

## Ice Patch Archaeology in Alaska: 2000–10

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**ABSTRACT.** In the past decade, ice patch archaeological research has been initiated in several areas of Alaska, including Wrangell-St. Elias National Park and Preserve, the Amphitheater Mountains, Lake Clark National Park and Preserve, Denali National Park and Preserve, Gates of the Arctic National Park and Preserve, Chugach National Forest, and Katmai National Park. Although still in its formative stages, this research demonstrates that high-altitude ice patches have been an important part of the annual subsistence cycles of Alaskan people for at least 4000 years. Researchers have found cultural materials at 13 Alaskan ice patches. Most artifacts recovered are related to caribou hunting; however, a growing body of evidence demonstrates that ice patches were the foci for a wide range of subsistence activities, such as hunting birds, harvesting berries, and snaring small mammals. Site interpretations are based on ethnographically documented cultural practices, animal behavior, alpine ecology and geology, and archaeological analyses.

**Key words:** ice patch archaeology, alpine subsistence, climate change

**RÉSUMÉ.** Au cours de la dernière décennie, des recherches archéologiques ont été entreprises dans plusieurs névés de l'Alaska, notamment dans les régions suivantes : Wrangell-St. Elias National Park and Preserve, monts Amphitheater, Lake Clark National Park and Preserve, Denali National Park and Preserve, Gates of the Arctic National Park and Preserve, Chugach National Forest et Katmai National Park. Bien que ces recherches en soient toujours au stade embryonnaire, elles ont déjà permis de constater que les névés en haute altitude ont joué un rôle important dans les cycles de subsistance annuels des peuples de l'Alaska pendant au moins 4 000 ans. Les chercheurs ont récupéré du matériel culturel dans 13 névés de l'Alaska. La plupart des artefacts qui ont été trouvés se rapportent à la chasse au caribou. Cependant, de plus en plus d'artefacts prouvent que les névés étaient le point de convergence d'une vaste gamme d'activités de subsistance, comme la chasse aux oiseaux, la récolte des petits fruits et le piégeage des petits mammifères. L'interprétation des sites s'appuie sur les pratiques culturelles documentées de manière ethnographique, sur le comportement animal, sur l'écologie et la géologie alpines ainsi que sur les analyses archéologiques.

**Mots clés :** archéologie des névés, subsistance en milieu alpin, changement climatique

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### INTRODUCTION

Cultural materials have been recovered from high-altitude and high-latitude glaciers and snowfields throughout the Northern Hemisphere. Artifacts have been found at locations where people used these snowfields and glaciers to travel through alpine passes—where they lost materials, discarded objects, and sometimes perished (Ebell, 1991; Spindler, 1994; Beattie et al., 2000; Grosjean et al., 2007). In other locales, people hunted animals on small stable snowfields, called ice patches, where they left tools behind in the surface snow (Farbregd, 1972, 2009; Kuzyk et al., 1999; Dixon et al., 2003, 2005, 2007; Farnell et al., 2004; Hare et al., 2004a, b, 2011; Dove et al., 2005; VanderHoek et al., 2007a, b; Helwig et al., 2008; Andrews et al., 2009). Ice

patches across the Arctic are widely recognized as sites that preserve ancient hunting tools because caribou or reindeer and other mammals use these locations to gain respite from heat and insects (Skoog, 1968; Ion and Kershaw, 1989). Ancient hunters relied on ice patches to locate their prey and hunt at close range. As a result of climate change, these bodies of ancient ice are melting and revealing important organic artifacts that are seldom preserved in other depositional contexts.

Ice patch archaeology in Alaska is being conducted by several research teams and collectively is part of a larger international research effort that is recovering, preserving, and analyzing artifacts and human remains from a variety of snowfields and glaciers around the world. These artifacts have been exposed because global warming is increasing

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the rate of glacial melt worldwide, particularly in high latitudes. The first archaeological survey on melting glaciers and ice patches in Alaska was conducted in Wrangell-St. Elias National Park and Preserve (WRST) in 2001 (Dixon et al., 2005). The WRST survey was inspired and guided by the pioneering research in the Yukon under the direction of Greg Hare (Hare et al., 2004b). During the past decade, research has expanded and become increasingly sophisticated in Alaska, and the artifacts recovered include a diverse assemblage of tools and materials that facilitate broader interpretation of ice patch subsistence and other aspects of culture.

Artifacts have been recovered from melting ice patches in the northern and western foothills of Wrangell-St. Elias National Park and Preserve, the Amphitheater Mountains, and Lake Clark National Park and Preserve (Fig. 1). Limited surveys have also been conducted on ice patches in the Brooks Range (J. Rasic, pers. comm. 2010) the Seward Peninsula (J. Anders, pers. comm. 2009), Denali National Park (Wygal, 2007; Lee and Karchut, 2010), the Talkeetna Mountains and Alphabet Hills (Jangala, 2004), the Kenai Peninsula (Karchut et al., 2010), and on Baranof Island (W. Hunt, pers. comm. 2010). Most of these projects were located on public land in remote, high-altitude regions, where field research was constrained by logistics and by difficulties in obtaining permits and timing surveys for late summer during the period of maximum melt.

In Alaska, ice patches occur at different elevations in different parts of the state, and many patches exhibit dramatic ablation in response to climate change. Their formation and survival depend on a number of interactive variables, including slope, aspect, elevation, latitude, albedo, basal topographic characteristics, summer temperatures, winter precipitation, prevailing winter wind direction, and catchment area. Alaska's ice patches range from 150 to 200 m amsl (above mean sea level) in the northern foothills of the Brooks Range in northern Alaska to more than 1930 m amsl in the Wrangell Mountains in southern Alaska (Dixon et al., 2005). In the Amphitheater Mountains, ice patches are found between 1200 m and 1700 m amsl (VanderHoek et al., 2007b). Farther to the southwest, permanent ice patches in Lake Clark National Park and Preserve occur between 650 and 1450 m amsl. In Katmai National Park ice patches range between 580 and 1067 m amsl; their lower elevation in Katmai may be due to higher winter snowfall caused by increased precipitation from the adjacent Gulf of Alaska.

