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Ethnographic and Archaeological Investigations of Alpine Ice Patches in Southwest Yukon, Canada

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ABSTRACT. Since the original 1997 discovery of ancient hunting implements in melting alpine ice patches of southern Yukon, approximately 146 well-preserved, organic artifacts have been recovered. Most of the artifacts, variously made of antler, bone, wood, and stone, represent complete or partial examples of throwing-dart (*atlatl*) and bow-and-arrow technology. Radiocarbon dates obtained thus far range from 8360 BP to 90 BP (uncalibrated). Our research indicates that in southern Yukon, throwing-dart technology persisted from at least 8360 BP to approximately 1250 BP, when it was abruptly replaced by bow-and-arrow technology. The collection has afforded archaeologists and First Nation researchers a unique opportunity to learn about past hunting technologies and practices and thus greatly improve our understanding of the enduring relationships between humans and caribou.

Key words: southwest Yukon archaeology, bow and arrow, throwing spear, *atlatl*, alpine ice patch

RÉSUMÉ. Depuis la découverte en 1997 d'anciens objets de chasse dans les plaques de glace alpines du sud du Yukon, environ 146 artéfacts organiques bien conservés ont été récupérés. La plupart des artéfacts, faits de bois d'animal, d'os, de bois ou de pierre, représentent des exemples complets ou partiels de propulseur lance-javelins (*atlatl*) et d'une technologie axée sur l'utilisation d'arc et de flèches. La datation au radiocarbone varie de 8360 ans B.P. à 90 ans B.P. (non étalonné). Les recherches effectuées rélèvent que dans le sud-est du Yukon, la technologie reposant sur l'utilisation du lance-javelines a été en usage de 8360 ans B.P. au moins jusqu'à environ 1250 ans B.P., époque à laquelle elle fut soudain remplacé par la technologie reposant sur l'utilisation de l'ensemble arc et flèche. Grâce à cette collection, les archéologues et les chercheurs des premières nations ont pu en apprendre davantage sur les technologies et les méthodes de chasse utilisées à cette époque et ainsi améliorer leur compréhension des relations durables entre l'humain et le caribou.

Mots clés: archéologie du sud-ouest du Yukon, arc et flèche, lance, *atlatl*, plaque de glace alpine

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INTRODUCTION

In 1997, a fortuitous discovery was made on an alpine ice patch in the Coast Mountains of southwest Yukon (Kuzyk et al., 1999). A small stick with a bit of sinew wrapped around one end was found near the edge of the ice. The ice patch itself presented an unusual aspect, in that it was partially blanketed by thick deposits of caribou dung in an area where caribou had not been seen for nearly 70 years (CAFN, n.d.). Subsequent radiocarbon dating produced dates of 2450 ± 50 BP for one of the caribou dung pellets and 4360 ± 50 BP for the wooden shaft fragment with sinew. A site revisit by government and First Nation researchers in 1998 recovered a second wooden shaft with sinew at the site. As well, a second ice patch located nearby was identified that also contained ancient cultural material (Bowyer et al., 1999; Hare et al., 2001).

Annual surveys and monitoring of alpine ice patches in southwest Yukon since 1999 have recovered approximately 146 artifacts from 18 ice patches (for ice patch distribution, see Fig. 2 in Farnell et al., 2004, this volume), almost all related to the hunting of alpine big game and most representing aspects of projectile technology. Radiocarbon dates obtained on selected, representative artifacts range from 8360 ± 60 BP to 90 ± 40 BP (uncalibrated, See Tables 1 and 2), indicating an almost uninterrupted subsistence focus on these alpine sites throughout much of the Holocene.

This paper addresses the preliminary ethnographic research that the Ice Patch discoveries initiated. It provides

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TABLE 1. Inventory of archaeological ice patches.

Borden #	IP Name	Latitude	Longitude	Elevation (m)	Patch Size	No. of Artifacts	Discovery Year
JdVb-2	Thandlät	60˚ 35'	136˚ 15'	1830	Large	8	1997
JdVb-3	Jo Jo 8	60˚ 01'	136˚ 15'	1760	Small	1	1998
JdUt-17	Granger	60˚ 32'	135˚ 15'	1875	Large	13	1998
JeVe-6	Van Bibber	60˚ 43'	136˚ 43'	1610	Medium	1	1998
JdVc-1	Marmot	60˚ 32'	136˚ 28'	1670	Medium	1	1998
JbVa-2	Sandpiper	60˚ 19'	136˚ 01'	1830	Large	3	1998
JhVl-3	L. Gladstone	61˚ 17'	137˚ 59'	1975	Large	2	1999
JhVl-1	Gladstone	61˚ 16'	138˚ 05'	1915	Large	33	1999
JcUu-1	Friday Creek	60˚ 23'	135˚ 26'	1950	Medium	25	1999
JcUu-2	Alligator	60˚ 24'	135˚ 27'	1945	Medium	24	1999
JgVe-1	Thulsoo	61˚ 04'	136˚ 36'	1675	Medium	13	1999
JgVf-10	S. Long Lk.	61˚ 09'	136˚ 50'	1640	Small	1	1999
JbVa-1	Texas Gulch	60˚ 18'	136˚ 00'	2011	Medium	15	1999
JfVa-1	Sifton	60˚ 54'	136˚ 02'	1760	Medium	1	2000
JhVl-4	E. Gladstone	61˚ 16'	137˚ 57'	1915	Large	1	2003
JhVl-2	Oakley	61˚ 11'	137˚ 54'	1875	Medium	1	2003
JgVj-1	Lower Killermun	61˚ 06'	137˚ 38'	1875	Medium	1	2003
JfUn-1	Argillite	60˚ 57'	134˚ 19'	1550	Medium	1	2003

an overview of the artifact collections and an initial discussion of the collection's significance for our understanding of the archaeological record and events in the prehistory of the southwest Yukon.

PRELIMINARY RESULTS OF ETHNOGRAPHIC INVESTIGATIONS

The Contemporary Community Context

The ice patches with dung are located either within or in close proximity to the traditional territories of four south Yukon First Nations: Carcross-Tagish, Champagne and Aishihik, Kluane, and Kwanlin Dün. These First Nations are of Tagish, Tlingit, and Southern Tutchone cultural backgrounds (McClellan, 1975). Caribou figure prominently in the oral history and traditional stories of all four First Nations (e.g., McClellan, 1975; Cruikshank et al., 1990).

While restrictions on hunting the species currently exist, and in some parts of the study area caribou are no longer found, until very recently the people of these communities relied heavily on the species and actively hunted them in the mountains where the ice patches are located. Other types of land-use activities, such as sheep hunting, trapping, plant gathering, and hiking, still take place in those parts of the study area where caribou hunting is no longer permitted.

Interest in the ancient caribou and the hunting artifacts is high within the First Nations communities (Farnell et al., 2000). For the four First Nations that are partners in the Ice Patch Research Project, the educational opportunities provided by the project are a priority (CAFN, 2001; CAFN et al., 2001). The First Nations recognize the research as a chance for their citizens, especially youth, to be involved in the study of their history and to link science with community. To this end, citizens of the First Nations have been participating in the Ice Patch field work, searching the patches for artifacts and biological specimens and surveying for related features such as hunting blinds, and interviewing Elders about their people's history with caribou. As well, in the summers since 2000, the First Nations have operated a week-long "Science Camp" for teenagers as an outreach component of the project. Highlights of the science camp week include a visit to a nearby ice patch where participants and visiting Elders can see the ancient caribou dung, help search for artifacts, and even try their hand at making and using an *atlatl*, one of the ancient tool forms being recovered from these unique archaeological sites. The four First Nations have also produced a colour newsletter (CAFN et al., 2002) and a poster on the project for distribution to community members, First Nations' offices, and local educational institutions.

