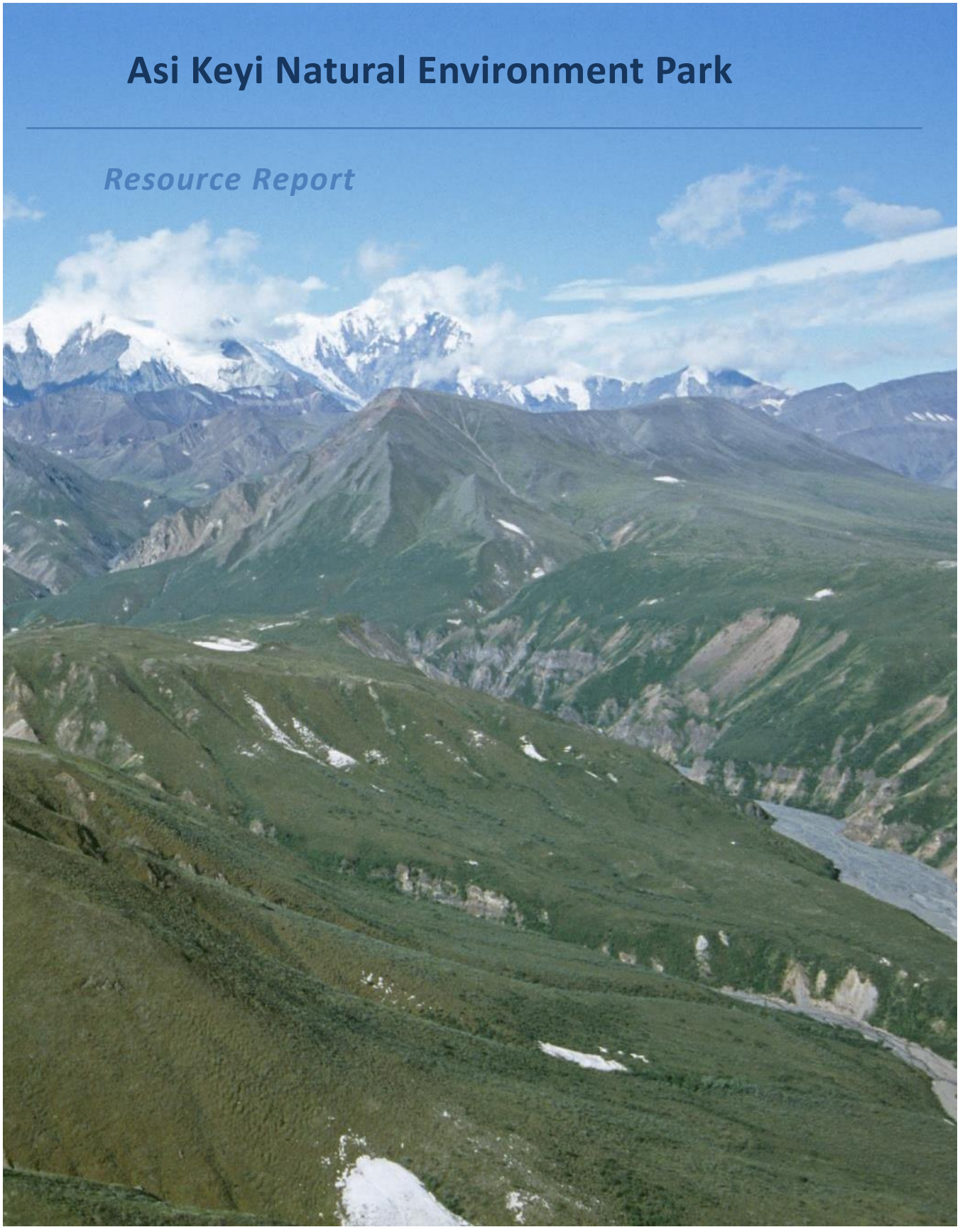
Asi Keyi Natural Environment Park

Resource Report



Acknowledgements

This report makes use of information collected in the field between in 2004 to 2006 by botanists Rhonda Rosie, Greg Brunner, Pipa Seccombe-Hett, Phil Caswell, and Bruce Bennett; soil scientists Karen McKenna and Nancy Stefan; and entomologist Gary Anweiler. Jennifer Line gathered information on bird habitat; while Afan Jones reviewed the recreational potential. Additional field participants included Lisa Christiansen, Kas Kuba, Bruce McLean, Fritz Mueller, Gord Hutchings, Connie Larochelle, Olympia Marra, Emma Bryant and Pauly Sias. Grant Lortie provided insight to the region while at the Chisana Caribou camp, including spring bird observations. Bob Beattie and staff at White River Lodge were of great assistance in field logistics. Delmar Washington of Capital Helicopters provided capable helicopter service. Andre Langois identified Lepidoptera collected in 2005.

