



# Archaeology In The Ice Patches

**As Earth continues to warm, researchers rush to document and preserve archaeological remains exposed by melting ice patches.**

**By Tamara Stewart**

**In 2007**, archaeologist Craig Lee recovered an incredibly-preserved, delicately-carved birch spear-throwing foreshaft from a melting ice patch north of Yellowstone National Park. The 10,300-year-old shaft, which Paleo-Indian people used to hunt big game, is the oldest artifact ever recovered from a North American ice patch. Lee, a research scientist at the Institute of Arctic and Alpine Research (INSTAAR) at the University of Colorado and at Montana State University, is a practitioner of ice patch archaeology, an emerging field that identifies and recovers evidence of past human use of ancient alpine, arctic and sub-arctic environments being exposed



*An aerial view of an ice patch located in the Greater Yellowstone Area. Aerial surveys help archaeologists determine which ice patches to focus on.*



*A 6,000-year-old digging stick emerges from a melting ice patch.*

INSTAAR/CRAIG LEE



INSTAAR/ JENNIE BORRESEN LEE

*Craig Lee (left) and his colleagues Jay Kyne (facing Lee) and Ben Woods start to drill into an ice core. This is the only invasive technique the researchers employ.*

by global warming. He has investigated ice patches in 16 national parks and forests across western North America, and spoken at dozens of educational gatherings to raise awareness about the growing crisis of melting ice patch archaeology.

Research in alpine and sub-alpine areas in North America shows that high-altitude ice patches have been an important part of annual native subsistence cycles since ancient times. According to traditional native history, alpine zones are special places for hunting, gathering, and ceremonial practices. Attracting animal herds and the hunters that pursued them, ice patches were cool places to forage and find water in the heat of summer, and to seek relief from biting insects. (Ice patches are not to be confused with glaciers. Glaciers are constantly moving, while ice patches are stationary. Because they're in motion, glaciers don't accumulate and store artifacts over centuries or millennia the way some ice patches do.)

Artifacts of various ages have been found preserved in North American ice patches, ranging from the 10,300-year-old wooden atlatl dart, to a recently discovered 130-year-old unidentified wooden artifact in the Wind River Mountains of Montana. "Most, but certainly not all, artifacts found on ice patches relate to hunting," says Lee. In addition to artifacts, researchers have found animal and human remains.

Kept cool by underlying permafrost, many ice patches have lasted for thousands of years, but as global warming increases, they are quickly melting. "It is clear that the level of melt probably exceeds anything seen in the past 6,000 to 7,000 years," says archaeologist Robert Kelly of the University of Wyoming. "The biggest crisis point, I would say, is how little longevity these materials have once they are exposed," says Rachel Reckin, a doctoral student at Cambridge University who has been working with Lee and Kelly. "We're doing our best, but we're only visiting a fraction of the ice patches in the Greater Yellowstone Ecosystem, let alone in the Rockies, let alone in the world at large. So for every artifact we are managing to recover, there are probably countless others that are lost."

Lee echoes Reckin. "The magnitude of cultural loss could be staggering," he says. "Those of us that are working in the field are so close to it—that is, working in our specific regions, ranges, and ice patches—that we can't always pull back and realize there are hundreds of other mountain ranges where no work is occurring whatsoever. I strongly suspect that there is ice patch potential throughout all of the mountainous regions in western North America."

As a result of global warming, the National Park Service, the U.S. Forest Service, tribal groups, and university researchers are collaborating on ice patch surveys. Systematic ice patch surveys have been undertaken in Alaska, the Colorado Front Range, the Greater Yellowstone Area (GYA), Olympic National Park in Washington, Glacier National Park in Montana, and the Yukon and the Northwest Territories of Canada. These surveys have resulted in the recovery of hundreds of artifacts.

**E. James** Dixon, now director of the Maxwell Museum of Anthropology at the University of New Mexico, first introduced Lee to ice patch archaeology. Funded by a National Science Foundation grant, Dixon worked with INSTAAR's geographic information specialist William Manley and Lee to survey and record melting ice patches in the Wrangell Mountains of Wrangell-St. Elias National Park and Preserve in Alaska from 2001 to 2004. Dixon continued monitoring sites there through 2011.