The four First Nations have all begun assembling traditional knowledge data related to caribou and land use in the mountains where the ice patches are located. Their efforts include new interview work with contemporary community members, as well as a review of previously recorded tapes, transcripts, interview notes, and other archival materials for information related to these subject areas (CAFN et al., 1999; CTFN, n.d.; KFN, n.d.; KDFN, n.d.). It is recognized that local oral history may be able to contribute a different perspective to some of the research questions being addressed by the Ice Patch scientific studies (cf. Cruikshank, 2001), including one of considerable local interest: "Why did the big herds of caribou disappear?" The preliminary data (stories) being assembled suggest that social (human) factors, as well as environmental factors, contributed to the disappearance of the big herds.

Alpine Hunting: Ethnographic and Archaeological Perspectives

The archaeological finds from the ice patches show that ancient hunters took advantage of the predictable behaviour of caribou (and other species) that brought these

TABLE 2. ^{14}C dates for diagnostic dart artifacts.

Site	Artifact #	Label	Segment	Lab #	Age (uncalibrated BP)
JcUu-1	9	dart shaft with fletching	proximal	Beta 172879	1250 ± 40
JcUu-1	17	dart shaft	complete	Beta 136340	1260 ± 60
JcUu-2	18	dart shaft fragment		Beta 162360	1590 ± 40
JgVe-1	10	dart shaft	distal/medial	Beta 152444	1600 ± 40
JcUu-2	8	dart foreshaft	complete	Beta 40626	1640 ± 40
JdUt-17	3	dart shaft	proximal/medial	Beta 140631	1840 ± 40
JbVa-1	7	dart foreshaft	complete	Beta 137728	1980 ± 50
JhVl-3	1	dart shaft with point	proximal/medial	Beta 185968	3050 ± 40
JbVa-2	1	dart shaft	complete	Beta 37730	3220 ± 60
JcUu-2	3	dart shaft	proximal	Beta140629	3580 ± 40
JhVl-1	23	dart foreshaft	distal	Beta 162658	3590 ± 50
JhVl-1	21	dart shaft fragments	distal	Beta 162352	3770 ± 50
JhVl-1	28	antler foreshaft	complete	Beta 185970	3880 ± 40
JcUu-2	2	dart shaft	distal	Beta 136345	3900 ± 70
JdVb-2	1	dart shaft fragment	proximal	TO 6870	4360 ± 50
JcUu-2	10	dart foreshaft	complete	Beta 140627	4440 ± 40
JdVb-2	9	dart shaft	distal/medial	Beta 172877	4460 ± 40
JcUu-1	15	hafted foreshaft	complete	Beta 37722	4480 ± 60
JhVl-1	22	dart shaft fragments	medial	Beta 162351	4500 ± 50
JhVl-1	31	dart shaft fragments	medial	Beta 185971	4540 ± 40
JcUu-2	1	dart shaft	proximal/medial	Beta 136344	4580 ± 70
JcUu-1	16	dart shaft	complete	Beta 137723	4700 ± 60
JhVl-1	2	dart shaft	proximal	Beta 152443	5240 ± 40
JgVe-1	7	dart foreshaft	complete	Beta 152452	5660 ± 40
JhVl-1	19	dart shaft fragments	proximal	Beta 162353	7290 ± 50
JhVl-1	32	dart shaft fragments	medial	Beta 185972	8360 ± 60

animals to ice patches during the height of the summer. A further advantage of hunting at ice patches may have been the ice itself, which facilitated the storage and preservation of meat for later use. Freezing would have eliminated the labour-intensive process of drying meat, which was a major task during the Southern Tutchone *shakat*, or late summer to early fall hunt (Allen, 1994).

At present, only preliminary comments can be offered regarding the role of ice patch hunting in regional land use over time. The existing data suggest that the ice patches were specialized hunting sites, that is, places where game species were killed and where primary processing of the animals occurred. There is no evidence, such as caches, domestic artifacts, habitation structures, or shelters, to suggest that hunters or their families stayed overnight or for extended periods in the high alpine area.

The ethnographic record of traditional First Nations alpine hunting provides a framework for the interpretation of prehistoric hunting at southern Yukon ice patches. All of the ice patch hunting sites are situated within a few hours' hike (10–15 km or less) of known archaeological sites in the adjacent valley bottoms (CHIN, 2002). These nearby camps, often in lakeside settings, were used in precontact as well as historic times. For example, one can easily reach the Thandlät ice patch from a well-known campsite on the shore of Kusawa Lake (*Nakhu Chù*). This particular campsite is reported to have been used in the 19th and early 20th centuries as a base camp for caribou and sheep hunting in the mountains surrounding the lake (CAFN, n.d.). Precontact archaeological finds have also been recognized at this same site and several other nearby localities (Greer, 1986).

Only preliminary perspectives on the hunting strategies employed at the ice patches, including the possibility of larger-scale, communal hunting, are presently available. Fences made of wood were used historically by the ancestors of all four First Nations in hunting caribou in valley-bottom settings (McClellan, 1975; Sidney, 1980; Greer, 1984; CAFN et al., 1999) but do not appear to have been part of ice patch hunting. No game drive lanes (cf. Benedict, 1996) have been recognized in the alpine setting of the ice patches. The association of hunting blinds with the Granger (JdUt-17) and Friday Creek (JcUu-1) and nearby Alligator (JcUu-2) ice patches suggests that visual cover may have been an important consideration. At locales where constructed blinds are absent, hunters may have used elements of local topography, such as lines of boulders, to conceal themselves. Some of these blinds are built around well-used sheep trails, however, which suggests they may have been used for hunting sheep rather than, or as well as, caribou.

A key factor in the hunting strategy employed at an ice patch would have been the weaponry used. Effective distance, accuracy, and impact differ significantly between the two types of projectile systems—bow and arrow versus throwing darts. These variables would also range considerably within the sample of darts represented in the collection of artifacts recovered from the ice patches.

OVERVIEW OF ARCHAEOLOGICAL INVESTIGATIONS

At the close of the 2003 field season, a total of 146 well-preserved, principally organic artifacts had been recovered at 18 ice patches in southwest Yukon (Table 1).

Almost all these artifacts are related to the hunting of alpine big game, and most represent elements of throwing-dart (*atlatl*) or bow-and-arrow technology. Artifacts are constructed variously of bone, antler, wood, and stone, and many are in excellent states of preservation.

AMS radiocarbon dates have been obtained from 55 artifacts in the Ice Patch collection (Tables 2–5). In several instances, the dating of nearby artifacts led us to suspect they were from the same original object, and we were able to fit them back together. AMS ^{14}C dates were determined by University of Toronto Isotrace Laboratory; Beta Analytic Inc., Miami, Florida; and Lawrence Livermore National Laboratory, University of California.

More than 600 large mammal remains, including bone, antler and teeth, have been collected from approximately 35 ice patches. The species represented in this inventory are described in the preceding paper (Farnell et al., 2004, this volume). There appears to be a strong correlation between archaeological materials and faunal remains: sites abundant in faunal materials tend also to be archaeological sites. These faunal materials are currently being studied for signs of butchering (D. Balkwill and S. Cumbaa, Canadian Museum of Nature, unpubl. data); positive identifications would increase the number of ice patches that are also archaeological sites.

The collection of artifacts from alpine ice patches can be grouped into three broad categories: throwing-dart (*atlatl*) technology, bow-and-arrow technology, and a small number of other or miscellaneous artifacts. The miscellaneous category includes a stitched leather pouch (JhVl-1:25), a carved wooden knife handle (JbVa-1:15), a variety of worked sticks of unknown function, a small piece of cordage (JgVe-1:14), various unmodified sticks (*manuports*), several stone flakes, and a collection of cut antler tines of uncertain function.