Cover Photo: Brooke Creek. John Meikle

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1. Introduction

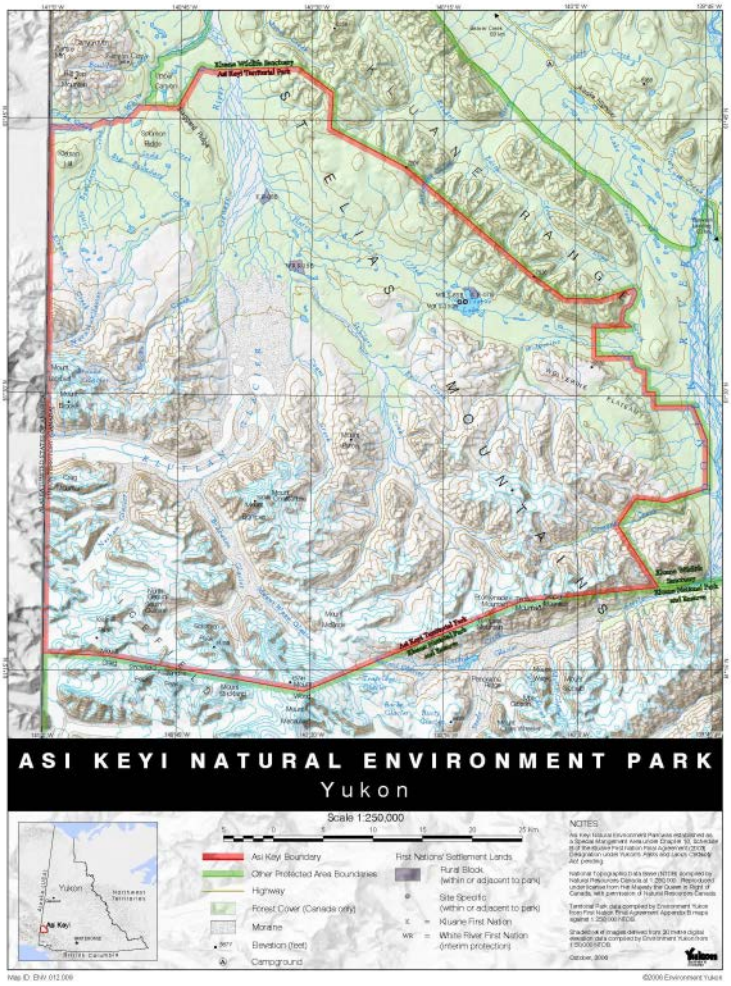
The commitment to establish Asi Keyi Natural Environment Park was made by governments through the Kluane First Nation Final Agreement in Schedule B of Chapter 10. It will be established under the *Yukon Parks and Land Certainty Act* following the completion of management planning.

The objectives of Asi Keyi Territorial Park, as identified in the Final Agreement, include:

- To protect for all time a natural area of territorial significance, which includes a portion of the Kluane Wildlife Sanctuary, containing physical and biological features of international significance as well as sites of archaeological, historical, and cultural value.
- To recognize and protect the traditional and current use of the area by Kluane and White River First Nation people.
- To provide economic opportunities for Kluane and White River First Nation people.
- To protect the full diversity of fish and wildlife and their habitats in the park from activities that could reduce the capability of the park to support fish and wildlife.
- To encourage public awareness, appreciation and enjoyment of the natural, historical and cultural resources of the park in a manner that will ensure it is protected for the benefit of future generations.

The park is adjacent to the northern boundary of Kluane National Park and Reserve, west of the Donjek River and south of the White River. It was part of the Kluane Wildlife Sanctuary that was initially established in 1943 as the Kluane Game Sanctuary. The park is 2,984 km^2 in size.