Ice patches can be divided into three morphological classes, defined by Lewis (1939), that reflect underlying topography and snow depositional processes. The first, circular ice patches, are generally round in shape and are visible as snowfields that occupy the slopes of high alpine basins. If they become large enough, they may become cirque glaciers. Ice patches of the second class, termed longitudinal ice patches, are located in horizontal or down-trending gullies. Snow and ice patches of the third class are called transverse ice patches. These commonly occur along the margins of plateaus or ridges, reflecting the wind

deposition of snow on lee slopes. It is this third class of ice patches that has produced the vast majority of archaeological sites in Alaska and the greatest number of ice patch artifacts.

The areas in which ice patch artifacts have been found in Alaska are within the traditional territories of several groups of Athapaskan people (upper Tanana, Ahtna, and Tanaina) who live in the region today. These people are linked through historic and ethnographic use of the region to the most recent artifacts recovered from ice patches. By employing this direct historical approach, we can use ethnographic data to trace organic material culture back in time, identify specific artifact types more accurately, and infer the activities that took place at the ice patch sites.

This paper summarizes survey results conducted in Wrangell-St. Elias National Park and Preserve (Dixon et al., 2005, 2007), the Amphitheater Mountains (VanderHoek et al., 2007a, b), and Lake Clark National Park and Preserve. Although ice patches are best known as locations where artifacts once used to hunt caribou have been found, we focus here on documenting the wider breadth of subsistence activities preserved in Alaska's ice patches.

#### WRANGELL-ST. ELIAS NATIONAL PARK AND PRESERVE

Artifacts have been found at six ice patches in the foothills of the Wrangell-St. Elias Range, as well as on the Chisana Glacier and two glaciers in the eastern Nutzotin Mountains. The ice patches have been named (from east to west, Fig. 1): 1) Fogenbera, 2) Bonanza, 3) Jaeger, 4) Tanada, 5) Hide, and 6) Basket (Dixon et al., 2005, 2007).

The Fogenbera Ice Patch is the easternmost ice patch in the WRST that is known to have been used by humans. Located approximately 1880 m amsl, the site extends along the north face of a steep east-west trending slope, about 2 m high at the eastern extreme and about 10 m high at its western terminus. A marshy area lies immediately to the north, presumably formed by water from the melting ice. The site has fluctuated in size since it was discovered in 2002. In 2003, no ice or snow was visible in early August, but the ice patch was present again at the same time the following year. When the ice disappears, what is left are patches of organic detritus—leaves, lichen, moss, twigs, grass, and other plant material—forming “hay-like” deposits on the rocky surface.

Two pieces of worked caribou antler and an antler projectile point have been found at the site. A sample of antler taken directly from the projectile point dated to  $1550 \pm 20$   $^{14}\text{C}$  BP, with a mean calibrated age of AD 485 (CURL-7538). A sample from one of the pieces of worked antler dated to  $795 \pm 25$   $^{14}\text{C}$  BP/AD 1240 (CURL-7537), indicating that the site was used on at least two separate occasions.

A stone feature (field-designated Fogenbera East) is located approximately 820 m WNW of the Fogenbera ice patch. It is a semicircular group of ~14 rocks, stacked along

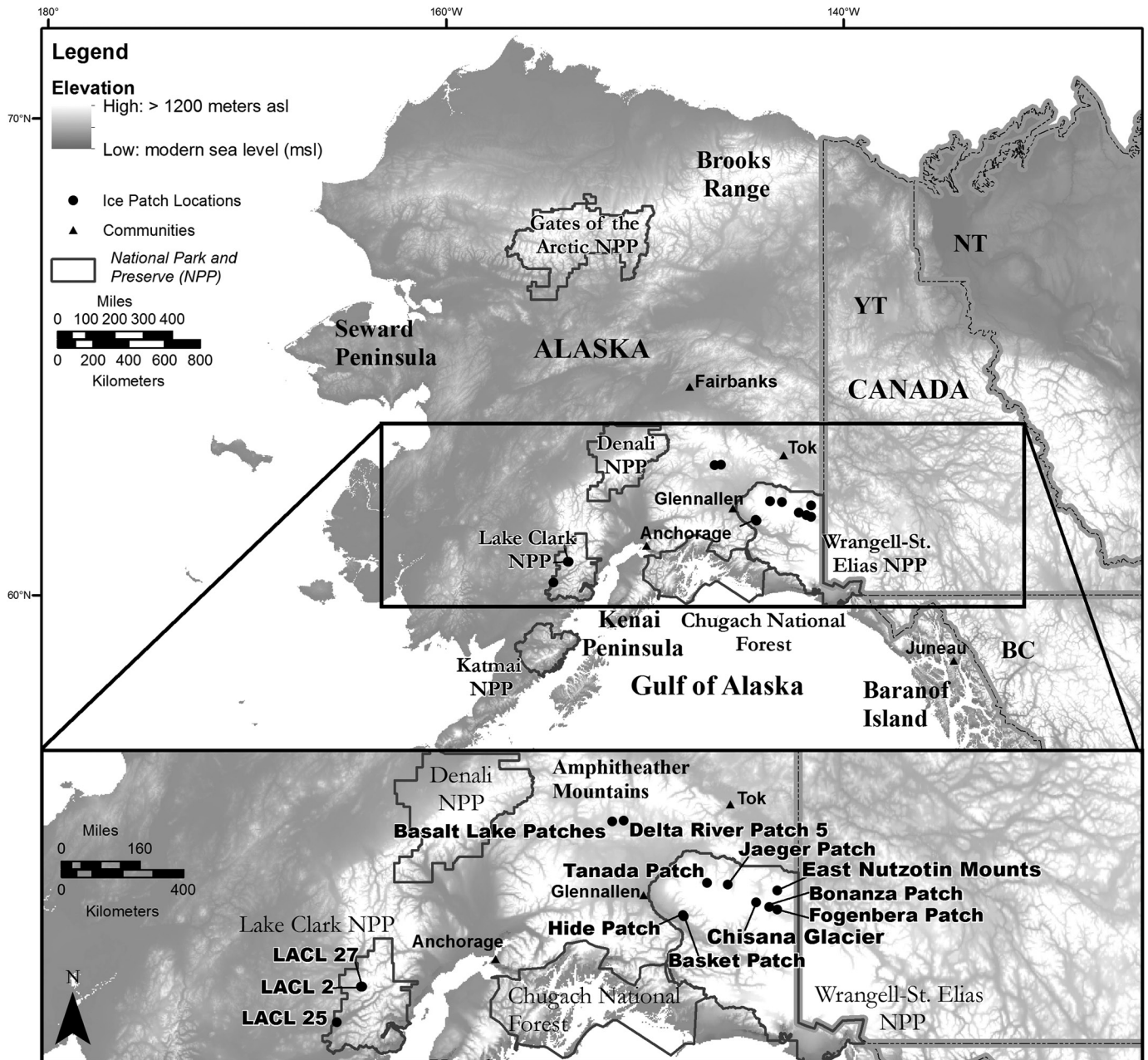


FIG. 1. Map showing location of ice patch study area in Alaska, the Yukon and Northwest Territories, and northern British Columbia. Enlarged area shows locations of specific ice patches and other features mentioned in the text.

the southwest margin of a depression 60 cm in diameter and 4 cm deep. Two additional rocks, possibly once part of the feature, are located within 20 cm of the others. Lichen growth on the rocks indicates that it is not a recent feature: it may be the remains of a cache pit.