Within the Yukon Ice Patch collection, approximately 64 artifacts are associated with throwing-dart technology: these include 43 complete or fragmentary wood dart shafts or foreshafts, 17 stone projectile points (which all appear to be dart points), two antler points, and two bone/antler foreshafts. Thirty-two artifacts are associated with bow-and-arrow technology, including 13 wood arrow shafts, 18 antler projectile points, and three fragments of a single wood bow. Approximately 15 other shaft fragments are too small or incomplete to be assigned to a particular projectile technology. A further 17 wood specimens are either too deteriorated or too fragmentary to be identified.

Throwing-Dart Technology

Exclusive of stone projectile points, preserved elements of throwing-dart or *atlatl* technology are rare in Canadian archaeology (Hutchings and Brüchert, 1997). Generally, large stone projectile points are assumed to relate to throwing-dart (and spear) technology, and smaller points to bow-and-arrow technology. These correlations and inferences are occasionally revisited or challenged in the archaeological literature (Thomas, 1978; Shott, 1993, 1997; Knecht, 1997; Bettinger and Eerkens, 1999; Nassaney and Pyle, 1999). The Ice Patch Research Project collections provide a unique opportunity to investigate throwing-dart technologies as a complete system, together with the associated stone points.

Dart Shafts: There is considerable variability in the sample of dart shafts in the Ice Patch Research Project collection. Specimens range from very thin, "spindly" dart shafts to thick and robust shafts; from shafts made of single pieces of wood to composite darts with detachable foreshafts; and from expertly shaped and carved shafts to shafts that were produced either expediently or inexpertly.

Dart shaft dimensions are highly variable. Of the complete or nearly complete dart shafts (n = 8), the maximum length is 194 cm (JcUu-1:16, Fig. 1). Variation in the thickness along the length of a dart shaft appears to be a critical design attribute of darts; most shafts can be characterized as long and tapered, with the thickest or heaviest section at the distal end, the point of hafting. It is apparent that most of these darts were very flexible and must have evidenced considerable spring force when propelled. A number of darts, however, are more uniform in thickness (and possibly shorter), indicating they may have been employed as more rigid projectiles. The largest observed distal end measured 1.54 cm in diameter (JdVb-2:9), while the smallest observed proximal end measured 0.46 cm in diameter (JcUu-1:18), a measurement considerably smaller than the average proximal end of an arrow.

By looking at the end grain, it was often possible to determine whether the darts were made from natural shafts (saplings) or split from larger pieces of wood in the form of staves. Of 43 dart shafts, 44% (n = 19) are fashioned from staves, 32% (n = 14) are made on natural shafts, and 23% (n = 10) could not be identified.

Seventeen dart shafts were microscopically examined by Gregory Young of the Canadian Conservation Institute (Young, 2000) to determine wood type. Of these, 70% (n = 12) were identified as made of birch (*Betula* sp.), two were spruce (*Picea* sp.) (12%), two were willow (12%), and one dart was made of maple (*Acer* sp.) (6%) (Table 6). While maple may seem out of place in an interior Yukon setting, Douglas or Rocky Mountain maple (*Acer glabrum* Torr.) has been noted on low mountain passes connecting with coastal Alaska, less than 75 km to the south (Bruce Bennett, Yukon Department of Environment, pers. comm. to Hare 2000). Ethnographically in the Yukon, birch is the preferred wood for bows, snowshoes, and other valued material culture items (cf., Legros, 1981:494ff).

A further aspect of the technology involves the manufacture of darts from a single piece of wood or of composite darts made up of a foreshaft and shaft spliced together along a bevel and fastened with sinew. One dart in the collection (JcUu-2:1) is composed of at least three sections, spliced at mid-shaft, and spliced or bevelled for a foreshaft (missing) at the distal end. Possibly this is an example of a repair on a dart shaft.

FIG. 1. A dart shaft (JcUu-1:16) 194 cm long, lying in situ on the dung-covered ice, with close-ups of distal end (right) and sinew and fletching (left).

FIG. 2. Four dart ends that show one of the diagnostic attributes of dart technology: the presence of a dimple at the proximal end. Selected sample of dart ends (left to right): JcUu-1:16 (4700 ± 60 BP), JbVa-2:1 (3220 ± 60 BP), JcUu-2:3 (3580 ± 40 BP), and JhVl-1:2 (5240 ± 40 BP).

While shaft midsections were recovered more frequently than either proximal or distal ends of darts, eight proximal and 13 distal ends of dart shafts were identified. Proximal ends are characterized by the presence of a small dimple or socket, designed to accommodate the hooked spur of the throwing board (Fig. 2). Distal ends were identified generally by the presence of a slotted haft element at the end of the shaft, designed to accommodate a stone projectile point (Fig. 3). The one exception to the apparently standard slotted haft was a 152 cm long dart shaft (JcUu-1:17, Fig. 4) with an open-socket haft element, intended to accommodate a spatulate-type antler or bone point.

Eight of the 13 identified distal portions are actually complete dart foreshafts: five are made of wood and three of antler. One antler foreshaft (JcUu-2:21, Fig. 5) is a massive, unilaterally barbed piece, featuring 35 barbs in total and measuring 39.5 cm long and 2.2 cm wide. The artifact is slotted at the distal end for the insertion of an end blade, while the proximal end tapers down to a point. Curiously, impact damage appears to be present at the proximal end of the foreshaft.

Three of the dart shafts exhibit traces of ochre staining. Nine still possess sinew ties, and a number of these also retained feathers or fletching.

Dart Projectiles: Seventeen stone projectile points and two antler points recovered from ice patches appear to be associated with dart-throwing systems (Fig. 6). Two stone points, JcUu-1:15 (Fig. 7) and JdVb-2:9, were still hafted to dart shafts, and four other points were found in direct association with (but not attached to) dart shafts.

Most of the stone projectiles are complete or nearly so. The collection is noteworthy in terms of its variability, including stemmed, unstemmed and side-notched types, and ranging from lanceolate to leaf-shaped in outline (Fig. 6). The points range in length from 6.4 cm to about 12.2 cm for complete points and weigh from 13.6 to 31 grams. Despite the variation in basal configuration, all of the recovered points would have been mounted in a slotted haft element at the distal end of a shaft. Seven of the points still exhibit traces of ochre, and one or possibly two of the points have traces of pitch associated.

We dated three styles of stone points from the dates of shafts that were either directly associated or found nearby. JcUu-1:15 is a side-notched point directly dated at 4480 ± 60 BP (Fig. 7); JcUu-1:2 is a stemmed/shouldered point dated by association to 3510 ± 70 BP; JhVl-3:1 is a concave base, lanceolate point dated by association to 3050 ± 40 BP; and JcUu-2:4, also a stemmed/shouldered point, is dated by association to 3900 ± 70 BP (Fig. 6).

Both antler points are complete, although one was recovered in two pieces. The latter (JhVl-1:1 Fig. 8) is slotted along both lateral margins, presumably for the insertion of microblades. The piece measures 24.6 cm long and 1 cm wide. The base of the point is somewhat spatulate, tapering to a blunt point and heavily scored, probably to facilitate hafting with sinew ties. The lateral slots extend along the entire length of the point, exclusive of the spatulate base. An engraved helical design, possibly an ownership mark, is present on the proximal end of one face of the point. The point is dated to 7310 ± 40 BP. An incomplete dart shaft with a dimpled proximal end (JhVl-1:19), recovered nearby at the same ice patch, provided an almost identical date of 7290 ± 40 BP and therefore may have been the shaft for this antler point.