This report is intended to provide background information on natural history, potential recreational use, land tenure and the broader management context to the eventual Steering Committee set up to prepare the management plan.



1: Asi Keyi Natural Environment Park map.

2.1. Physiography

The majority of Asi Keyi NEP is at the northern edge of the Icefield Ranges physiographic region. The Teepee Lake valley and White River valley to the west occupy the Duke Depression while the mountains northeast of Teepee Lake are part of the Kluane Ranges physiographic region. The lowest elevations in the park are west of the Donjek River, at 770 m asl. and at the confluence of the Generc and White rivers. The Kluane Ranges, which rise between the Denali and Duke River faults, reach close to 2300 m asl. The highest terrain is in the southwest of the park, topped by Mount Wood at 4845 m asl. Asi Keyi NEP is drained to the north by the White River, with secondary drainage east into the Donjek River, both part of the Yukon River watershed.

2.2. Bedrock Geology

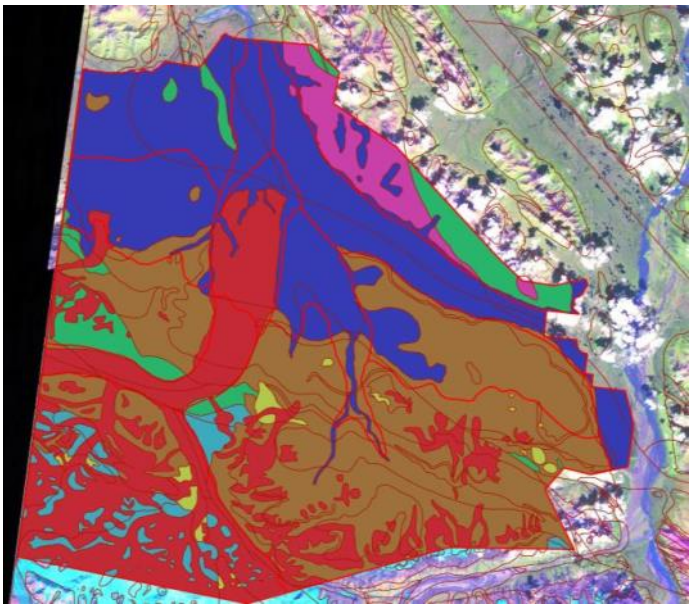
The park lies southwest of the Denali Fault that underlies the Shakwak Valley. To the northeast is the Coastal Plutonic Complex, of which the Ruby Ranges are part. To the southwest is the Insular Belt. Asi Keyi NEP It is comprised of volcanic and sedimentary rocks that formed as ocean sediment and volcanics that formed as the western edge of the North American plate collided with was uplifted by the Pacific plate (Heon 2006).

The Duke River Fault is a secondary fault in the Denali Fault system. It runs in a northwesterly direction on the coastal side of the Denali Fault. It is the major fault through Asi Keyi, where it runs in a westerly direction. It enters the park at the southeast corner, having crossed the Donjek River, and runs south of Cement Creek, across the headwaters of St. Clare Creek, immediately north of Mount Bompas and underlies the eastward flowing portion of the Klutlan Glacier. In general terms, the Duke River Fault divides the park into the Alexander Terranne to the south and Wrangellia to the north. These two terranes were joined together over 310 m.y. and rafted northward where they were accreted to North America (Carter 1999; Israel and Cobbett 2007).

Alexander Terrane is comprised of volcanic rocks and altered sedimentary rocks (Smith 2004). The alterations, or metamorphosis, has been the result of intense pressure being placed on the layers through multiple collisions and uplift.

Studies on the magnetic orientation created at the point of formation in rocks in Alaska in the 1960s and 1970s pointed to them having formed separate from North America and over 2000 km to the south. These rocks became known as a terrane, based on common origin, which was a new concept in geology. The first rocks studied were grouped into the Wangell Terrane, or Wrangellia (Carter 1999). This terrane is also comprised of volcanic and sedimentary rocks that have been metamorphosed (Smith 2004).

