

The Frozen Past



The Yukon Ice Patches

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Front cover: Left: Friday Creek ice patch; Right, top: Field assistant Gillian Farnell discovers a hunting arrow at the edge of the ice; Right, bottom: A dart shaft embedded in dung-filled ice. Stephen J. Krasemann photo

Back cover: Greg Hare, James Baker and Gordon Jarrell (University of Alaska Museum) examine a newly discovered arrow at an ice patch site.

Contents



Introduction	2	“When we first started...”	3
What are ice patches?	4	What do ice patches mean to First Nations people?	5
First find.....	6	A learning opportunity.....	7
The Yukon Ice Patch Project	8	Caribou in south Yukon First Nations history.....	9
Map: Yukon Ice Patches	10	Traditional land use	11
Where are the ice patches?	12	“My Grandma told me...”	13
A changing climate	14	“Lots of caribou around here, used to be”	15
Changes in ice.....	16	Hunters and caribou on ice.....	17
Ancient footwear.....	18	Traditional knowledge.....	19
Hunting technology: Dating ancient tools	20	“We go up on the mountain...”	23
Caribou and ice patches	21	Uses of caribou	25
Dart technology	22	“My aunt...told me”	29
Dart shafts	24	Working together.....	34
Slotted caribou-antler dart point.....	26	Stewardship of the ice patch sites	35
Projectile points	27		
Bow and arrow technology	28		
Why a change in weaponry?	30		
History of bison in the Yukon	31		
Changes in wood	32		
Alpine fauna	33		
Acknowledgements	36		



Introduction

The Yukon is celebrated for its stunning landscapes and rich history. Its vibrant First Nations cultures extend back to ancient times. Yukon history, culture and landscape came together in dramatic fashion in September 1997, when two hunters made a spectacular discovery in the mountains near Kusawa Lake, 60 kilometres (km) west of Whitehorse. The ice patches they found began a new era in Yukon archaeology and marked the beginning of a distinct specialty in the archaeology of the world's northern and alpine regions.

The Yukon Ice Patch Project began in the late 1990s in a period of extremely warm summer temperatures. These hot summers resulted in significant melting of alpine glaciers and ice patches. As the ice melted, evidence of thousands of years

Right: The melting surfaces of the ice patch appear black with caribou dung. The tiny figures are researchers looking for specimens.



of human and animal activity was exposed at many of these locations. Ancient hunting tools, bones of long-dead animals — even preserved tissue, hide and feathers — melted out of the ice in abundance.

Left: CAFN elder Jimmy G. Smith remembered when caribou were plentiful at Kusawa Lake.



Above: A dart foreshaft with its stone point still attached. Stephen J. Krasemann photo

A man wearing a plaid jacket, blue jeans, a baseball cap, and gloves stands on a rocky, reddish-brown ridge. He is looking towards the camera. In the background, there are rolling hills and mountains under a cloudy sky. The foreground is composed of dark, jagged rocks.

Standing in the melted-out dung at a south Yukon ice patch can be an overwhelming experience. Some patches feature so much dung that it must have taken thousands of years and/or thousands of caribou for it to accumulate.

“When we first started the [caribou] recovery program, we went around and asked elders about what their ancestors said about the caribou. And they said the caribou was so thick around here that when they were on the side of a mountain you would think the whole mountain is moving.

CTFN elder Art Johns



What are ice patches?

Cryologists —the scientific specialists who study ice — think that ice patches such as those found in the Yukon alpine regions are relatively rare.

Ice patches are fundamentally different from glaciers, which are constantly on the move. Glaciers build up gradually through time; when they reach a certain mass, they begin to flow downhill. It

may take a hundred or so years for ice and snow to travel from the top of a glacier to the bottom, or toe. And because glacial ice moves, objects that are imbedded in it are often crushed, deformed and out of context.

Left, above: Close up of hunting dart with well preserved sinew binding, nearly 5,000 years old.

Left, below: CAFN member Carrie Brown and archaeologist Christian Thomas skirt newly fallen snow.



Ice patches don't flow as glaciers do; they exist in a delicate balance between winter snow accumulation and summer melting. Snow builds up year after year, but significant amounts of it melt every summer. The remaining snow is gradually compressed into ice. Although the ice patch may continue to grow in volume, it never achieves sufficient mass to flow downhill. Because the ice does not move, artifacts that are buried in it are not crushed but are preserved, frozen in the past. The oldest Yukon ice patches have ice in them that is more than 9,000 years old!

Above: A sample block of ice from an ice patch provides researchers a wide variety of information.

What do ice patches mean to First Nations people?

In the decade since the first ice patch sites were recognized, the discoveries have become a source of pride for local First Nations people. They think the ice patches are important for several reasons.

They provide a window into the world of the ancestors, grounding people in where they've come from.

Below: Wooden dart shaft melting out of an ice patch.



They help renew old ties between south Yukon First Nations as they explore their common history. The ice patches provide an opportunity to bring together past and present, old and new, and different ways of knowing — using both science and traditional knowledge.

Right: CTFN member Edna Helm scales an ice patch searching for the past.

The ice patches reveal lessons about caribou biology, land management and the environmental history of First Nations' homelands.

They help strengthen aboriginal communities as First Nations people learn about and share their history with the wider public.

Left: KDFN elder Martha Van Heel examines a find at an ice patch.





First find

In September 1997, Kristin Benedek and her husband Gerry Kuzyk were hunting Dall sheep in the mountains west of Kusawa Lake, in the southern Yukon. As they walked towards an ice-covered peak, they noticed a thick black area near the base of the ice. They also smelled an odour like manure from a barnyard. Kuzyk, a wildlife biologist, recognized the black material at the edge of ice as a massive deposit of caribou dung. This was doubly significant: not only was it the largest concentration of caribou dung he had ever seen, but for

decades, caribou had been all but absent from the area.