The second organic projectile (JcUu-1:21) is an unbarbed antler point, 22.5 cm long and 1.4 cm wide. The artifact is bipointed, with the proximal end somewhat rounded or blunted. In cross-section, the point is plano-convex. The point may have functioned as a self-barbed point, mounted on a bevelled shaft, although it appears that the blunted end has sustained minor impact damage. JcUu-1:21 has been

FIG. 3. Large-diameter shafts of throwing darts, slotted for insertion of stone points. Selection (top to bottom), with radiocarbon dates: JcUu-2:8 (1640 ± 40 BP), JcUu-2:10 (4440 ± 40 BP), JbVa-2:1 (3220 ± 60 BP), and JcUu-2:2 (3900 ± 70 BP).

FIG. 4. Close-up of open socket hafting element with sinew on a throwing dart (JcUu-1:17). This dart was complete, measuring 152 cm in length. The artifact is dated at 1260 ± 60 BP.

dated at 3870 ± 40 BP. This point closely resembles two bone points recovered from Goldstream Pit in Alaska and dated to about 8500 BP (Dixon, 1999:53, Fig. 3–4; identification of this point was made with the kind assistance of James Dixon, August 2001).

Chronology for Throwing Dart Systems

The availability of organic artifacts in the Ice Patch Research Project collection provides the opportunity to date elements directly associated with throwing-dart systems. Selection of artifacts for dating was based on the presence of at least one unequivocal characteristic of throwing-dart technology: a dimple at the proximal end of a dart, a large-diameter slotted hafting element on the distal end of a shaft or foreshaft, shaft diameter greater than 1.20 cm, or a midsection measuring longer than 100 cm. In all, these criteria identified 28 dart-related artifacts to be sampled for AMS radiocarbon dating. Resultant dates ranged from 8360 ± 60 BP to 1250 ± 40 BP, with the majority of dates falling between 4700 and 3200 BP (see Tables 2 and 3). The oldest artifact in the ice patch collection (JhVl-1:32) is a nondescript medial segment of a dart shaft (in four pieces).

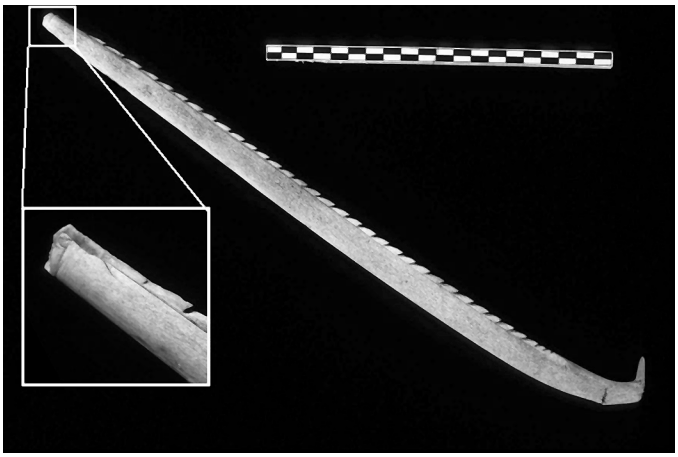

FIG. 5. Very large barbed foreshaft (JcUu-2:21), slotted on distal end for endblade (close-up). Dated at 4360 ± 40 BP.

FIG. 6. A sample of stone dart projectile points. Top row (left to right): JdVb-2:8, JcUu-1:2, JcUu-2:4, JbVa-1:10, JbVa-1:9, JbVa-1:8, and JcUu-1:4; Bottom row (left to right): JdUt-17:1, JhVl-3:1, JhVl-1:26, JhVl-1:27, and JfVa-1:1.

The stylistic, construction, and metrical variations observed in the Ice Patch Research Project throwing-dart collection do not appear to pattern chronologically. Throughout most of the time-range for the technology, saplings and staves were selected for shaft production in about equal numbers, and no obvious preference is evident for single shaft or composite shaft/foreshaft manufacture. Birch is the preferred wood throughout the temporal range of the technology (Table 6).

The preponderance of U-shaped slotted hafting elements on the dart shafts indicates that stone points were the preferred armature for throwing darts. Within the Ice Patch collection, only five examples of throwing-dart technology appear to incorporate bone or antler components. These include JhVl-1:1, the slotted antler point dated at 7310 BP (Fig. 8); JcUu-1:21, the unbarbed antler point dated at 3870 ± 40 BP; JcUu-2:21, the massive antler foreshaft (Fig. 5) dated at 4360 ± 40 BP; JhVl-1:28, an antler foreshaft dated at 3880 ± 40 BP; and JcUu-1:17, a complete dart shaft 152 cm long with an open socket at the

FIG. 7. A bevelled foreshaft for a throwing dart (JcUu-1:15). The hafted side-notched stone point is inserted into a slot in the end of the piece and held in place by multistrand, untwisted sinew. The artifact is dated to 4480 ± 60 BP.

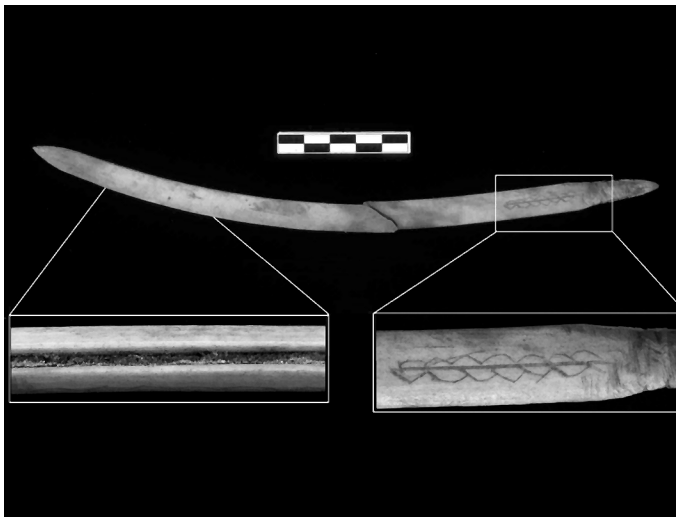

FIG. 8. This bilaterally slotted or grooved antler point (JhVl-1:1), likely armed with microblade insets, is dated to 7310 ± 40 BP. The point has an engraved helical design near the proximal end (right). The hafting element is a slightly flattened tang, which has been heavily scored to provide additional grip (left).

distal end. The open socket, with well-preserved sinew lashing, was designed to accommodate a spatulate-stemmed antler projectile point. This dart shaft is intriguing because it is radiocarbon dated at 1260 ± 60 BP. With this date, it represents the latest appearance of throwing-dart technology and apparently heralds the transition from stone to bone/antler projectiles and the wholesale adoption of bow-and-arrow technology.

Bow-and-Arrow Technology

Bow-and-arrow technology is well represented in the Ice Patch Research Project collection. Arrows were often recovered intact rather than broken into numerous pieces, as was common in the dart sample. This superior preservation may be due to several factors, such as the shorter overall length of arrows vs. darts; the greater antiquity of darts, possibly subjecting them to different post-depositional stresses; different impact dynamics; or some combination of these factors.

A total of 12 complete arrow shafts were recovered, four with projectile points still attached or in direct association (see Fig. 9). Two partial arrow shafts were also identified (identification of a specimen as an arrow was based on the presence of a nocked proximal end). In addition, 13 barbed antler projectile points and one barbed bone point were recovered without associated shafts. Three bow fragments (JcUu-2:6), all assumed to be from the same self bow, also were collected from an ice patch.

Arrow Shafts: Arrow shaft length in the collection ranges from 52 cm to 73 cm, with a median length of 58 cm. Arrow shaft diameter ranges from 1.0 cm to 0.45 cm, depending on where on the shaft the measurement is taken. The location of the point of maximum diameter on shafts is variable. Most of the complete arrow shafts (75%, n = 9) are broadest at about the midpoint (barrelled shaft), although in the case of three artifacts, the difference between the diameters of the midpoint and the distal end is so minimal that the shaft could be considered parallel in form. One shaft is widest in the proximal third.