The Bonanza Patch is located along the northern foothills of the Wrangell-St. Elias Range and contains periodic evidence of bow-and-arrow and atlatl dart hunting over the last 4000 radiocarbon years (Dixon and Jarman, 2010). While research at the site continues, considerable evidence suggests that activities other than large mammal hunting also took place there. A possible antler blunt projectile point was discovered at the Bonanza Patch in 2007. A single

AMS determination of  $3090 \pm 20$   $^{14}\text{C}$  BP/1376 BC (CURL-9651) was obtained from a sample of the extensively weathered specimen. Ptarmigan commonly nest adjacent to ice patches and predictably can be found at the Bonanza Patch throughout the summer. Blunt projectile points are commonly used to hunt birds and small game, such as ground squirrel and hare. If the provisional identification of this artifact is correct, it suggests birds (probably ptarmigan) or ground squirrels were anticipated prey at this ice patch.

Not all materials recovered at the Bonanza Patch appear directly related to hunting. Numerous fragments of saplings, several of which exhibit cut marks, were recovered from the site over three field seasons (Fig. 2a). Several of

the saplings have been identified as willow (*Salix* spp.). Other than harvesting cut marks they exhibit little cultural modification. Radiocarbon dates from three of the saplings (Table 1) suggest that they were transported and deposited at the site at approximately the same time. The mean calibrated age of the saplings indicates they were used sometime between AD 735 and AD 749. The Bonanza Patch is above the tree line, and the nearest modern willow is approximately 1 km downslope of the site. Both the cut marks on the saplings and their distance from the nearest source of wood indicate that they were transported to the site for a specific purpose. While it is possible they may have been used in the construction of a hunting blind, there is little need for concealment to ambush caribou and sheep at the site, and people can get extremely close to animals on the patch by lying in wait or stalking from above. The spatial distribution of these sapling fragments suggests that they were originally deposited in a sheltered area of comparatively low topography on the upper edge of the ice patch. Although the shafts are fragmented and broken (Fig. 2a), their size and estimated lengths are similar to ethnographically documented poles used to support Athapaskan lean-tos (Fig. 2b; de Laguna and McClellan, 1981:646).

The Jaeger Patch is located at an elevation of 1936 m amsl. Like both the Fogenbera and the Bonanza patches, it is situated on a north-facing escarpment. Abundant fecal material indicates it is frequented by sheep and caribou. Dall sheep are regularly observed in the vicinity of the patch in early August. At its eastern edge are the remains of a historic camp containing cans and bottles dating from the 1940s to 1950s. A modern wooden axe handle was found at the camp's western edge. No artifacts have been collected from this site, and no pre-contact period artifacts have been found. Historic remains found at the site suggest a transition from subsistence to sport hunting, foreshadowing the current economic importance of the commercial guiding industry.

The Tanada site was found by a local sheep hunter in the 1990s when he discovered an exceptionally well-preserved antler projectile point at approximately 1767 m amsl in the vicinity of Tanada Peak. The projectile point has a groove carved into the distal end and exhibits a green copper staining, presumably from the presence of a native copper end blade. A subsequent survey of the site using a metal detector was unable to locate the copper point. A punctured caribou scapula was recovered by the survey at this locale in 2001. AMS dating of the antler projectile point to  $740 \pm 30$   $^{14}\text{C}$  BP/AD 1269 (CURL-6666) (Dixon et al., 2005) and the scapula as modern established that the two specimens were not contemporaneous.

The Hide Patch takes its name from the numerous fragments of decaying animal hide that were exposed by the melting ice (Fig. 3b). The spatial distribution of the fragments was mapped and the specimens were collected, stored in plastic bags, and refrozen in Glennallen, Alaska. They were later shipped to the University of Colorado's Institute of Arctic and Alpine Research (INSTAAR), where

the specimens remained in frozen storage at  $-20^{\circ}\text{F}$  for two and a half years until funding could be obtained to conserve and analyze them. A sample of hair taken from the hide was radiocarbon dated by the AMS method to  $345 \pm 15$   $^{14}\text{C}$  BP/AD 1569 (CURL-7539) (Dixon et al., 2005). A sample of hair from the hide was submitted to the Alaska Department of Fish and Game (ADFG, 2010) for identification, and the analysis confirmed that the hide was caribou (*Rangifer tarandus*), probably from a calf less than three months old (Anderson-Milhausen, 2008:55). Because of the advanced state of decomposition, it was not possible to rearticulate the hide, but straight edges on eight of the pieces indicate that it had been cut and culturally modified (Fig. 3a). The fact that caribou calves are born in mid-to-late May in interior Alaska (ADFG, 2010) suggests that this site was occupied in late summer, possibly in mid-August. Although fawn caribou hide was commonly used to make clothing (Mishler and Simeone, 2006), Anderson-Milhausen (2008) concluded that this specimen had either been discarded following a kill or may have been part of a tent or ground cloth.

Two other discoveries were made at the Hide Patch. One was a small antler tine that was trimmed from the beam of a caribou antler and radiocarbon-dated as modern. The other, the vertebral column of a caribou, was found approximately 100 m south of the patch. The bones had been cut with a metal saw and are the result of a recent hunting event.