Subsequent to drifting in to place southwest of the Denali Fault, the Alexander and Wrangell terranes have experienced numerous intrusions of magma. This is an ongoing process as rocks of the Pacific Plate continue to be subducted, or forced under, North America. Subducted rocks are melted and rise, crystalizing as subsurface batholiths, or reaching the surface as volcanoes. Most notable of these in Asi Keyi are the Harris Creek Batholith in the Kluane Ranges, the Constantine Complex and Count Glacier Pluton, and the Mount Steel Pluton to the south (Dodds and Campbell 1992).



2: Generalized bedrock geology.

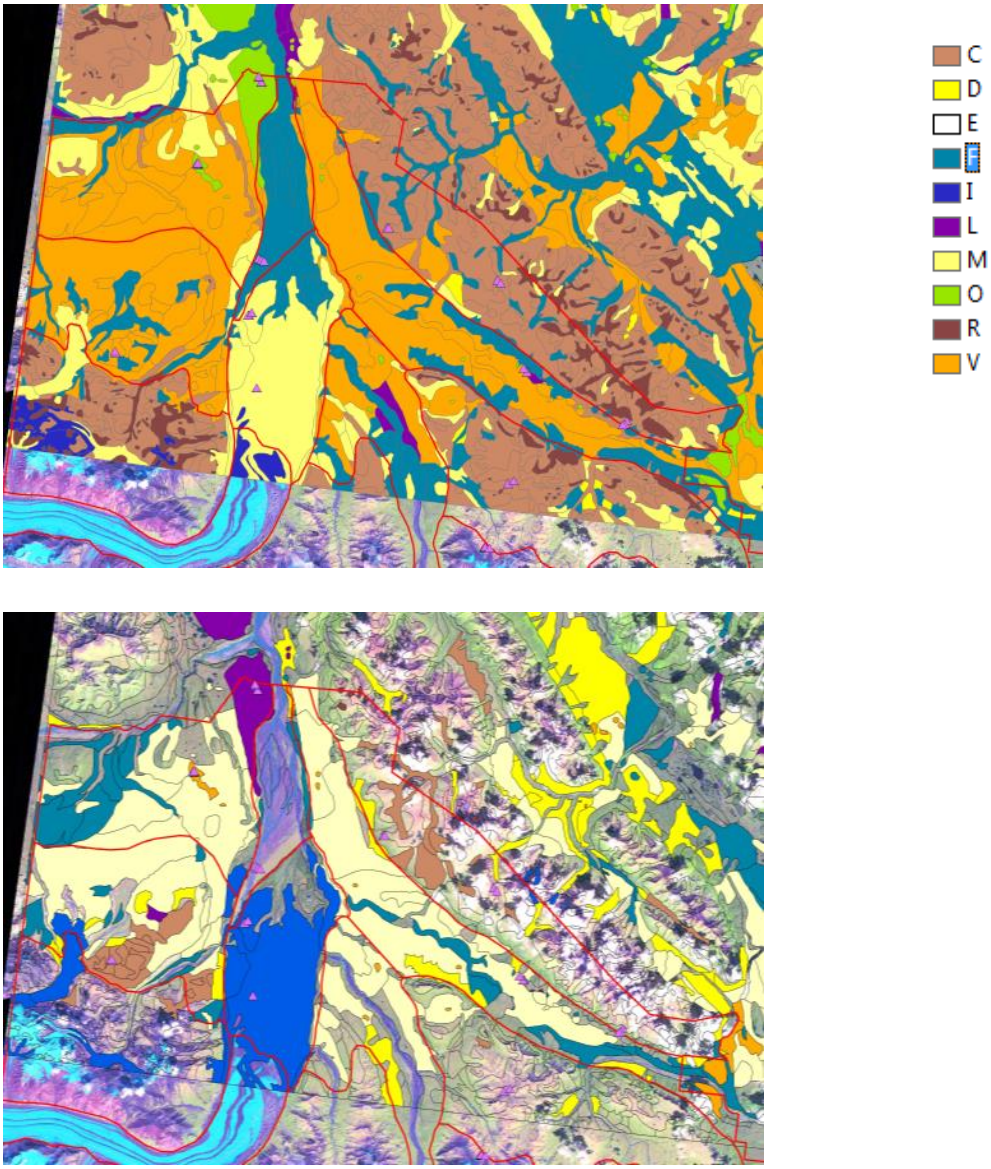
3: Most of the rocks in Asi Keyi NEP are volcanic in origin. Some basalt weathers to maroon, mica schists to black, with marble and limestone white to light grey.