Kuzyk sought the assistance of caribou biologist Don Russell from the Canadian Wildlife Service. They returned to the ice patch and found what appeared to be a

short wooden stick with a bit of string attached. Staff archaeologists from the Yukon Government recognized the piece of “string” as a traditional sinew

lashing, and saw that there were even remnants of a feather tucked under the sinew. They wondered if the stick was part of an arrow lost by a hunter within the last century.



Left: The first artifact found at a Yukon ice patch, this willow dart shaft still has sinew and the remains of a feather. It was radiocarbon dated at nearly 5,000 years old.

Above: Biologist Gerry Kuzyk at the place where the first ice patch discovery was made.



Above: Illustration of a hunter using a throwing board to propel a dart. In North America the throwing board is often called an atlatl.

Below: Students from Aboriginal Science Camp practise scaling the walls of a steep ice patch.



A learning opportunity

The recovery of well preserved hunting tools — including dart shafts and arrows — has sparked interest in traditional and ancient technologies and hunting strategies. Workshops in First Nations communities have explored various techniques of working with wood, antler and stone, and most Yukon schoolchildren are now familiar with the construction and use of an atlatl.

First Nations science camps have been held in conjunction with ice patch field studies to highlight the scientific research being done in First Nations' traditional territories. In 2005, nearly 100 aboriginal students from across Canada had the opportunity to visit and learn about one of the Yukon's ice patches as part of the Canadian National Aboriginal Science Camp.



The Yukon Ice Patch Project

During a return visit to the ice patch, ice core samples were taken to determine if the caribou dung was only on the surface of the ice or deeply embedded in it. Dung pellets were seen throughout the bed of ice, suggesting that they had

accumulated over a long time.



That fall, a small sample of the wooden stick and a pellet of caribou dung were submitted to a lab for radiocarbon dating. The dung was dated at 2,400 years old and the stick was 4,300 years old. Suddenly the “old stick” (see photo, above) was one of Canada’s most ancient organic artifacts — and the Yukon Ice Patch Project came into being.

Above: This wooden “stick” was the first artifact found at a Yukon ice patch site.

Right: A dart shaft with a stone point still embedded in dung-filled ice.

Stephen J. Krasemann photo



Above: Archaeologist Greg Hare uses a chainsaw to cut a sample of the frozen layers of ice and caribou dung.

Caribou in south Yukon First Nations history

While caribou are now found only in a limited area in the southern Yukon, the species is vital to the history and culture of local First Nations. Caribou are frequently mentioned in traditional stories set in the long-ago time when animals and humans could talk together. The species is also featured in traditional stories of a more recent vintage, including those that refer to caribou as being an individual's "medicine" or power.

Caribou are also mentioned in stories related to 19th century trade between the people of the south Yukon and those of coastal southeast Alaska. Caribou skin clothing made by the residents of the Yukon interior people was highly valued by coastal trading partners.



“Our elders, like Sam Williams and my mom (Äshènja, Bessie Allen), told me that on Aishihik Lake, you could see campfires all around the lake when they were harvesting caribou, like either in the fall or in the springtime when caribou were starting to move back. They said that people from Carmacks came over, from Selkirk, a lot of people came over to harvest caribou.

James Allen, CAFN elder



Left, above: KDFN and TKC elders Bill Webber, Frances Woolsey and Martha Van Heel.

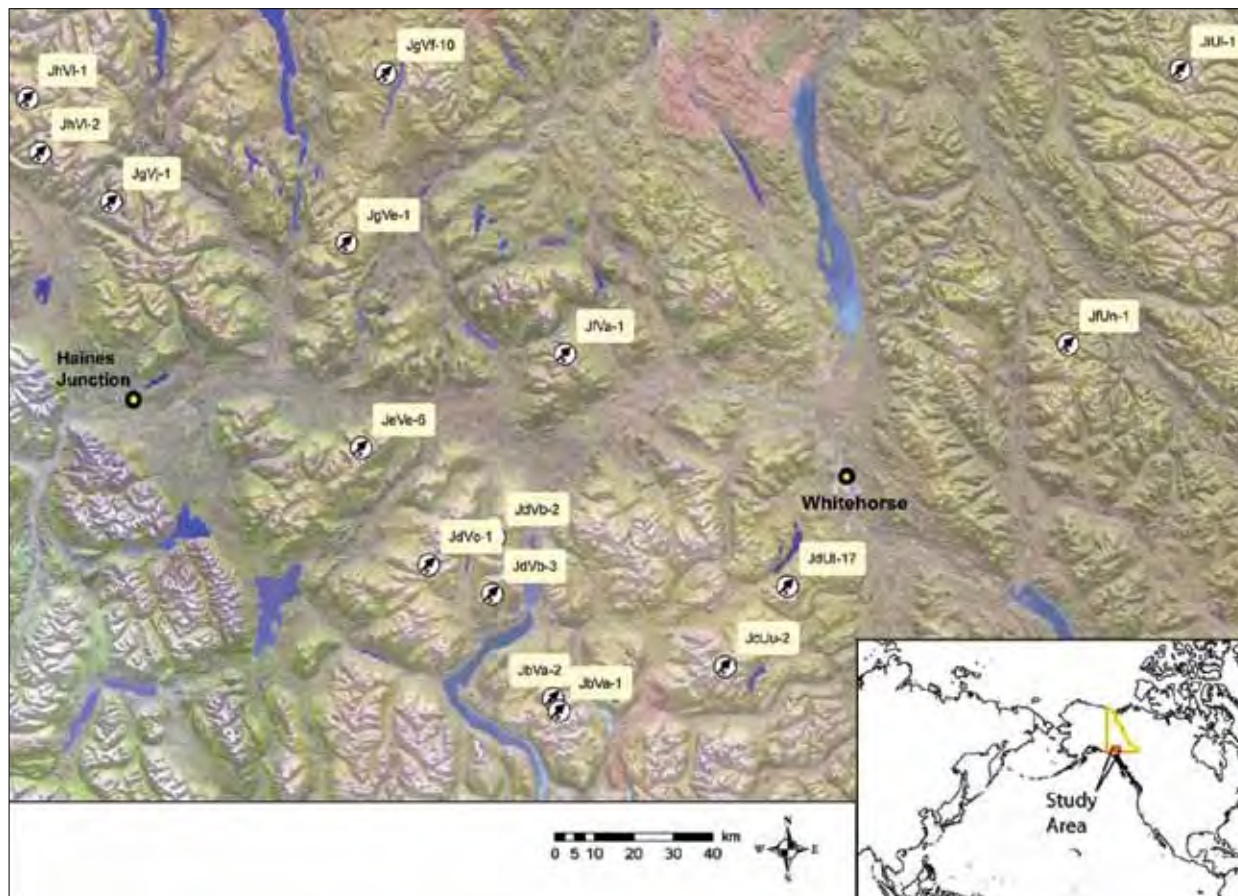
Left: Woodland caribou in autumn.