The Basket Patch, located 5.25 km (3.26 mi) southwest of the Hide Patch, was named for a fragment of a birchbark basket that was recovered at the base of the ice patch in 2003 (Fig. 4a). Although no hunting implements were found at this site, Dall sheep are frequently observed in the summer on this and adjacent patches (Fig. 4b). The basket fragment was dated to  $660 \pm 30$   $^{14}\text{C}$  BP/AD 1338 (CURL-7077) by Dixon et al. (2005:137). Subsequent conservation and analysis of the basket fragment demonstrated that the height of the sides was about 5–6 cm and that the basket had slightly outward-sloped sides (Hunzicker, 2003). The length of one preserved side is 25 cm. The basket's measurements, the folds in the bark, and pattern of the stitching holes suggest that it was a folded birchbark basket reinforced with birchbark side panels 2.5–3 cm wide. These types of baskets are still made by Athapaskan people in interior Alaska and are also documented in the regional archaeological and ethnographic literature (de Laguna, 1956; McKennan, 1959; Oswalt and Vanstone, 1967).

Two primary classes of birchbark vessels are used throughout interior Alaska. The first class encompasses a wide range of shallow folded birchbark containers reinforced by a thin wooden branch or additional bark panels around the rim, stitched to the body of the container with spruce root. Vessels of the other class are cylindrical, with a wooden or bark bottom attached to the body with spruce root stitching. Although there do not appear to be strict functions ascribed to the various types, the shallow folded baskets tend to be used for a variety of domestic tasks, while the cylindrical types were more commonly used to

TABLE 1. Radiometric determinations for items associated with ice patches in the Wrangell and Amphitheater Mountains.

Patch and Lab #	NSRL Receipt #	Description	<sup>14</sup> C Age BP	Means for calibrated age ranges	Calibrated age range (1-sigma)	Relative probabilities for age ranges (1-sigma)	Calibrated age range (2-sigma)	Relative probabilities for age ranges (2-sigma)
<b>Fogobera:</b>								
CURL-7538	NSRL-13796	Antler projectile point	1550 ± 20	AD 485	AD 437-489 AD 530-549 AD 514-515	0.705 0.276 0.019	AD 432-561	1
CURL-7537	NSRL-13795	Cut antler tine	795 ± 25	AD 1240	AD 1224-1259	1	AD 1209-1276	1
<b>Bonanza:</b>								
CURL-11661	16151	Willow bark sapling fragment (manuport)	1240 ± 20	AD 749	AD 706-748 AD 765-780 AD 792-805	0.577 0.218 0.135	AD 687-829 AD 837-867	0.911 0.089
CURL-11655	15675	Willow bark sapling fragment (manuport)	1240 ± 20	AD 749	AD 694-703 AD 706-748 AD 765-780 AD 792-805	0.07 0.577 0.218 0.135	AD 687-829 AD 837-867	0.911 0.089
CURL-11678	16145	Sapling or shaft fragment	1250 ± 20	AD 735	AD 694-703 AD 706-748	0.07 0.691	AD 681-783 AD 788-820	0.897 0.079
CURL-9651	NSRL-15642	Possible antler blunt projectile (weathered)	3090 ± 20	BC 1376	AD 765-777 BC 1410-1375 BC 1339-1320	0.19 0.648 0.352	BC 1418-1310	1
<b>Tanada:</b>								
CURL-6666 <sup>1</sup>	NSRL-13022	Antler projectile point	740 ± 30	AD 1269	AD 1259-1284	1	AD 1224-1290	1
<b>Hide:</b>								
CURL-7539	NSRL-13797	Caribou calf hide	345 ± 15	AD 1569	AD 1491-1522 AD 1574-1603 AD 1610-1627	0.415 0.371 0.214	AD 1554-1633 AD 1472-1527	0.598 0.402
<b>Basket:</b>								
CURL-7077 <sup>1</sup>	NSRL-13397	Birch bark container fragment	660 ± 30	AD 1338	AD 1363-1385 AD 1285-1306	0.513 0.487	AD 1347-1392 AD 1278-1322	0.502 0.498
<b>E. Nutzotin Mountains:</b>								
CURL-7070 <sup>1</sup>	NSRL-13391	Possible dart shaft	1200 ± 30	AD 825	AD 801-872 AD 779-794	0.814 0.186	AD 767-895 AD 712-745	0.922 0.065
CURL-7073 <sup>1</sup>	NSRL-13394	Possible dart shaft	680 ± 30	AD 1299	AD 1279-1301 AD 1368-1382	0.672 0.328	AD 925-936 AD 1270-1316	0.013 0.628
CURL-7074 <sup>1</sup>	NSRL-13395	Arrow shaft	370 ± 25	AD 1509	AD 1458-1515 AD 1598-1617	0.734 0.266	AD 1449-1524 AD 1558-1631	0.605 0.395
<b>Chisana Glacier:</b>								
CURL-6512 <sup>1</sup>	NSRL-13011	Probable cut wood	170 ± 30	AD 1771	AD 1732-1782 AD 1928-1951	0.513 0.209	AD 1722-1817 AD 1916-1953	0.535 0.198
<b>Basalt Lake 1:</b>								
Beta-185014 <sup>2</sup>		Nearly complete arrow	60 ± 30	AD 1865	AD 1880-1915	0.586	AD 1812-1919	0.727
<b>Basalt Lake 2:</b>								
Beta-201470 <sup>2</sup>		Self-armed antler point	1010 ± 40	AD 1020	AD 983-1043 AD 1105-1118 AD 1144-1146	0.892 0.096 0.012	AD 966-1059 AD 1075-1155 AD 901-917 AD 1066-1072	0.713 0.256 0.026 0.005

TABLE 1. Radiometric determinations for items associated with ice patches in the Wrangell and Amphitheater Mountains – continued.

Patch and Lab #	NSRL receipt #	Description	<sup>14</sup> C Age BP	Means for calibrated age ranges	Calibrated age range (1-sigma)	Relative probabilities for age ranges (1-sigma)	Calibrated age range (2-sigma)	Relative probabilities for age ranges (2-sigma)
<b>Basalt Lake 3:</b> Beta-185015 <sup>2</sup>		Chopped antler	950 ± 40	AD 1095	AD 1080–1129 AD 1027–1052 AD 1132–1153	0.517 0.275 0.208	AD 1016–1179	1
<b>Basalt Lake 4:</b> Beta-201471 <sup>2</sup>		Arrow shaft fragment	1000 ± 40	AD 1031	AD 989–1045 AD 1097–1119 AD 1142–1147	0.756 0.203 0.04	AD 975–1155	1
<b>Delta River 5:</b> Beta-201472 <sup>2</sup>		'Gopher stick'	390 ± 40	AD 1502	AD 1445–1515 AD 1597–1617	0.798 0.202	AD 1437–1528 AD 1551–1634	0.642 0.358

<sup>1</sup> Dates previously reported by NSRL number in Dixon et al. (2005).