Observations of the end grain of the wood indicate that all of the identified arrow shafts (n = 14) are made on staves of wood rather than natural saplings. Wood identifications have been completed on seven of these shafts to date: four (57%) were made of spruce (*Picea* sp.), two (28%) of birch (*Betula* sp.), and one (14%) of pine (*Pinus* sp.) (Young, 2000). A comparison of wood types for dart shafts and arrows is presented in Table 6.

When present, the distal end of all arrow shafts possessed a socketed hafting element for insertion of a tanged or stemmed antler point. All preserved proximal ends of arrows exhibited a U-shaped nock (Fig. 10).

Several of the arrows still retained sinew ties in association with fletching or hafting of the antler arrow points, or both. On one specimen, the fletching is complete, comprising three split feathers tied onto the shaft with sinew. Ochre was also present on a number of shafts, often associated with sinew ties. On one artifact (JbVa-1:1), four concentric ochre rings were painted at various locations along the length of the shaft; on the majority of arrow shafts, however, the ochre seems to have been applied randomly.

Arrow Points: All of the points associated with bow-and-arrow technology are fashioned from antler (n = 17) or bone (n = 1). Twelve of 17 projectile points (69%) are unilaterally barbed, conically tanged points **(**Fig. 11) (see Le Blanc, 1984:318–321 for discussion of bone and antler point terminology). Within this group, however, there is considerable stylistic variation: two unilaterally barbed points are slotted for an end blade (JgVe-1:5; JgVf-10:1) and another is bilaterally barbed at the tip (JbVa-1:12), while a fourth exhibits three different styles of barbs along the lateral edge (JbVa-1:2). Finished points range in size from 8 cm to 35 cm, with an average size of 20.07 cm.

TABLE 3. ^{14}C dates for diagnostic bow-and-arrow artifacts.

Site	Artifact #	Label	Segment	Lab #	Age (uncalibrated)
JcUu-2	7	arrow shaft	complete	Beta-140625	90 ± 40
JcUu-2	12	bone point	complete	Beta-137724	140 ± 40
JcUu-2	16	arrow shaft	complete	Beta-152445	190 ± 40
JbVa-1	2	antler point	complete	Beta-139098	360 ± 40
JbVa-1	5	arrow shaft	complete	Beta- 37726	400 ± 40
JbVa-1	1	arrow shaft	complete	Beta-137725	440 ± 50
JgVe-1	5	antler point	complete	Beta-139101	590 ± 40
JgVe-1	1	antler point	complete	Beta-139100	660 ± 40
JhVl-2	1	arrow shaft	complete	Beta-172878	670 ± 40
JgVe-1	2	arrow shaft	complete	Beta-137729	680 ± 40
JcUu-1	10	antler point	complete	Beta-1329097	740 ± 40
JcUu-1	3	arrow shaft	complete	Beta-136342	810 ± 40
JcUu-2	5	arrow shaft fragment	fragments	Beta-140628	810 ± 40
JgVf-10	1	antler point	complete	Beta-185973	840 ± 40
JbVa-1	12	antler point	complete	Beta-139099	930 ± 40
JbVa-1	3	arrow shaft	complete	Beta-137727	1010 ± 40
JcUu-2	6	bow fragments	fragments	Beta-136343	1300 ± 60
JcUu-1	1	arrow shaft[1]	complete	Beta-136341	3510 ± 70
				Beta-140630	3600 ± 40

[1] Dated twice.

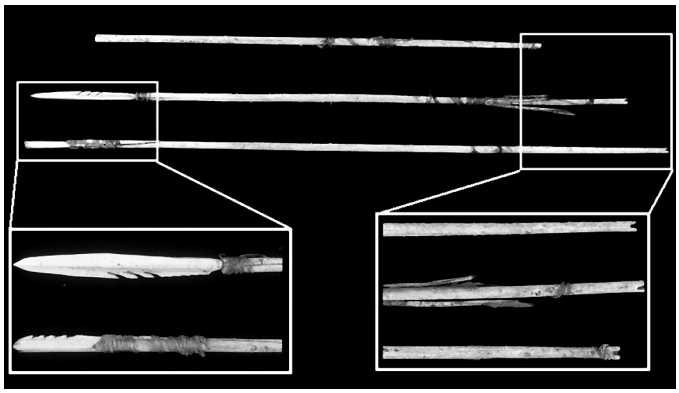

FIG. 9. A sample of complete or near-complete arrows, all retaining sinew and evidence of ochre staining. The feathers are preserved on the arrow in the centre. A total of 11 complete arrow shafts have been recovered in the southwest Yukon ice patches to date. Top to bottom: JcUu-2:19, JcUu-2:16, and JcUu-2:17.

FIG. 10. Close-up of U-shaped nocks on proximal ends of arrows. Top to bottom: JcUu-2:17, JcUu-2:16, and JcUu-2:19.

Other projectile types include bilaterally barbed, conically tanged, (n = 2) and unilaterally barbed, spatulate stemmed (n = 3) points.

Almost all of the barbed points have incised longitudinal lines, variously located at the base of the barbs, medially on the point, or laterally along an unbarbed edge.

Notably absent from the collection are any examples of diminutive side-notched or stemmed stone points, generally considered to be the diagnostic indicator of bow-and-arrow technology throughout North America. Such small stone arrow points are known from other archaeological contexts in the study area (Greer, 1982) and are of similar age to the bow-and-arrow artifacts dated in this study, as discussed below. It appears that during Late Prehistoric times, stone points were not the preferred armature for bow-and-arrow hunting of caribou at ice patches.

Bow: A medial segment and two end segments of a single bow (JcUu-2:6) were recovered in the investigations. This appears to be a simple self bow, with a flat back and a slightly crowned belly. The ends are squared, with paired square notches for the string attachment. The bow is incomplete but originally measured more than 82 cm in length (the overall length of the fragments); maximum width is 2.59 cm and maximum thickness is 1.43 cm. The wood used in construction was identified as maple (Young, 2000). As noted earlier, Douglas maple is present in the mountain passes to the south of the study area. Turner (1979:156) reports that this wood was favoured traditionally by certain British Columbia groups for bow construction.

Chronology of Bow-and-Arrow Technology

A total of 19 AMS radiocarbon dates were run on elements of bow-and-arrow technology: these include 10 AMS dates on arrow shafts, seven on antler/bone points, and one on a fragment of the bow. With the exception of

TABLE 4. ^{14}C dates for non-diagnostic dart artifacts.

Site	Artifact #	Label	Segment	Lab #	Age (uncalibrated BP)
JhVl-1	14	dart shaft fragment?	medial	Beta-165101	3010 ± 40
JcUu-1	21	antler/bone point - unbarbed	complete	CAMS-71939	3870 ± 40
JhVl-1	4	dart shaft fragment	medial	Beta-152442	4100 ± 40
JcUu-1	25	dart shaft fragment?	proximal	Beta-162659	5320 ± 50
JdVb-2	2	dart shaft fragment	proximal	TO-7552	6860 ± 70
JhVl-1	1	antler point - slotted	complete	Beta-154960	7310 ± 40
JhVl-1	32	dart shaft fragments	medial	Beta-185972	8360 ± 60

FIG. 11. A sample of unilaterally barbed antler and bone points. From top to bottom: JgVe-1:5 (590 ± 40 BP), JbVa-1:2 (360 ± 40 BP), JgVe-1:1 (660 ± 40 BP), JcUu-2:12 (140 ± 40 BP), JbVa-1:4 (undated), and JbVa-1:12 (930 ± 40 BP). Note that JgVe-1:5 (at top) has a slot for an end blade at the distal end.