Stephen J. Krasemann photo



Yukon Ice Patches

Distribution of the principal ice patches in southern Yukon, indicated by their archaeological site numbers.



Traditional land use

The Yukon ice patch sites are located within the traditional territories of six Yukon First Nations: Kwanlin Dün First Nation (KDFN), Carcross/Tagish First Nation (CTFN), Champagne and Aishihik First Nations (CAFN), Kluane First Nation (KFN), Ta'an Kwäch'än Council (TKC) and Teslin Tlingit Council (TTC). The Southern Tutchone, Tagish and Tlingit ancestors of these people have a

Below: Mountains west of Kusawa Lake



long history of alpine land use and caribou hunting. Before the arrival of Euro-Canadians to the Yukon, people lived most of the year in small semi-nomadic family groupings. They made their living through hunting and fishing, and followed seasonal rounds that involved a high degree of mobility. Their homes were seasonal villages or campsites rather

than permanent settlements. Trade within and between these different peoples — and with neighbours and relatives located outside of what is now the Yukon Territory — was also an important part of pre-contact indigenous life.



Above: Feathers tied to a dart shaft by a fine strand of sinew.

Archaeological investigations show that the ice patch sites have been used for thousands of years. No evidence of hunting camps has been found immediately adjacent to the ice patches, but many of the ice patches are located within several hours' walk of traditional campsites at lakesides or valley bottoms. It is likely that during the summer months, when conditions were right, hunters based at these camps could quickly reach many of the best ice patches. Hunters would butcher caribou and sheep on the ice patch and carry the meat back down to the camps, where other family members remained. In some cases, hunters would temporarily cache carcasses on or within the ice.



Where are the ice patches?

The Yukon ice patches are scattered across the southern Yukon, from the Kluane Lake area to the Teslin region, in an area covering approximately 19,000 square km. They are inland from the highest mountains of the Coast Ranges. The combination of marine weather systems from the Gulf of Alaska and the alpine landscape of the Coast Mountains seems to have

A global phenomenon

Ice patches with dung like those in the Yukon have now been found in Alaska, British Columbia, Northwest Territories, Colorado and Norway, but so far the Yukon ice patches are the oldest and among the largest in the world.

created the conditions for the southern Yukon ice patches to form.

Almost all of the Yukon ice patches are located on the north side of mountains, at elevations between 1,550 and 2,100 metres above sea level. Often situated in alpine cirques or basins where snow accumulates, their length varies from a few metres to more than a km. At some patches, particularly



those where much of the ice has melted away, the dung supports lush green alpine plants.

Above, right: Once caribou dung has melted from the ice it provides nutrients that allow alpine plants to grow. A stone dart point (circled) emerges from a bed of plants and old dung.

“My Grandma told me she shoot...
so many caribou there [Fish Lake,
Alligator Lake and Coal Lake].

Ronald Bill, KDFN





A changing climate

Yukon ice patches provide insight into a changing climate. When there are heavier snowfalls or cooler summer temperatures, ice accumulates and the patches grow in size. When summers are warmer or there are lower rates of precipitation, the ice patches shrink.

Scientists studied three ice patches in detail to understand the changes in climate over the last 10,000 years.

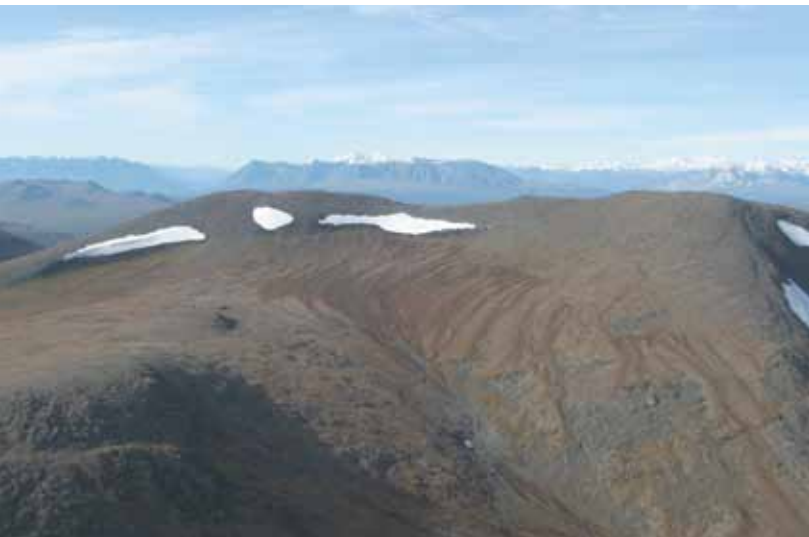
This period — from immediately after the end of the last ice age to the present — is referred to as the Holocene Epoch. The climate in Yukon fluctuated throughout the Holocene. During warm periods, alpine ice melted; during colder periods, ice accumulated. From radiocarbon dates of caribou pellets found at ice patches, it appears that there were three main warm periods: prior to 9,000 years ago; between 7,500 and 5,500 years ago; and right now. Only three Yukon ice patches appear to have survived the entire past 9,000 years; the rest melted away in the mid-Holocene.



