fish procurement tools at any of the lake’s sites. The most proximate site with a net sinker ($n = 1$) is the Malin Creek site (24YE353), some 20 miles downstream of the lake on the Yellowstone River near Gardiner, Montana (Vivian et al., 2008:167). Also, while the Smithsonian Institution has two fishing artifacts supposedly from Yellowstone Lake—a notched stone/net sinker and a possible prehistoric fishing lure—these are not well-documented and are of uncertain provenience, age, and cultural association (Sanders, 2002, 2006; Elaine Hale, Yellowstone archaeologist, personal communication, March 20, 2012). We find it problematic to cite the Smithsonian fishing artifacts as evidence of fishing, not only because of their uncertain origins, but also in light of the fact that not a single net sinker (or other fishing tool) has ever been recovered during professional survey of more than 200 km of lake shoreline, nor during excavations at dozens of sites.

Based on sound archaeological data, we have no reason to believe that fishing comprised a substantial portion of the prehistoric diet at Yellowstone Lake. However, the absence of fishing evidence at the lake’s sites does not necessarily refute the hypothesis that fishing occurred at the lake. Tools produced from organic materials could have been exclusively used for fishing at the lake, while the refuse from fish predation may be lost to the vagaries of the archaeological record. While fish weirs have never been conclusively identified at feeder streams of the lake, it is likely that such rock features would be lost to heavy spring run-off and not preserved in the archaeological record.
SUMMARY AND CONCLUSION

We used GIS, archaeological, and ethnohistoric data to inform our view of the prehistoric use of Yellowstone Lake. The various data sets strongly support the hypothesis that Native Americans targeted open/riparian habitats due to their concentrated diversity of resources. There is ample evidence from sites at the lake to support a generalized hunting and gathering pattern, likely initiated in early spring and intensifying in summer.

Our lithic data support multiple points of origin for hunter-gatherers that visited Yellowstone Lake in prehistory. People camping on the north shore were likely Plains-adapted hunter-gatherers spending most of their time in the northern Yellowstone Valley and vicinity. People camping on the east shore of the lake were likely occupants of the Plains as well and the hot-dry portions of western Wyoming, including the Big Horn Basin. People on the southeast lake shore were likely residents of the Jackson area and points south, while people on the southwest and western shores may derive from north, south, and west, including the northern Great Basin of eastern Idaho. Our data, thus, do not support the hypothesis that the GYE was the center of a large territory used by a single group, as proposed by Johnson et al. (2004) and Scheiber and Finley (2011). Rather, the GYE and Yellowstone Lake were at the cross-roads of multiple tribal and/or band territories, a model best defined by Johnson et al. (2004) and Park (2010).

The ethnohistoric, archaeological, and GIS data combine to answer the five major research questions we proposed at the beginning of this article. Native Americans from multiple regions used the lake, traveling there from all directions. Subsistence was oriented around land-based resources within open/riparian habitats, with fishing perhaps representing a minority subsistence strategy by the Shoshone (if at all). Access to the lake’s islands was by pedestrian foragers across ice in early spring, an activity likely associated with the seasonal procurement of bear and the scouting of lake conditions for later spring subsistence activities (e.g., root collection and/or fishing). Finally, mobility around the lake shore was not via boats, but by pedestrian travel, as best evidenced by the lithic fall off at archaeological sites on the lake’s south shore compared to the north shore.

Yellowstone Lake is a concentrated resource area, accounting for 40% of the riparian habitat in all of Yellowstone National Park. With such a biodiverse habitat, the lake attracted hunter-gatherers for the last 10,000 years from multiple points on the landscape. The archaeological remains of their use of the lake are abundant around the entire 200 km shoreline, with many sites yielding significant data on the use of land-based resources by pedestrian hunter-gatherers. While fishing would also have been a productive subsistence strategy, our ethnohistoric, archaeological, and spatial data do not support fishing as a substantial portion of subsistence at Yellowstone Lake, nor do our data support boat use to travel around the lake or to access the lake’s islands.
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