<sup>2</sup> Dates previously reported in VanderHoek et al. (2007a).

contain liquids and possibly used more frequently for berry picking. Although it is not possible to ascribe a specific function to the basket based on its morphology, the Basket Patch specimen suggests the site may have been used as a brief camp that provided a source of fresh water from the melting ice and a base from which to gather plants or berries in the adjacent area.

The caribou calf hide and basket fragment from the two sites suggest that these ice patches may have been used as brief hunting and foraging camps. Sheep and caribou are commonly observed on or near the Hide and Basket patches as well as other nearby patches (Fig. 4b), though there is no evidence yet that sheep were hunted there. The caribou hide and antler tine date to two different times and demonstrate that the Hide Patch was used at least twice. The saw-cut vertebral column could indicate a third period of use or may have been deposited at the same time as the antler tine.

Artifacts were also found at two small glaciers in the eastern Nutzotin Mountains (Fig. 1). At the easternmost site (NAB-0363 - Nutzotin B), several branch or sapling fragments were recovered that may have possibly been used as shafts for spears or atlatl darts. The glacier is located above both the modern and the historic tree line, and the wood fragments are manuports. Two of these specimens were dated to  $1200 \pm 30$  <sup>14</sup>C BP/AD 825 (CURL-7070) and  $680 \pm 30$  <sup>14</sup>C BP/AD 1299 (CURL-7073). The radiometric determinations demonstrate that this glacier was used by people during at least two intervals in the past.

An isolated arrow shaft broken into four articulating sections was found at a second site (NAB-0362 - Nutzotin A). A wood sample from one of the medial fragments of the arrow shaft was AMS dated to  $370 \pm 25$  <sup>14</sup>C BP/AD 1509 (CURL-7074). There is evidence of red ocher staining on the shaft and nock of this specimen. A socket on the distal end is shaped to receive a conical-based osseous projectile point; however, no point, lashing, or fletching remained on the shaft.

A crushed metal can and several wood fragments were found on the ice near the terminus of the Chisana Glacier. A piece of cut wood was collected and subsequently dated using the AMS method to  $170 \pm 30$  <sup>14</sup>C BP/AD 1771 (CURL-6512). The radiocarbon determination and metal suggest that these remains may be associated with the Chisana gold rush of 1913 to 1915, when the Rohn and Chisana Glaciers were used as the primary routes over the Wrangell-St. Elias Mountain Range to the Chisana gold fields (Bleakley, 1996).

#### AMPHITHEATER MOUNTAINS, DENALI HIGHWAY

Ice patch surveys began in the Amphitheater Mountains near the Denali Highway in 2003. Since that year, five ice patches with cultural materials have been located, four near Basalt Lake on the western side of the range (Basalt Lake Ice Patch 1–4), and one on the eastern side (Delta River Ice Patch 5).

The Basalt Lake ice patches have been monitored annually since 2003 for the emergence of artifacts, and the amount of melt has been measured by a GPS track around the largest ice patch in the area, Basalt Lake Ice Patch 1. The small size of Basalt Lake Ice Patch 1 in 2003, 2004, and 2007 was attributable to extended periods of high summer temperatures, and in 2010 to lower than normal snowfall the previous winter.

A survey of Basalt Lake Ice Patch 1 in 2003 produced a nearly complete arrow with a full-length spruce shaft (in three articulating

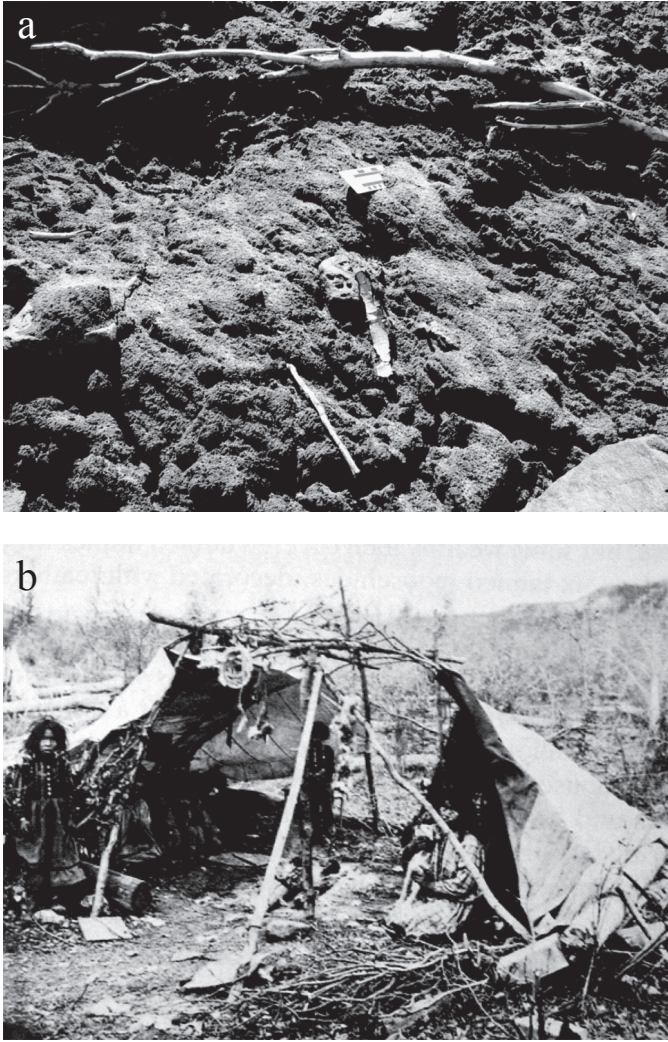


FIG. 2. a) Saplings in situ Bonanza Patch; b) Cloth-covered Ahtna lean-to with sapling frame (de Laguna and McClellan, 1981: 646).

segments), barbed antler point, sinew binding (which fastened the antler point to the shaft), and two split feathers used for fletching. The antler point was slotted for the inclusion of a copper or bone point (Fig. 5c). No green staining was evident on the antler point, and no copper or bone end blade was recovered. A sample from the wooden arrow shaft returned an AMS determination of  $60 \pm 30$   $^{14}\text{C}$  BP/AD 1865 (Beta-185014), suggesting it was constructed within the last 150 years. Seven short segments of another spruce arrow and a rolled piece of birch bark were also recovered at this ice patch, but have not been dated. The site is above the timberline, and the birch bark may have been transported there in order to manufacture or repair birchbark containers or to use as fire starter.