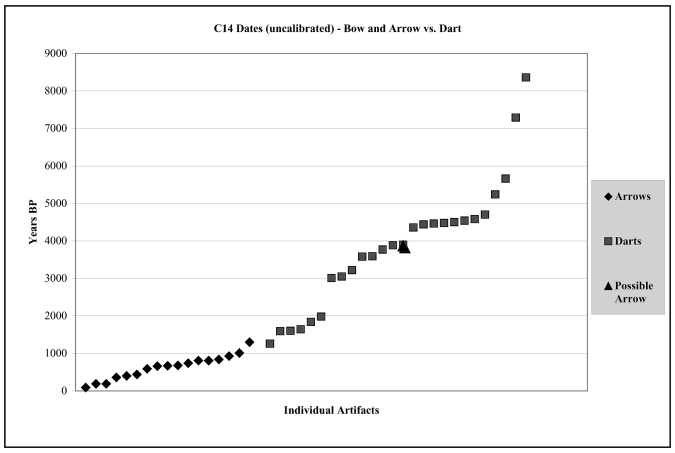

FIG. 12. Timeline of AMS dates for diagnostic bow-and-arrow vs. throwing-dart (*atlatl*) artifacts.

one aberrant shaft (JcUu-1:1), discussed below, the dates all cluster between 1300 BP and 90 BP (Table 3).

When these dates are contrasted with the radiocarbon results for dart shafts (Table 2), it is clear that there is virtually no temporal overlap between *atlatl* and bow-and-arrow technology in southern Yukon (Fig. 12). The oldest unambiguous evidence of bow-and-arrow technology is the fragmented maple bow (JcUu-2:6) dated at 1300 ± 60 BP. The most recent evidence of *atlatl* technology is the 126 cm long dart shaft (JcUu-1:17) discussed above and dated at 1260 ± 60 BP. All of the recovered artifacts dated after 1200 BP are unequivocally bow-and-arrow technology.

These observations being made, one intriguing artifact in the Ice Patch Research Project collections requires further discussion. JcUu-1:1 is a birch shaft measuring 100 cm in length, with its greatest diameter at the distal end. Although its distal end and haft element are missing, the shaft was recovered in close proximity to a thin, very well made stemmed lanceolate point (JcUu-1:2) that is assumed to be associated. On the basis of these characteristics, the artifact can be classed in the sample of throwing darts. However, a distinct U-shaped nock, which is one of the defining attributes of arrows, is present on the proximal end of the shaft. Two samples from the shaft were submitted for AMS dating: both returned dates of about 3500 BP (Table 3), which would place the artifact firmly within the temporal range of throwing-dart technology. Possibly the nock is an unusual or idiosyncratic design for seating the dart on the throwing board; alternatively, this is an early example of bow-and-arrow technology, apparently unrelated to the more widespread technology of the last millennium (see discussion below).

Miscellaneous Artifacts

A small assemblage of miscellaneous artifacts was recovered on or in the vicinity of ice patches. These include stone flakes (debitage); a collection of sticks, some of which are presumed shaft preforms; a leather pouch; a wood artifact of unknown function; a wooden knife handle; and a number of modified antler tines.

The antler tine artifacts appear to have been intentionally selected and produced, but their function is uncertain (Fig. 13). Approximately 10 transversely cut tines have been recovered from various ice patches. In all cases, they consist of a single tine removed from a palmate section of an antler beam. The tines have been snapped or cut off at a transverse angle and usually retain some portion of the palmation. Several of the tines show pitting or damage at the tip, but it is not clear whether this damage is cultural. Le Blanc (1984:313, Plate 46) interpreted similar objects from the Rat Indian Creek site in northern Yukon as by-products of antler core preparation. At Rat Indian Creek, however, other artifacts related to the preparation and reduction of antler and bone tools were abundant. Within the Ice Patch Research Project collection, no other elements of antler preparation have been identified. Further-

TABLE 5. ^{14}C dates for miscellaneous/indeterminate artifacts.

Site	Artifact #	Label	Raw Material	Lab. #	Age (uncalibrated BP)
JfUn-1	1	carved wooden board	unidentified wood	Beta-185969	1210 ± 40
JhVl-1	25	leather pouch	leather	Beta-182661	1430 ± 40
JcUu-2	20	antler tine	antler	Beta-152439	3720 ± 40
JdUt-17	11	antler tine	antler	Beta-152438	3810 ± 40
JdUt-17	3	broomed shaft	unidentified wood	TO-7554	3830 ± 50
JdVb-3	1	carved wooden shaft	unidentified wood	Beta-165100	3880 ± 40
JcUu-2	21	antler foreshaft - lance	antler	CAMS-71938	4360 ± 40
JbVa-1	11	antler tine	antler	Beta-152440	5000 ± 40

FIG. 13. A sample of antler tines recovered in the southwest Yukon ice patches. The function of these artifacts remains to be determined, but many show use damage on the tips. Top row (left to right): JhVl-1:8 (undated) and JdUt-17:11 (3810 ± 40 BP). Bottom row (left to right): JcUu-2:20 (3720 ± 40 BP), JgVe-1:12 (undated), and JbVa-1:11 (5000 ± 40 BP).

FIG. 14. Close-up of the drawstring and closure of a small leather pouch (JhVl-1:25). The pouch has been dated at 1430 ± 40 BP.

more, the majority of the antler-derived artifacts within the collection have been radiocarbon dated to within the past 1200 years (see Table 7). However, the three transverse-cut antler tines sampled were dated at 3720 ± 40 BP, 3810 ± 40 BP, and 5000 ± 40 BP (Table 5). These dates suggest that the tines were not related to a period of the most intensive use of antler; they are likely artifacts in their own right, rather than by-products.

The antler tines may have been used as pressure flakers on stone projectile points and knives, although there was no evidence of microdebitage imbedded in the damaged tips. They may also have been employed as expedient skinning tools.

A rare hide artifact in the Ice Patch collections is a small leather pouch (JhVl-1:25, Fig. 14) that was recovered almost 20 m from the edge of an ice patch. The pouch, approximately the size of a man's mitten, is stitched together with sinew and has a leather drawstring. Prolonged exposure has resulted in significant deterioration of the centre portions of the bag. The bag has been radiocarbon dated at 1430 ± 40 BP.

One of the more remarkable artifacts recovered is a small, carved wooden stick (JfUn-1:1, Fig. 15) approximately 22 cm long, with a square hole incised 1.6 cm from the proximal end. The tool tapers gradually from the proximal to the distal end before flaring into the shape of a blunt arrow. One interpretation is that it may be an Athapaskan hunting tool known as a "Little Owl." According to Reverend Salmon, a Fort Yukon elder, the tool was used to hunt rabbits. Several owl feathers were tied to the wooden handle, and the device was thrown through the air to mimic the sound of an owl in flight, frightening the rabbit into immobility so that the hunter could easily capture it by hand (O'Brien, 1997). Another interpretation of the object is that it was an unusually small throwing board. The incised hole would have been the location of an inset bone or antler hook for propelling a dart. The artifact has been dated at 1210 ± 40 BP.

Several largely unmodified wooden sticks (manuports) were recovered in a cluster at the Granger ice patch. A degree of selection is evident in the relatively uniform length and diameter of these sticks, which is consistent with the size of dart shafts in the Ice Patch collections. As well, wood of this size is not locally available at the Granger site (elevation 1890 m asl) and would have had to be imported. Two of the shafts exhibit flattening and "brooming" at one end, although it is not clear whether this is a deliberate modification. One of the broomed pieces was dated at 3830 ± 50 BP (Table 5).

The carved knife handle (JbVa-1:15) is straight piece of wood approximately 17 cm long, with a rounded handle and an open socket haft element on the distal third of the piece. The artifact is undated.

TABLE 6. Projectile shafts by wood type.