Lorealee Laberge and Rick Farnell (Yukon Environment) prepare to measure changes in the size of the ice patch.



This delicate barbed antler point was dated at 900 years old.



“Lots of caribou around here, used to be”

These words were spoken by Champagne and Aishihik First Nations elder Annie Ned in the 1980s. Large herds of caribou still existed in the Kusawa Lake area when Mrs. Ned was a young woman in the 1930s. For the First

Nations whose traditional territory encompasses the ice patches, the notion that there used to be an abundance of caribou in the southern Yukon is not something new, but rather a topic that their elders had often spoken about.

TKC elder Frances Woolsey (*below, right*) hunted in the mountains with her family when she was a child. She remembers that each year, for perhaps five years, they went after whatever game they could get in the Big



“My mother tell me... if they stay some place in the mountains, they make houses. You know? Just like dog houses ... every fall they go up there. And every place where they stay [in the] winter time, they [build] log house... They have this way all around, in the middle smoke stack up there. That's what she tell me.

Angela Sidney, late CTFN elder

Salmon Range. They saw the snow and ice patches frequented by the caribou, but never bothered going to these places. They would see small bands of caribou, and one time got one.

Right: TKC elder Frances Woolsey sits at the base of an ice patch near Alligator Lake.
Jason Shorty photo. Right, above: Stephen J. Krasemann photo





Changes in ice

Ongoing analysis of dung and pollen in the ice continues to provide new insights into past climates.

Ice began accumulating again about 5,000 years ago, when colder and snowier conditions returned. Ice



accumulations over the last 2,000 years were especially significant, peaking about 500 years ago with the beginning of a global cold period known as the Little Ice Age. The Little Ice Age ended in Yukon near the beginning of the 20th century. We think that alpine ice has been melting steadily since then.

Right: Field researchers Erik Blake and Christian Thomas camped near an ice patch.

Aerial photographs of several of the ice patches since 1948 show a rapid reduction in alpine ice over the past 50 years. Weather data indicate that the late 1990s were some of the hottest years on record. Several of the larger ice patches at higher elevations have proved resistant to melting, but within a few years many of the smaller ice patches will likely disappear.

Above, left: Chenopod pollen grains (seen through a microscope) provide valuable information about past climates.



Above: CWS caribou biologist Don Russell scales the steep face of an ice patch to collect samples of caribou dung.





Close-up of a dart point, with caribou hair wedged between the wooden shaft and the stone point.

Hunters and caribou on ice

The highly predictable behaviour of the caribou — going to the ice patches during the summer heat — made them a reliable food resource for First Nations families. Hunters could approach caribou on the ice, hiding behind boulders or hunting blinds. They used spears, darts and arrows to take down the animals (the hair caught in the dart point, *left*, tells us that the dart once pierced the hide of a caribou). When a hunter missed the target, the projectile became embedded in the soft summer snow. Today, centuries and even millennia later, these hunting weapons are melting out of the alpine ice patches,

along with the bones of diverse birds and animals that lived in the mountains of the Yukon in prehistoric times.

Left: TKC researcher Jason Shorty and CTFN elder Art Johns visited stone hunting blinds that were shown to Art by his father Johnny Johns more than 60 years ago. Heather Jones photo



Why did the caribou go away?

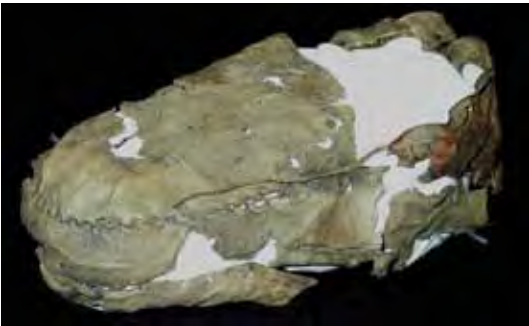
The accumulation of dung on ice patches is evidence that at one time there were thousands of caribou in these alpine regions. The First Nations and the biologists are trying to answer one question: Where have all the caribou gone?

First Nations elders remember a time when wild food sources were not so scarce. They have observed changes in the plants that caribou eat and the loss of the habitat that the animals depend on. They believe that these changes — which are connected to climate change, expanding human populations and pollution, among other factors — affect the ability of the species to thrive. The late Joe Johnson of Burwash Landing once pointed out that in recent winters, rain has fallen in the Kluane Lake area. When the rain freezes, it covers the lichen that the caribou normally eat with a thick layer of ice.



Ancient footwear

In 2003, an artifact was recovered during summer fieldwork at an ice patch near Kluane Lake. It was a shapeless lump of hide, covered with moss and thought to be a small bag or pouch (*see photo, right*). After many months of detailed conservation work, however, scientists recognized that it was the remains of a moccasin. This was an important find — early pieces of aboriginal clothing are very rare. A small fragment from the footwear



Hundreds of hours of careful work were needed to restore the 1400-year-old moccasin to its present shape.