Basalt Lake Ice Patch 2 is located approximately 2 km south of Basalt Lake Ice Patch 1. Survey there in 2003 produced a long (27 cm) self-armed antler point (Fig. 5b) dated to  $1010 \pm 40$   $^{14}\text{C}$  BP/AD 1020 (Beta-201470).

A third ice patch in the area, Basalt Lake Ice Patch 3, was also surveyed in 2003. It yielded both a piece of rolled birch bark and a caribou antler palm where the beam had

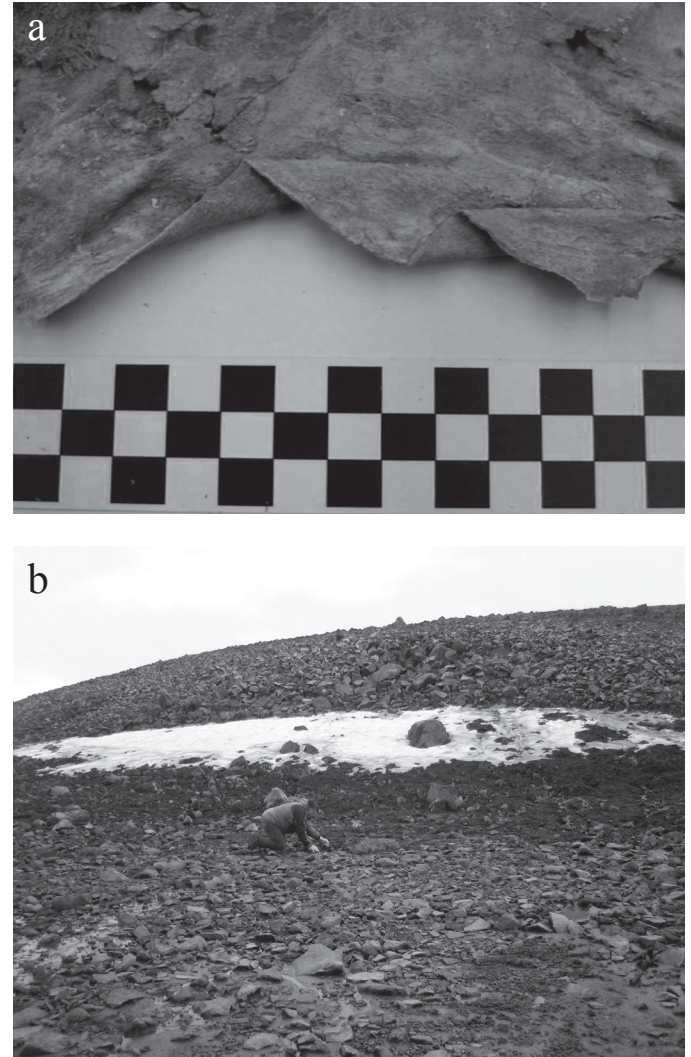


FIG. 3. a) Close-up photograph of a fragment of caribou hide from the Hide Patch depicting a straight cut edge (specimen 2004-F026E) (Anderson-Milhausen, 2008:56); b) Recording and collecting hide fragments at the Hide Patch, 2004.

been removed from the antler body, possibly for the manufacture of barbed projectile points. This chopped antler returned an AMS determination of  $950 \pm 40$   $^{14}\text{C}$  BP/AD 1095 (Beta-185015).

A fourth Basalt Lake ice patch yielded evidence for both bow and atlatl use. In 2004, Basalt Lake Ice Patch 4 produced a fragment of an arrow shaft and three lithic bifaces (VanderHoek et al., 2007a: Fig. 6:1–4). The spruce arrow shaft fragment dated similarly to materials from Basalt Lake Ice Patches 2 and 3 with an AMS determination of  $1000 \pm 40$   $^{14}\text{C}$  BP/AD 1031 (Beta-201471). The three lithic bifaces resemble mid and late Holocene atlatl dart points found elsewhere in southern Alaska. One, a basalt biface (VanderHoek et al., 2007a: Fig. 6:3) closely resembles a biface found hafted in a foreshaft at the Bonanza Patch on the north flank of the Wrangell Mountains. The Bonanza Patch specimen is dated to circa 2700  $^{14}\text{C}$  BP [2880  $\pm$  25  $^{14}\text{C}$  BP (NSRL-13393) and 2600  $\pm$  30  $^{14}\text{C}$  BP (NSRL-13392)] (Dixon et al., 2005: Fig. 6:a, Table 1). In 2007 Basalt Lake



FIG. 4. a) Birchbark basket fragment in situ, Basket Patch 2004; b) Two large rams (*Ovis dalli*) on an ice patch adjacent to the Basket Patch, 2007 (Anderson-Milhausen, 2007:57).

Ice Patch 4 also produced a well-preserved antler projectile point (VanderHoek, 2010) (see Fig. 5a).

In the eastern Amphitheater Mountains, a wooden stave was recovered in 2004 from the northern crest of a mountain overlooking the lower Tangle Lakes and the Delta River. The spruce stave, recovered at Delta River Ice Patch 5, was 75 cm long, with a hook on one end and a point on the other (Fig. 6). The stave appears to be a “gopher stick,” similar to those used by the Southern Tutchone for setting ground squirrel snares (Johnson and Raup, 1964; McClellan, 1975; G. Hare and R. Gotthardt, pers. comm. 2005). This artifact dated to  $390 \pm 40$   $^{14}\text{C}$  BP/AD 1502 (Beta-201472).

Evidence suggests that other ice patches in the region were also used by ancient hunters. According to collection documentation on file at the University of Alaska Museum of the North, a barbed antler arrow projectile point in the museum collections was discovered in 1957 “on the edge of a snowfield west of Maclaren Glacier. Elevation 5000 feet” (J. Whitney, pers. comm. 2005). The Maclaren Glacier is located just to the northwest of the Amphitheater Mountains, 18 km away from the cluster of artifact-bearing ice patches at Basalt Lake.