	Betula sp.	*Picea* sp.	*Pinus* sp.	*Salix* sp.	*Acer* sp.
Dart Shafts (n = 17)	70% (12)	12% (2)	-	12% (2)	6% (1)
Arrow Shafts (n = 7)	28% (2)	57% (4)	14% (1)	-	-

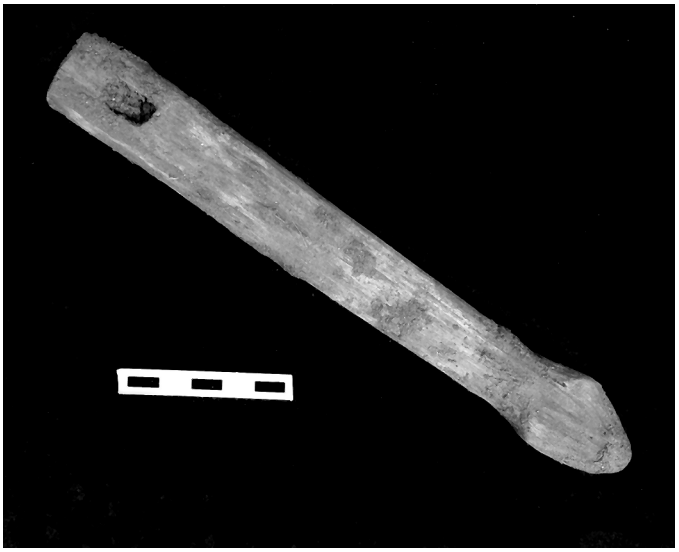

FIG. 15. Carved wooden handle (JfUn-1:1), possibly a "Little Owl" hunting stick or a short throwing board. Dated at 1210 ± 40 BP.

Artifact JgVe-1:14 is a small piece of two-ply cordage approximately 10 cm long. It appears to be made from very fine sinew or animal hair. Further analysis of the cordage is planned.

DISCUSSION

The Ice Patch archaeological collection offers a rare opportunity to observe organic elements of material culture that seldom are found in an archaeological context. The preservation of wood shafts, sinew bindings, fletchings, ochre paint, and projectiles of antler and bone provides an opportunity to investigate poorly known aspects of ancient material culture, as well as technological changes through time.

Several features of the Ice Patch collection relating to the technology of hunting merit special discussion. While technological change is routinely encountered in the archaeological record, abrupt transitions in technologies are often difficult to observe. The Ice Patch collection provides evidence of rapid change and likely replacement in the weaponry associated with the caribou hunt in the southwest Yukon.

Dates on the artifacts in the Ice Patch collections indicate that at about 1200 BP, throwing-dart weaponry was replaced by the bow and arrow (see Fig. 12). As discussed above, one anomalous artifact recovered may be an arrow dating to about 3700 BP, although the florescence of bow-and-arrow technology did not occur until about 1200 BP. The first unequivocal evidence of bow and arrow is three fragments of a maple bow dated at about 1300 BP. The latest evidence of a throwing dart was dated at 1260 BP. All identifiable projectiles dated later than that point in time are arrows, rather than darts.

This transition in the Yukon is broadly comparable to the timeline for bow-and-arrow technology elsewhere in North America. Many researchers suggest that the bow and arrow were present in most culture areas of North America between 1500 and 1200 BP. (Christenson, 1986; Shott 1993, 1997). It appears that the Ice Patch collection provides some of the best organic evidence in North America for the technological shift to bow and arrow.

Accompanying the change from throwing-dart to bow-and-arrow technology is an apparent shift from stone points to barbed antler points. As noted above, while small stone arrow points are documented in the southern Yukon archaeological record of the past millennium (Workman, 1978:206, 216), none occur in the ice patch sites. As a kind of transitional object, the last dated throwing dart (JcUu-1:17), dated to 1260 BP, exhibits an open socket hafting, designed to take a tanged or spatulate stemmed antler point rather than a stone point.

Another trend seen in the Ice Patch collections at about this time appears to be a transition in preferred or available wood types for shaft construction. As shown in Table 6, 70% of dart shafts were made of birch (*Betula* sp.), but with the transition to bow and arrow, spruce (*Picea* sp.) became the predominant wood type.

All of these dramatic changes were taking place at approximately the same time as the cataclysmic eruption of Mount Churchill in the headwaters of the White River, which blanketed southern and central Yukon with a thick mantle of volcanic ash (Lerbekmo et al., 1975; Clague et al., 1995). The fall of the White River ash likely had devastating consequences for the native residents of the Yukon, and numerous authors have suggested that the eruption initiated a large-scale Athapaskan migration out of the area. It is also important to note that an earlier large eruption in the White River area, at about 1900 BP (Lerbekmo et al., 1975), may have contributed to an overall cultural destabilization of the area during the first millennium AD.

SUMMARY

The archaeological sites discovered during the Yukon Ice Patch Research Project represent a previously undocumented type of site that preserves an exceptional sample of

organic artifacts and faunal and botanical remains. For many archaeologists working in a boreal forest environment, this collection provides a first opportunity to observe complete ancient projectile systems and identify clear chronological frameworks for technological change through time.

The demonstration that the transition from throwing-dart to bow-and-arrow technology was in the nature of a technological replacement is, archaeologically speaking, one of the most significant contributions that this research has made to our interpretations of the material culture record in the Yukon. Further, the dating of this transition as coincident with White River eruptions provides fertile ground for further inquiry into the events in regional prehistory in the critical first millennium AD. As studies become more focused and collections increase, we may anticipate an improved understanding of the history and material culture of ancestral Yukon people.

The Ice Patch work is incorporating both Western science and First Nations traditional knowledge perspectives on topics of interest and concern. The project is expected to considerably improve our understanding of the land mammal species most important throughout history for people across the circumpolar North, illuminating both the biological history of the caribou and its long-term relationship with humans.

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REFERENCES

ALLEN, J. (TUTCHONE RESOURCES). 1994. Traditional knowledge report Aishihik caribou recovery area. Unpubl. ms. Available at the Champagne and Aishihik First Nations, Haines Junction, Yukon Y0B 1L0, and Government of Yukon, Department of Renewable Resources, Whitehorse, Yukon Y1A 2C6, Canada.

BENEDICT, J.B. 1996. The game drives of Rocky Mountain National Park. Research Report No. 7. Ward, Colorado: Center for Mountain Archaeology.

BETTINGER, R.L., and EERKENS, J. 1999. Point typologies, cultural transmission and the spread of bow-and-arrow technology in the prehistoric Great Basin. American Antiquity 64(2):231–242.

BOWYER, V., KUZYK, G.W., RUSSELL, D.E., FARNELL, R.S., GOTTHARDT, R.M., HARE, P.G., and BLAKE, E. 1999. Caribou remains at Thandlät: Archaeology and paleoecology of some well-preserved sites on ice patches in the southwestern Yukon. Paper presented at the 32nd Annual Conference of the Canadian Archaeological Association, Whitehorse, Yukon.

CAFN (CHAMPAGNE AND AISHIHIK FIRST NATIONS). 2001. Project Proposal: South Yukon ice patch studies: Linking science and community in the investigation of the environment and climate change. Submitted to Northern Ecosystem Initiative, Environment Canada (successful). On file at Heritage Office, Champagne and Aishihik First Nations, Haines Junction, Yukon Y0B 1L0.

——— n.d. Interview files and transcripts of the CAFN Oral History Files. Unpublished materials on file at Heritage Office, Champagne and Aishihik First Nations, Haines Junction, Yukon Y0B 1L0.

CAFN (CHAMPAGNE AND AISHIHIK FIRST NATIONS), STRAND, D., and GREER, S. 1999. People and caribou (Mäzi) in the Champagne and Aishihik First Nations traditional territory. Paper presented at the 32nd Annual Meeting of the Canadian Archaeological Association. Whitehorse, Yukon.