English	Southern Tutchone	Tagish	Tlingit
moccasin/ slipper	ke kenkat ke	kē	xh'exh jiksexet

was radiocarbon dated to about 1,400 years old, making it the oldest known moccasin in Canada.

The moccasin is made in the old “high-top” style. Commonly worn by Yukon First Nations people until the mid-20th century, it is less often seen today. It is about as big as a North American man’s size 5 shoe. The moccasin is made from three pieces of hide, sewn with sinew thread. A tie wrapped around the ankle helped to secure the moccasin on the foot. The moccasin shows traces of red ochre (*see photo, left*) and its toe and sole had been repaired several times before it was lost or abandoned at the ice patch.



CAFN field assistant Cody Joe examines the fragile remains of a leather artifact, later revealed to be a moccasin.



Traditional knowledge

Both scientific and indigenous traditional knowledge are part of the Yukon ice patch investigations. First

Nations researchers have been working with elders to document traditional knowledge related to caribou, hunting practices and alpine land use in general. Elders are also providing insight into the manufacture and use of the items of traditional technology that are being found at the ice patch sites. Some of the knowledge shared by the elders appears in this booklet.

Besides the ice patches, there are other indicators of the past abundance of caribou across the southern Yukon. First Nations elders remember seeing remnants of fences that were once used in the hunt. They have also seen signs of the trails formerly used by caribou; in certain locations these old pathways are still evident.

Above: Even delicate strands of sinew are often preserved in the ice.

Below: KDFN elders Martha Van Heel and Bill Webber at an ice patch near Alligator Lake in 2008.

Jason Shorty photo



The base of this stone projectile point was coated with spruce pitch and ochre, which helped fasten it to a wooden shaft.



Hunting technology

Dating ancient tools



TKC researcher Kristina Kane points to an arrow she found at the edge of this ice patch. The wood was quite fragile and had likely been exposed for several years before its recovery.

Almost all of the artifacts collected from the ice patch sites are hunting tools such as arrows and throwing darts. Approximately 200 artifacts have been collected from 24 different sites. Made of natural materials such as bone, antler, wood and stone, these artifacts are extraordinarily well preserved; they have remained frozen almost from the moment they were last used by ancient hunters.



A beautifully flaked stone projectile point rests atop a thick layer of caribou dung.

This exceptional preservation makes these artifacts very unusual. Typically, archaeologists uncover only stone tools from ancient camps and hunting sites in the Yukon. Boreal forest soils are very acidic and organic materials do not survive very long there. If scientists do not find any organic artifacts at a site, they date their finds by looking at other associated materials, such as charcoal or burned bone.

Organic ice patch artifacts can be radiocarbon dated; this provides a very accurate estimate of age. More than 90 artifacts have now been dated, providing fascinating new insights into the history of hunting technology in the Yukon.



Caribou and ice patches

The Yukon is home to numerous herds of caribou. In the summer months, the woodland caribou of the southern Yukon migrate to alpine regions, and during the hottest days of summer

“Just in the hot weather they go on them places. And they stick their nose in the snow, you know, I guess that’s to cool them off.

CTFN elder Art Johns

they congregate on patches of ice and snow near the tops of mountains. This helps them stay cool and provides relief from ever-present swarms of insects. When the insects and summer temperatures are at their worst, caribou are very reluctant to leave these ice patches, even in the face of potential predators.





Dart technology

Ancient darts have been found at numerous south Yukon ice patches. For thousands of years the dart — longer and heavier than an arrow — was the principal hunting tool in the Yukon. For the most effective results they were used with some type of throwing device; the spear thrower propelled the dart with greater force and accuracy than could be accomplished simply throwing it by hand.

The oldest evidence for dart and spear-thrower technology in the Yukon was found at an ice patch west of Aishihik Lake, where a dart at least 9,000 years old was found.



From the radiocarbon dates, it appears that darts were used for hunting in the southern Yukon until about 1,200 years ago.

Above: The butt end of these darts clearly shows the dimples for use with a throwing board.

Radiocarbon dating and microscopic analysis of the darts reveal changes in technology over time. Generally, most throwing darts were tipped with large stone points, which gave them enough “knock-down” power to fell a large

animal. However, one of the earliest dart tips was constructed of caribou antler, with thin grooves along both edges (*page 26*).



This is an artifact of unknown function found on an ice patch; it may be a small throwing board or atlatl.



Left: Close-up of a dart with a stone tip fastened to it. The stone tip has been damaged but the sinew binding is well preserved.

A wide-angle landscape photograph showing a vast mountain valley. In the foreground, a dark, rounded hillside slopes down towards a valley floor. A large, calm lake is nestled in the middle ground, reflecting the blue sky. In the background, a range of mountains stretches across the horizon, with several peaks covered in snow. The sky is a clear, pale blue with a few wispy clouds.

“ We go up on the mountain and we treat everything good, used to be, what they killed. Even the bones. The old people say, “Heh, you don’t go over these bones. Don’t step over it.” We put it out of sight to respect that, what they killed, everything. We always do what they tell us to do....You’ve got to look after everything good, the oldtimers say that. ‘Don’t waste nothing. Don’t do anything crazy with it. Put it away good. Make something to eat out of it.’