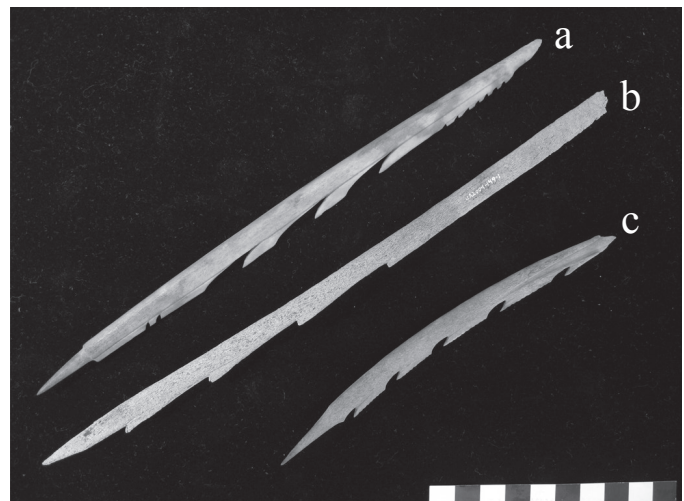


FIG. 5. Antler projectile points from a) Basalt Lake Ice Patch (BLIP) 4, b) BLIP 2, and c) BLIP 1.

#### LAKE CLARK NATIONAL PARK AND PRESERVE

Three localities where artifacts have been exposed from melting ice patches have been identified in Lake Clark National Park and Preserve (LACL). The first, designated LACL Patch 27, consists of five transverse ice patches. The site is located on a low hillside overlooking a broad, gently sloping bench and stream drainage. Volcanic ash from Mt. Redoubt’s March 2009 eruption still covered portions of the lower areas of the ice patches when we visited in August 2009, making a surface survey difficult. Several shed caribou antlers and large mammal bones that were present at the site document repeated use of these patches by caribou. Two complete antler projectile points and a distal fragment of a third antler point were found at the base of these patches. These small patches have a western exposure, which is somewhat unusual considering the northerly orientation of most ice patches, and appear to result from high winter snow deposition caused by katabatic winds from the nearby glaciers in the Telaquana Mountains.

Another site, LACL Patch 2, surveyed in 2009, consisted of three transverse ice patches on the edge of a north-facing bench. The lower margins of these patches were also covered by ash from the 2009 Mt. Redoubt eruption. A complete barbed antler projectile point and a fragment of a large mammal long bone exhibiting cut marks were found at this site (Fig. 7).

A third ice patch, LACL Patch 25, produced ten bone fragments from two species, lynx (*Lynx canadensis*) and wolverine (*Gulo gulo*) (Fig. 8). The wolverine is represented by a mandible fragment, while one of the lynx bones, a section of cranium, has a .22 caliber bullet hole in the occipital bone. Because .22 caliber firearms were not introduced until the 1850s, the site postdates that time. By the late 1800s and early 1900s, .22 caliber weapons had become popular for dispatching small game because they were economical and caused relatively little damage to the fur or



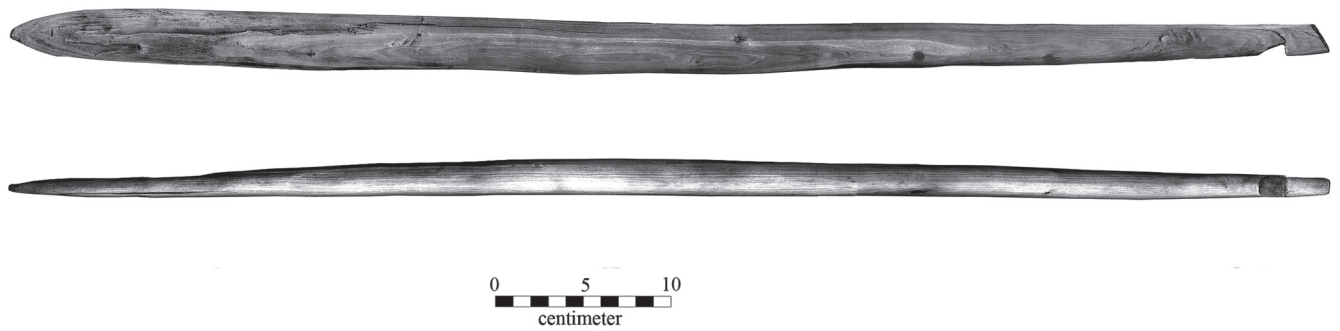


FIG. 6. Spruce stave “gopher stick” recovered from Delta River Ice Patch 5.

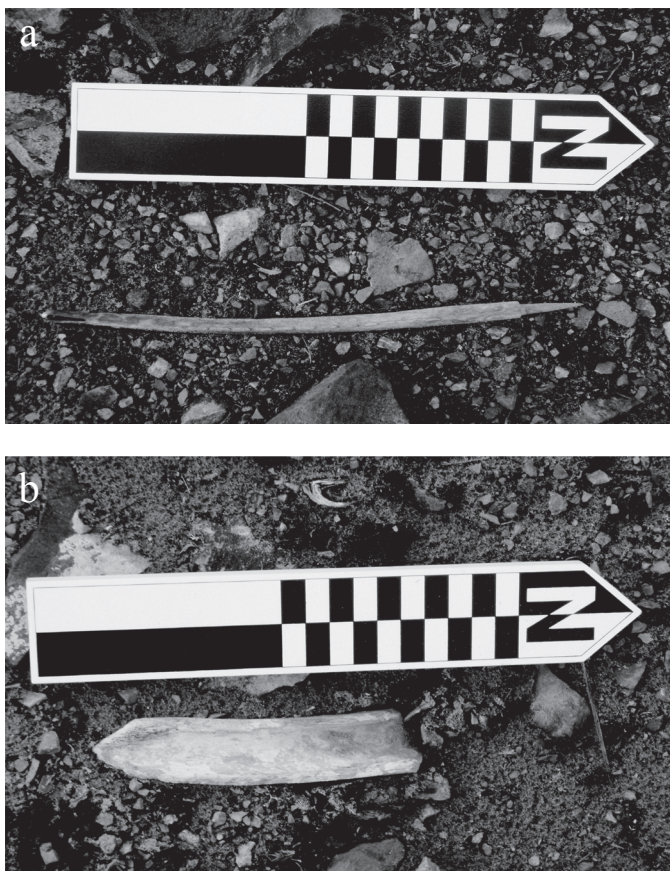


FIG. 7. a) Antler projectile point and b) cut bone, LACL Patch 2, 2009.

carcass (Hawks, 2005). This find suggests that the animals may have been skinned at the ice patch, where the skulls and other bones were discarded, whereas the fur and perhaps portions of the carcasses were transported elsewhere.