Dixon and his colleagues developed a model that helped them predict which of the myriad ice patches in the Wrangell Mountains were likely to contain artifacts. The researchers focused on ice patches that could be accessed by ancient peoples, were of a certain shape and were found in particular locations, and were permanent—meaning they didn't melt away in summer and then reform the following winter. In addition to surveying the mountains from helicopters, the archaeologists reviewed aerial images of the ice patches that were taken over a period of decades. By doing this they could determine if an ice patch met their definition of permanent. The predictive model was helpful, but far from foolproof. The archaeologists made 285 helicopter landings to investigate ice patches that met the model's criteria, yet they found only five archaeological sites.



*This 1,400-year-old beveled pine artifact is the first of its kind found in an ice patch. The two pieces of the artifact appear to have organic staining along the beveled margin. It was recovered from an ice patch that sits at an elevation of nearly 11,000 feet. The researchers also found other organic, as well as lithic, artifacts there.*



INSTAAR/CRAIG LEE

**The researchers carry lightweight plastic archival boards, gauze, plastic bags, splints, and other materials to stabilize any delicate objects, such as this 5,100-year-old atlatl dart shaft fragment, that they find.**

“About that same time, hikers and hunters in the Colorado Front Range began to notice that permanent ice bodies there were melting more than they had in historic memory, and as a result, they were also finding the remains of locally extinct animals, specifically bison,” says Lee. “Based on my experiences in Alaska and in the Colorado Front Range, I presented a paper at the 2004 Plains Anthropological Conference, speculating that there might be potential for ice patch archaeology in the Greater Yellowstone Area.” Archaeologist Halycon LaPoint, with the Custer-Gallatin National Forest, approached him after his talk and asked if they could put a proposal together to survey melting ice patches in the Greater Yellowstone Area. “From that point forward I have worked extensively on ice patch archaeology in the GYA,” says Lee.

The Greater Yellowstone Area (GYA) covers roughly 24,000-square miles in Wyoming, Idaho, and Montana, a region that includes Yellowstone and Grand Teton national parks as well as five national forests. Lee began his GYA field project in 2006. In the meantime he refined the predictive model, benefiting from advances in imaging technology such as LiDAR. In 2013, the Greater Yellowstone Coordinating Committee (GYCC) funded Lee to conduct an ice patch inventory of the entire region. The GYCC is comprised of representatives from the area’s national parks and forests and is also funded by those agencies. “Their aim is to facilitate cross-boundary research of cross-boundary issues,” explains Lee.

Lee surveyed aerial images that cover the vast GYA, and then, using the predictive model, he ranked the ice patches that seemed the most promising. Investigating ice patches is not easy work. In some cases it requires a few days of strenuous hiking to reach them. The work is further complicated by the unpredictability of the weather and the amount of snow coverage. After backpacking or horse packing into mountainous backcountry areas, the archaeologists set up camp for several days to inspect promising ice patches. The aerial images of the ice patches they intend to survey have GPS coordinates, so, armed with hand-held GPS units, they locate the ice patches and search for recently exposed artifacts. These are photographed, mapped, and recorded. A representative sample of paleobiological specimens is also collected for analysis, providing a great deal of information about the ancient environment and past human subsistence strategies and animal behavior.

Archaeological surveys in the GYA have identified about 450 ice patches that meet the criteria of accessibility, persistence, and morphology, giving them high potential for archaeology. So far the researchers have found more than a dozen prehistoric sites in ice patches at elevations above 9,800 feet. They are recovering a great diversity of fantastically preserved items such as wooden atlatl dart shafts and fragments, bows, numerous unknown wooden artifacts, baskets of woven plant fibers, butchered animal remains, and chipped stone artifacts.

Most of these artifacts have melted out of the ice patch



*These spirally fractured big horn sheep leg bones, some of which have soft tissue still adhering to them, were broken by humans to extract the delicious marrow. A similar bone fragment recovered from the same site where these were found was radiocarbon dated to approximately 2,200 years ago.*

and were recovered using noninvasive techniques. Several years ago Lee found a wooden shaft approximately a foot long, an inch of which was still encased in an ice patch. Not wanting to damage the shaft, Lee and his colleagues used hot water to melt the ice, carefully extricating the shaft. Subsequent dating showed the item, which perhaps served as a digging stick, to be more than 5,300 years old.