CAFN (CHAMPAGNE AND AISHIHIK FIRST NATIONS), CARCROSS/TAGISH FIRST NATION (CTFN), KWANLIN DÜN FIRST NATION (KDFN), and GREER, S. 2001. Emergency recovery of artifacts from melting ice patches. Final Report to Yukon Community Development Fund, February 2001. On file at Heritage Office, Champagne and Aishihik First Nations, Haines Junction, Yukon Y0B 1L0.

CAFN (CHAMPAGNE AND AISHIHIK FIRST NATIONS), CARCROSS/TAGISH FIRST NATION (CTFN), KWANLIN DÜN FIRST NATION (KDFN) and KLUANE FIRST NATION (KFN). 2002. Ice Patch (newsletter). On file at Heritage Office, Champagne and Aishihik First Nations, Haines Junction, Yukon Y0B 1L0. 12 p.

CHIN (CANADIAN HERITAGE INFORMATION NETWORK). 2002. Yukon archaeological sites database. Ottawa: Archaeological Survey of Canada, Canadian Museum of Civilization.

CHRISTENSON, A.L. 1986. Projectile point size and projectile aerodynamics: An exploratory study. Plains Anthropologist 31(112):109–128.

CLAGUE, J.J., EVANS, S.G., RAMPTON, V.N., and WOODSWORTH, G.J. 1995. Improved age estimates for the White River and Bridge River tephras, western Canada. Canadian Journal of Earth Sciences 32:1172–1179.

CRUIKSHANK, J. 2001. Glaciers and climate change: Perspectives from oral tradition. Arctic 54(4):377–393.

CRUIKSHANK, J., SIDNEY, A., SMITH, K., and NED, A. 1990. Life lived like a story. Vancouver: University of British Columbia Press.

CTFN (CARCROSS-TAGISH FIRST NATION). n.d. Interview files and transcripts. Unpubl. materials on file, Carcross-Tagish First Nation, Box 130, Carcross, Yukon Y0B 1B0.

DIXON, J. 1999. Bones, boats and bison: Archeology and the first colonization of western North America. Albuquerque: The University of New Mexico Press.

FARNELL, R.G., HARE, G., GOTTHARDT, R.M., BLAKE, E., JOE, L., STRAND, D., and. GREER, S. 2000. Southern Yukon alpine ice patches: Climate change records, caribou history, ancient hunters and much more. Published Abstract, Arctic Science 2000 – Crossing Borders: Science and Community, 21–24 September 2000. Whitehorse, Yukon: American Association for the Advancement of Science and Yukon Science Institute.

FARNELL, R., HARE, P.G., BLAKE, E., BOWYER, V., SCHWEGER, C., GREER, S., and GOTTHARDT, R. 2004. Multidisciplinary investigations of alpine ice patches in southwest Yukon, Canada: Paleoenvironmental and paleobiological investigations. Arctic 57(3):247–259.

GREER, S. 1982. Field report of the 1982 Southern Lakes (Yukon) Archaeology Project. Unpubl. manuscript on file at the Archaeological Survey of Canada, Canadian Museum of Civilization, Ottawa. 24 p.

———. 1984. Traditional land-use patterns of the Carcross-Tagish Band. Manuscript prepared for the Clifford E. Lee Foundation, Edmonton, Alberta, on behalf of the Carcross-Tagish Indian Band. Unpubl. ms available at Yukon Archives, Department of Tourism & Culture, Government of Yukon, Box 2703, Whitehorse, Yukon Y1A 2C6. 32 p.

———. 1986. Kusawa Lake archaeology: Management, research and interpretation. Unpubl. ms. Available at Government of Yukon, Department of Business, Tourism and Culture, Box 2703, Whitehorse, Yukon Y1A 2C6.

HARE, G., GREER, S., GOTTHARDT, R., and STRAND, D. 2001. What's the point? New insights into projectile technology from ice patches in southern Yukon. Paper presented at the 34th Annual Conference of the Canadian Archaeological Association, Banff, Alberta.

HUTCHINGS, K.W., and BRÜCHERT, L.W. 1997. Spearthrower performance: Ethnographic and experimental research. Antiquity 71:890–897.

KDFN (KWANLIN DÜN FIRST NATION) n.d. Interview files and transcripts. Unpubl. materials on file, Kwanlin Dün First Nation, 35 McIntyre Drive, Whitehorse, Yukon Y1A 5S2.

KFN (KLUANE FIRST NATION) n.d. Interview files and transcripts. Unpublished materials on file, Kluane First Nation, Box 20, Burwash Landing, Yukon Y0B 1V0.

KNECHT, H. 1997. The history and development of projectile technology research. In: Knecht, H., ed. Interdisciplinary contributions to archaeology: Projectile technology. New York and London: Plenum Press. 3–35.

KUZYK, G., RUSSELL, D.E., FARNELL, R.S., GOTTHARDT, R.M., HARE, P.G., and BLAKE, E. 1999. In pursuit of prehistoric caribou on Thandlät, southern Yukon. Arctic 52(2):214–219.

LE BLANC, R.J. 1984. The Rat Indian site and the Late Prehistoric Period in the interior northern Yukon. Mercury Series, Archaeological Survey of Canada Paper No. 120. Ottawa: National Museum of Man.

LEGROS, D. 1981. Structure socio-culturelle et rapports de domination chez les Indiens Tutchone Septentrionaux du Yukon au dix-neuvième siècle. Doctoral dissertation. University of British Columbia, Vancouver. 1098 p.

LERBEKMO, J.F., WESTGATE, J.A., SMITH, D.G.W., and DENTON, G.H. 1975. New data on the character and history of the White River volcanic eruption, Alaska. In: Suggate, R.P., and Cresswell, M.M., eds. Quaternary studies. Wellington: Royal Society of New Zealand. 203–209.

McCLELLAN, C. 1975. My old people say: An ethnographic survey of southern Yukon Territory. Publications in Ethnology No. 6. Ottawa: National Museums of Canada. [Republished in 2001, as Mercury Series, Canadian Ethnology Service Paper 137, by the Canadian Museum of Civilization, Hull.]

NASSANEY, M.S., and PYLE, K. 1999. The adoption of the bow and arrow in eastern North America: A view from central Arkansas. American Antiquity 64(2):243–263.

O'BRIEN, T.A. 1997. Athabascan implements from the Skin House Days as related by Reverend David Salmon. Master's thesis, Department of Anthropology, University of Alaska Fairbanks.

SHOTT, M.J. 1993. Spears, darts and arrows: Late Woodland hunting techniques in the Upper Ohio Valley. American Antiquity 58(3):425–443.

———. 1997. Stones and shafts redux: The metric discrimination of chipped-stone dart and arrow points. American Antiquity 62(1):86–102.

SIDNEY, A. 1980. Place names of the Tagish Region, southern Yukon. Whitehorse: Yukon Native Languages Project, Council for Yukon Indians.

THOMAS, D.H. 1978. Arrowheads and *atlatl* darts: How the stones got the shaft. American Antiquity 43(3):461–472.

TURNER, N. 1979. Plants in British Columbia Indian technology. Handbook No. 38. Victoria: British Columbia Provincial Museum.

WORKMAN, W.B. 1978. Prehistory of the Aishihik-Kluane Area, southwest Yukon Territory. Mercury Series, Archaeological Survey of Canada Paper No. 74. Ottawa: National Museum of Man.

YOUNG, G. 2000. Wood identification of artifacts recovered from Yukon glacial ice fields. 1999. Canadian Conservation Institute Report No. 73807. Unpubl. ms. available at the Government of Yukon Heritage Branch, Whitehorse, Yukon Y1A 2C6.