## DISCUSSION

A variety of ecological and cultural factors affect ice patch use by early hunters and the occurrence of ancient artifacts. The most important determinant is the presence of caribou, which can be detected by caribou tracks or dung

on the surface of the ice patch (Greer et al., 2004; Hare et al., 2004b; Dixon et al., 2005). Ice patches covered with brown ice are often indicative of extensive caribou use over time. Fecal lag deposits remaining on the surface of the ice demonstrate that the patch was used repeatedly by animals and has been melting, and consequently holds greater potential for the discovery of archaeological remains.

Most artifacts are found on or near transverse ice patches, where it was much easier for hunters to remain concealed, ambush, or stalk animals from above. This advantage greatly increased the possibility of a killing shot with atlatl dart or arrow (VanderHoek et al., 2007b; Andrews et al., 2009:3).

The relationship between ice patches, caribou ecology, and human predation has been the primary focus of ice patch research in Alaska, Canada, and Scandinavia (Farbregd, 1972; Hare et al., 2004b; Dixon et al., 2005; VanderHoek et al., 2007b; Andrews et al., 2009). Although ice patches were important for caribou hunting in Alaska, the discovery of an increasing number of artifacts documenting other activities demonstrates that ice patch sites were also used for other subsistence activities. Field observations in the Wrangell-St. Elias foothills suggest that mountain sheep were another important resource that attracted early hunters to ice patches. As the number of research projects has increased and the geographic scope of field research has expanded, a wider variety of artifacts has been recovered from ice patches in Alaska and Canada. The “gopher sticks” found in the Amphitheater Mountains (VanderHoek et al., 2007a) and with Kwāday Dān Ts’ínchi in British Columbia (Beattie et al., 2000; S. Greer, pers. comm. 2005), the ground squirrel snare in the Northwest Territories (Andrews et al., 2009), the remains of the birchbark basket from the Wrangell Mountain foothills (Dixon et al., 2005), and birch bark from the Amphitheater Mountains (VanderHoek et al., 2007a) demonstrate greater variation in the use of ice patches and glaciers by indigenous people. Although caribou hunting may have been the most important activity that drew people into the high country in the late summer and fall, ice patches were important sites near which a variety of resources could be harvested. High-altitude environments are often regarded as marginal habitats; however,

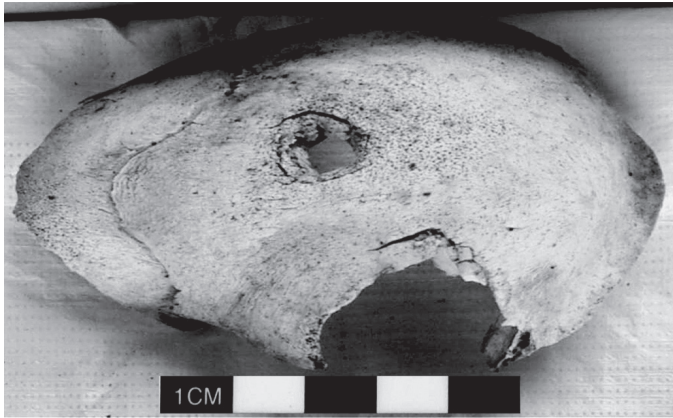


FIG. 8. Lynx cranium with bullet hole, LACL Patch 25, 2009.

archaeological and ethnographic evidence from western North America demonstrates that groups of people commonly moved into the high country in the summer months to harvest alpine resources (Thomas, 1982; Bettinger, 1991; Reimer, 2000; Adams et al., 2009; Wygal 2010).

Ethnographies for the Ahtna living along the Copper and upper Susitna River drainages record an alpine adaptation by groups of men and women in the late summer (Reckord, 1983a, b). This alpine part of the seasonal round included hunting large mammals, fishing in the lakes, picking berries, and trapping small mammals. Reckord (1983a:29) reports, “In August, the main party of hunters left for the hunting grounds ... Generally the women made a base camp near a fish lake and a good berry-picking location while the men ranged more widely in search of meat.” Reckord (1983b:33) also states:

even the grease of the tiny mountain squirrel was carefully saved. After skinning and skewering the carcasses on a green stick, the women arranged them in a circle around the fire. During the roasting, oil was rendered into a pan usually made of birch bark or carved from wood. The younger girls picked blueberries in the high elevations in hunting territories and prepared them with the squirrel grease in a traditional delicacy called *tseles caadze*....

Other ethnographers have noted that the Ahtna rendered grease in birchbark buckets with berries and caribou meat (de Laguna and McClellan, 1981). These Alaska ice patch discoveries indicate that hunting large mammals on ice patches was part of a more complex summer subsistence strategy that included harvesting alpine berries, hunting birds, and trapping, hunting, and snaring small mammals.

A series of cultural correlates suggests the types of ice patches that may have greater potential for producing archaeological finds. Many ice patches in Alaska are a considerable distance (more than a day’s walk) from known winter villages and summer fish camps. Consequently, ice patches used by early hunters were usually near other resources that were also used during the summer and early

fall. These patches may have been in view of commonly used travel routes, campsites on fish lakes or streams, abundant habitat for small animals (ground squirrels, marmots, and ptarmigan), stone tool sources, or high-producing berry areas (Hare et al., 2004b; Dixon et al., 2005; VanderHoek et al., 2007a, b). Ice patches like the Bonanza Patch, located near commonly used campsites or along travel routes, were large stable features that may have been used repeatedly for thousands of years. Such sites regularly attracted caribou or sheep, and they could reliably be expected to yield other subsistence resources such as ground squirrel, ptarmigan, and berries.

## SUMMARY

The artifacts recovered from ice patches provide information from one of the few types of environments in interior Alaska in which rare organic tools are preserved. Because ice patch artifacts are seldom discovered in their primary depositional contexts, innovative analytical methods are sometimes required to date specific periods of site use and interpret the activities that occurred at these sites. The lack of intact stratigraphic and areal context at ice patch sites requires researchers to place greater reliance on the dating and analysis of individual artifacts and the application of relevant ethnographic data. Ice patch hunting and gathering were integrated as part of a larger subsistence cycle. Archaeological surveys in Subarctic Alaska during the last decade have recovered a suite of cultural materials, including several types of projectile technologies (primarily atlatl darts and arrows), other harvesting tools, and equipment for setting ground squirrel snares, and possibly for harvesting and preserving berries. These artifacts from Alaskan ice patches provide information that helps explain the alpine part of a regional seasonal round.

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