Florence Smarch, TTC elder

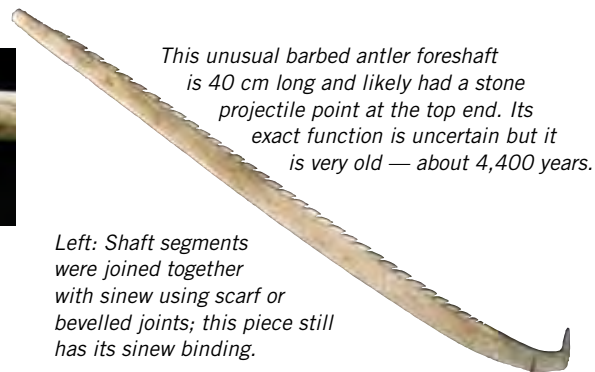


Dart shafts

Many of the wooden dart shafts found at the ice patches were made of a single piece of wood, but several had a shorter wooden section that could be attached to a longer wooden mainshaft (see photo, right). Some of the main-

shafts were made up of two or more short and carefully connected segments of wood bound with sinew.

Right: Three examples of dart foreshafts that would be attached to the front of a longer shaft. These could be removed and perhaps used as cutting knives.



This unusual barbed antler foreshaft is 40 cm long and likely had a stone projectile point at the top end. Its exact function is uncertain but it is very old — about 4,400 years.

Left: Shaft segments were joined together with sinew using scarf or bevelled joints; this piece still has its sinew binding.



Throwing darts come in many sizes and are made in many ways.

Uses of caribou

Lots of things were made from caribou. Caribou bone and antler are particularly strong for their weight. Caribou hide, thinner but stronger than moose hide, was used to make clothing, footwear, blankets and other items. Caribou sinew was highly valued for sewing and people made *nshü* (Southern Tutchone for *awl*) from caribou antlers. They used hoofs on nets and blankets and to make rattles.

“People...lived off the land. For tools they used stone and moose bone for fleshing and tanning. Bone knife to make babiche out moose and caribou skins to make snares. Large snares for moose, sheep, caribou, and nets for beaver, sinew nets for fish.

Jonny Smith, TKC



Respect for caribou

For First Nations people, caribou — like all animals — must always be shown respect. One has to behave properly when dealing with them, as explained by TTC elder Florence Smarch (page 23).

Left: CTFN elder Patrick James visited an ice patch in 2008.

Right: CTFN field researcher Tagish Johns examines a barbed antler arrow point. Tagish's reputation for finding artifacts amidst the boulders and ice was near-legendary.

Stephen J. Krasemann photo





Slotted caribou antler dart point



This rare dart point, made of caribou antler, is approximately 8,000 years old. It is one of the oldest artifacts recovered from the Yukon ice patch sites and it represents one of the earliest technological traditions in Yukon archaeology.

The dart point is one of the few artifacts with an incised decoration (*see detail, below*) found in the ice patches. The person who made the dart point all those years ago carved narrow grooves on either side of the point so that sharp thin wafers of

stone (called microblades (*see photo, right*) could be inserted. This formed the tool's cutting and piercing edges. A tiny fragment of a microblade remains in one groove. Ancient adhesive, which was identified by scientists at the Canadian Conservation Institute as spruce resin, can also be found in the grooves; under ultraviolet light it shows up as glowing greenish lines.



Above, right: close-up of microblade core.



Projectile points

Projectile points, made of stone or antler, were affixed to the end of darts, arrows and spears. Dozens of stone projectile points of various shapes and sizes have been recovered from the ice patches, some still attached to or lying near their wooden shafts.

Most of these points range in age from about 2,000 to 4,500 years old. They were probably used for

hunting caribou on the ice patches. Scientists think they belong to a single local stylistic and technological tradition. From the preserved dart shafts, we know that all the points were tied to the shaft in the same way: they were inserted



into a U-shaped slot (see *photo, far left*) and then tied to the shaft with sinew. Since this is so, why are the stone points such different shapes?

At least eight different types of stone projectile points have been found on the Yukon ice patches. The antler arrow points have a similar diversity

of size and style; almost no two points are the same design.

Through the Ice Patch Project, archaeologists are now considering the likelihood that much of the variation in stone points is due to the maker's individual style. Another factor is the stone point's "life history" — broken or discarded points may have been reworked by thrifty hunters.



Left and above, right: Stone projectile points often show evidence of the ochre and spruce pitch used to fasten them to a wooden shaft.



Bow and arrow technology

For a long time, archaeologists have debated when bows and arrows first appeared in North America. Some archaeologists believe that bow and arrow technology has been around for as long as 9,000 years; others maintain that it was not commonly used until 1,500 years ago.

Archaeologists have not been able to precisely identify when the technology arrived because a whole arrow or bow

is rarely preserved. Usually, only the stone elements of implements such as projectile points or scrapers are found at an archaeological site. Furthermore, it is often difficult to be certain if a small stone point was part of an arrow or a dart.

Many complete well-preserved arrows and dart shafts have been found on the Yukon ice patches. Some arrows still have sinew lashings, feathers and antler projectile points — even red ochre decoration (see photo, top). When the organic parts of these tools were radiocarbon dated the results

Left: A variety of barbed arrow points made from caribou antler.

suggested that the bow-and-arrow system of weaponry was first used in the southern Yukon about 1,200 years ago. Within a very short time, it seems to have become the preferred hunting technology used at the ice patch sites, replacing the older dart and throwing board weaponry.

Right: These pieces of a broken bow provide some of the earliest evidence of bow-and-arrow technology in Yukon. The bow, made of maple, is about 1,200 years old.



“My aunt...told me about this bow and arrow we used to make with caribou...[for] caribou hunting... they could go a long ways...they had spears too, you had to throw them with stick and string...like a sling.

Ronald Bill, KDFN

This stone hunting blind was one of many found in alpine areas of southern Yukon. Its age is not known.



Why a change in weaponry?

Radiocarbon dates indicate that around 1,200 years ago, people began hunting with bows and arrows rather than darts at the ice patch sites. This shift occurred shortly after the eruption of a volcano in the extreme southeast corner of what is now Alaska, near the Canadian border. The eruption blanketed southern and central Yukon with a thick layer of volcanic ash. It would have had a devastating effect on local flora and fauna, and on the human societies that relied on these resources.