Depending on the materials they're made of, frozen artifacts, once exposed, can last anywhere from a few days to

about a year before disintegrating. "The nature of ice patch work does require a somewhat different collection and curation process—especially when dealing with perishable materials," says Molly Westby, the assistant regional heritage program manager of the U.S. Forest Service's Rocky Mountain Region. "You need to take care when packing fragile materials out of the backcountry—you need to stabilize them and try to maintain a moisture content so they don't dry out too quickly."

Reckin agrees that the process of recovering artifacts often requires "creative problem solving. The artifact has to be stabilized sometimes for up to 20 miles of travel on the back of a mule, which can be difficult when we're faced with fragile wooden artifacts that can be half a meter long, or basketry that's falling apart before your eyes. We carry lightweight plastic archival boards, gauze, plastic bags, splints, etc., but sometimes we still end up using our own clothing, our photo scales, everything we can think of to stabilize an artifact for transport." Most of the artifacts recovered from the GYA are curated at the Billings Curation Center in Billings, Montana.

Unlike a typical archaeological site, where the older items are located beneath the younger ones, artifacts derived from ice patches melt down and end up altogether in one layer. Although this makes for a confused jumble, well-preserved organic objects can be directly radiocarbon dated. "The dating is very precise and carefully done to capitalize on small breaks in the artifacts so they are minimally modified," Lee explains.

**Glacier** National Park contained more than 150 glaciers in 1910, and now holds only 26. It is projected that these will have all melted by 2020. In 2010, funded by a large grant from the National Park Service's Climate Change Response Program, Kelly, Lee, and Reckin partnered with the Confederated Salish and Kootenai Tribes and the Blackfoot Nation to survey the eastern and



*Montana State University student Sari Breitenfeldt stands next to a melting ice patch, demonstrating its massive size.*

INSTAAR/CRAIG LEE



INSTAAR/CRAIG LEE

**A group of archaeologists, volunteers, and academics attend a workshop focused on ice patch archaeology. The workshop was sponsored by the Greater Yellowstone Coordinating Committee.**

western slopes of the Rocky Mountains within the park.

The tribes, whose ancestral territories include land that's now part of the park, maintain strong cultural, economic, and spiritual ties to the mountain landscape. The tribes' input, such as oral histories relating where their ancestors hunted, informed the archaeologists' survey. Despite this, the researchers haven't found any archaeological material to date.

Nonetheless, Lee says "the project was fantastic," and he's used some of the techniques they established here in his GYA work. The Glacier National Park survey did, among other things, make a number of paleoecological discoveries, and for these they were given the Partners in Conservation Award in 2012 in recognition of outstanding conservation achievements attained through collaborative partnership.

Researchers will wrap up the Glacier National Park project next year. "We're still trying to figure out how these ice patches operate," says Kelly, noting that artifacts have been found in various places, but not in Glacier. "Could be the poor snow conditions, or since ice patches elsewhere are used for hunting, it could be that the cost-benefit ratio of hunting at ice patches in Glacier National Park was not as good" as the GYA and other areas. "We don't know yet."

"Ice patch work desperately needs more interdisciplinary cooperation, which is something we've really been

reaching for lately," says Reckin. "There is archaeology in these places, yes, but potentially more importantly there is an incredibly detailed and well-preserved paleobiological and paleoclimatic record which is not yet being exploited by scientists in those fields. Ancient DNA, dendrochronology, palynology, those interested in paleoclimatic reconstruction, studies in some of these fields are beginning to develop, but there is still so much more potential." This rarely preserved organic component of the archaeological record can provide important clues to past environmental conditions people endured, the seasons they hunted and gathered on the ice patches, their hunting and general survival strategies, and their patterns of travel.

"Ice patch archaeology needs to expand from the one-off finds occurring in places other than the GYA," Lee says. "I hope the rest of the Western U.S. wakes up to the potential loss—large areas of Canada, those run by provincial governments, also need survey. Beyond those close-to-home challenges, there are huge swaths of the cryospheric world in desperate need of initial survey and later monitoring. Now is the time; in 20 to 30 years the ice patches will likely all be gone."

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