The volcanic eruption and the change in hunting technology are likely related. Southern Yukon people displaced by the ash fall could have come into contact with distant groups

English	Southern Tutchone	Tagish	Tlingit
arrow	k'à	k'ā	chùnèt
gun/firearm	gwān k'a	k'onk'à	ûnà

and learned about the new technology, or new people may have moved into the region after the ash fall. Coincidentally, recent analysis of DNA from ice patch caribou indicates that there was a large shift in the caribou population immediately after the eruption.

Below: Helicopter pilot Karl Ziehe holds a a lead musket ball found at an ice patch in 2009.

Other changes in hunting

Muskets likely became locally available in the 19th century via trade with coastal Tlingit, who obtained them from European trading ships in the Gulf of Alaska. Muskets were inaccurate and unreliable, however, and hunters continued to rely on bow and arrow until the introduction of repeating rifles around the turn of the 20th century.



History of bison in the Yukon

The recovery of bison bone from Yukon ice patches has given scientists a better understanding of the history of this animal. During the ice age, bison, horse and mammoth were the three main large mammal species that occupied the steppes of Beringia, the unglaciated area in the northern Yukon, Alaska and Siberia. Unlike many other large herbivores, however, the bison



did not go extinct after the climate changed at the end of the ice age.

Bison remains from ice patches, including bones, horns and dung, show that bison lived in the southern Yukon for most of the past 10,000 years. Some of the bison bones found date to about 300 years ago; this suggests that the species became locally extinct only in recent centuries.



In the late 20th century, the species was re-introduced to the territory and has thrived here since then.

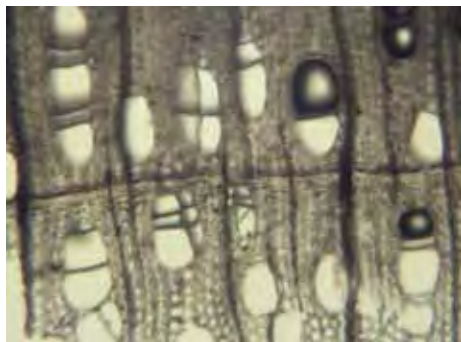
Above: Wood bison.

Below: Bison can be seen today using alpine ice patches. Fossil evidence of bison at ice patches goes back many thousands of years.

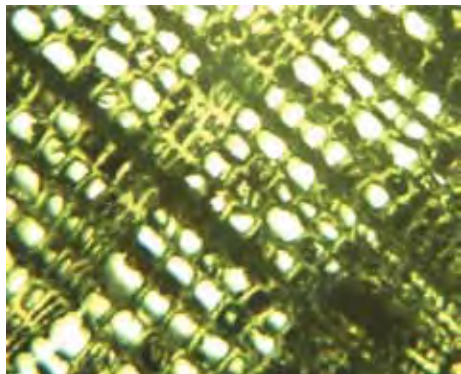




Changes in wood



Microscopic view of birch wood



Microscopic view of spruce wood

One of the technological changes that fascinate archaeologists working on ice patch artifacts is the use of different types of wood over the years. Microscopic analysis (*see photos, left*) allows scientists to identify the wood used for darts and arrows. Changes in the types of wood used may be linked to evolving technological ability, or may have occurred because changes in climate affected the availability of various tree species.

In general, the older dart shafts (about 5,000 to 9,000 years old) are made of willow saplings. About 5,000 years ago there was a marked shift to dart shafts made of birch. Birch shafts would have taken

far longer to construct but were much better balanced. About 1,200 years ago, when bows and arrows appeared, spruce largely replaced birch. It is not clear whether spruce was superior to birch or just more readily available.



Archaeologist and wood identification specialist Claire Alix, from l'Université Paris-Sorbonne, examines arrows from the ice patch collection to determine what type of wood was used.



Alpine fauna

The Yukon Ice Patch Project is significant not only for its archaeological riches, but for the important biological specimens that have been recovered from the melting ice. More than 1,700 pieces of bone and animal tissue have been collected. The finds include many species of animals common to the southern Yukon, as well as species that have since gone extinct from the local area. These

Above: Hoary marmots are found in alpine settings and were also hunted in the past.

remains have been preserved by being frozen in the ice.

Most of the remains are of caribou, but sheep are also common. Other species include mountain goat, moose, elk, bison, muskrat, ground squirrel, vole, lemmings and porcupine. Birds include ptarmigan, savannah sparrows, blackpoll warbler, gray-cheeked thrush, sharp-shinned hawk and gyrfalcon.

Although caribou were the principal prey species, people likely hunted other species as well. Butchering cut marks have been found on only a few of the caribou and sheep bones, so it is likely that many of the bones are from animals that died naturally or were killed by animal predators.

Numerous scientific studies have been undertaken on these remains, including DNA of caribou and birds, heavy

metal contamination, analysis of diet and parasites in caribou and reconstruction of past environments based on pollen found in the ancient caribou dung.

Below: Dozens of mummified birds and small mammals have been recovered from alpine ice patches. Many of these "fossils" are thousands of years old.



Right: Dall sheep. Stephen J. Krasemann photo



- Champagne and Aishihik First Nations (CAFN);
- Kluane First Nation (KFN);
- Kwanlin Dūn First Nation (KDFN);
- Ta'an Kwäch'än Council (TKC); and
- Teslin Tlingit Council (TTC).

In the past decade partners included University of Alberta, University of Alaska, Canadian Wildlife Service, Environment Canada, the Henry Wellcome Ancient Biomolecules Centre at Oxford University, Geological Survey of Canada, and Icefield Instruments Inc.



Working together

The Ice Patch Project is a collaboration of the Yukon and First Nation governments and research institutions. These are the principal partners:

- Yukon Government Department of Environment;
- Yukon Government Department of Tourism and Culture;
- Carcross/Tagish First Nation (CTFN);

Above: KDFN researcher Rae Mombourquette kneels beside an arrow she has found.

A large number of Yukoners have had the opportunity to assist with fieldwork and visit the ice patch sites; many others have assisted with laboratory studies.



Left: Christian Thomas with stone dart point recovered among the boulders at the edge of an ice patch.

Above: CAFN field assistant Karrie Brown displays an arrow found at an ice patch near Killermun Lake.



Stewardship of the Yukon Ice Patch Sites

Since the discovery of the ice patches in 1997, the Yukon Government and the six Yukon Ice Patch First Nations have worked in partnership to document, research and educate the public about the sites. Together, they visit the ice patches annually to observe melting, collect artifacts and specimens, and monitor recent human presence. The governments support responsible stewardship

of these important heritage resources and discourage unauthorized collecting of artifacts and specimens.

Research continues on the annual melt and the resulting discoveries. Fieldwork depends greatly on how much snow fell the previous winter and how much has melted. It is difficult to predict these conditions, and in many years fieldwork is limited to short-term monitoring of ice conditions.

The Yukon and First Nation governments are committed to using ice patch research to increase local awareness of environmental issues, and to educate youth and the wider community about First Nations heritage and culture and the unique and important archaeological record preserved in the ice patch sites.

Right: TKC researcher Jason Shorty shows elders some of the hunting artifacts recovered from ice patches. Mark Nelson photo

With ongoing monitoring of the ice patch sites, and analysis of the artifacts and biological specimens recovered there, the frozen past will provide further insight into the history and culture of Yukon's first peoples and the environmental history of their homelands.

Today's citizens of the Yukon Ice Patch First Nations identify strongly with the traditions of their ancestors. Working on the Ice Patch Project provides a valuable opportunity to strengthen their relationship with the land that has sustained them for generations.





Acknowledgements



KDFN elders Kitty and Louie Smith relax at an ice patch in 2008. Jason Shorty photo

Many individuals and organizations have contributed to the Yukon Ice Patch Project. Principal funding was provided by the Yukon Department of Environment, Department of Tourism and Culture, and by the Yukon Community Development Fund. Canada's Department of the Environment (Northern Ecosystem Initiative) also provided financial support.



Researchers Vandy Bowyer and Tagish Johns document an artifact in a field of ancient caribou dung. Stephen J. Krasemann photo

Additional support was provided by Yukon Parks, Canadian Wildlife Service, the University of Alberta, University of Alaska Museum, the American Bald Eagle Foundation of Alaska, the Yukon Development Corporation, and Parks Canada (Kluane National Park & Reserve).

More information on those who have contributed can be found online at www.tc.gov.yk.ca/966.html.

This booklet is dedicated to the memory of Tagish Johns.



The Yukon Ice Patch Project is one of the most important North American archaeological and natural science discoveries of recent years. This booklet describes the process of discovery, the development of community partnerships and research strategies to locate and study ice patches, the importance of ice patches

to caribou and the importance of caribou to Yukon First Nations. This is a story of extraordinary artifacts and biological samples preserved for thousands of years in Yukon alpine ice patches.

The Yukon Ice Patch Project



The booklet, *The Frozen Past: The Yukon Ice Patches*, is available on line at www.tc.gov.yk.ca/966.html. Hard copies are available from the Government of Yukon Archaeology Program at 133A Industrial Road, Whitehorse or can be ordered by e-mailing heritagepublications@gov.yk.ca.

Acknowledgements

Many individuals and organizations have contributed to the Yukon Ice Patch Project. Principal funding was provided by the Yukon Departments of Environment, and Tourism and Culture, and by the Yukon Community Development Fund. Canada's Department of the Environment (Northern Ecosystem Initiative) also provided financial support. Additional support was provided by Yukon Parks, Canadian Wildlife Service, the University of Alberta, University of Alaska Museum, the American Bald Eagle Foundation of Alaska, the Yukon Development Corporation, and Parks Canada (Kluane National Park & Reserve).

Through the years many people have provided field assistance to the Yukon Ice Patch Project:

Gord Allison, Walter Alexi, Larry Bagnell, James Baker, Karrie Brown, Marten Berkman, Ian Burnett, Maryann Carroll, Lenny Charlie, Gary Darbyshire, Josh Darbyshire, Gerald Dickson, Aaron Doris, Cathy Egli, Robert Fox, T.J. Hammer, Edna Helm, Albert James, Patrick James, Trish James, Lawrence Joe, Heather Jones, Stacey Jones, Cody Joe, Kristina Kane, Stephen Krasemann, Mark Nelson, Garry Njootli, Robert McLaren, Jamie McLelland, Jen Meurer, Rae Mombourquette, Gus Morberg, Frances Oles, Steven Reid, Dave Sembsmoen, Pauly Sias, Jason Shorty, Claude Smarch, Kitty Smith, Louie Smith, Marlene Smith-Tutin, Richard Smith, Testloa Smith, Diane Strand, Christian Thomas, Martha Van Heel, Les Wilson and Grant Zazula.

We especially acknowledge the many contributions of the late Tagish Johns, whose enthusiasm for the ice patch work is greatly missed. Appreciation is extended as well to the elders who have assisted, with particular thanks to Art Johns and the late Wilfred Charlie and Jimmy G. Smith for their interest and commitment. We thank pilots Delmar Washington, Capital Helicopters, and Karl Ziehe, Helidynamics for continued support and assistance.

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Our apologies to anyone we have inadvertently overlooked.

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