2.3. Surficial Geology and Geomorphology

Bedrock geology is the foundation on which repeated glacial events over the past few hundred thousand years have worked to shape the landscape seen today. Major glacial events have shaped the main valleys, the White and Donjek, which have cut through from the high coastal mountains, through the Kluane Ranges, and through to the interior of Yukon. These glaciations and a series of smaller cool spells since the last major glacial event, the McConnell glaciation, have cut mountain valleys and deposited glacial till that shapes Asi Keyi NEP today. Alpine glaciers are still shaping the landscape and along with interior icefields, supply midsummer moisture to the lower lying ecosystems.

During glacial events prior to the McConnell Glaciation the White River valley was filled with ice to levels that enabled it to spill northward. Moraines in the Tchawshamon Valley support this idea (Krinsley 1965). During the McConnell Glaciation, or locally, the Kluane Glaciations (29 to 12.5 ka), ice flowed eastward through the White River valley. This glacier merged with other mountain glaciers, reaching its furthest extent near Snag at about 14,000 yr B.P. (Rampton 1971). While dates are not available for the White River glacier, rapid deglaciation followed regionally such that by approximately 11,000 yr B.P. the large valleys were ice free (Denton 1974). Till from this era blankets the perched valley floor, above the contemporary White River valley and the Teepee Valley.

Above the McConnell age till, Asi Keyi NEP is dominated by exposed bedrock, glacial ice and weathered rock or colluvium, that has eroded from the underlying rock but has not been transported.



4: White River Ash, orange in 4a, blankets lowlying areas of the park and covers morainal till, yellow 4b. The alpine is largely rock, and weathered bedrock that has not been transported known as colluvium, light brown.

One of the most notable features of the park is the blanket of White River ash. Material from a volcanic eruption approximately 1200 years B.P., or AD 803, in the vicinity of Mounts Churchill and Bona was carried eastward. The magnitude of the event is such that it is possible that Churchill and Bona are side peaks to a larger volcanic mountain that was obliterated by the eruption. Close to the source, the park area was blanketed by ash, lapilli (4-32 mm) and blocks, and by increasingly smaller granular ash. Undisturbed deposits in the west of the park are as deep as 1.5 m. Based on the eastward wind

direction and evidence that air borne material froze after deposition suggests that the eruption occurred in late fall or early winter. It is possible that the westernmost portion of the park has ash deposited from an eruption 740 years earlier that was carried northward.

Continued uplift of the St. Elias Mountains, coupled with the heavy snowload in the mountains results in a wide range of active earth process occurring within Asi Keyi. The most obvious processes are the alpine glaciers that continue to downcut mountain valleys in the south and southwest of the park. Frost –freeze action on bedrock, along with the plucking action of mountain ice, results in the production of extensive colluvium. In steep mountain terrain, colluvium is pulled downslope creating chutes, fans and steep blankets. In the alpine on gentle slopes to level areas, moisture freezes creating sorted circles in fine material to felsenmeer fields in coarser colluvium. Summer meltwater shapes the landscape by incising glacial till and bedrock, redepositing these sediments downstream, in places such as the Generc River channels.

5: On level to gently sloping sites in the alpine, such as this location in the Kluane Ranges, colluvium is sorted by frost into rings surrounding uplifting finer materials. This landscape is described as a felsenmeer field.

6: Present day streams, such as the headwaters of Bull Creek on the Wolverine Plateau, are bounded by glacial till and are creating new channels, even cutting through bedrock.

7: Rapid glacial retreat is resulting in dynamic landscape features, such as this one in the St. Clare Creek headwaters. Blue lines trace the upper edge of lateral moraines; arrows indicate former glacial flow direction; and the yellow star is to the left of stagnant glacial ice that is capped and insulated by till.

2.4. Hydrology

Asi Keyi is in the Yukon River Basin. It is drained to the east by the Donjek River and to the north by the White River. The Generc River is a major hydrologic feature in the park. Laden with glacial silt, it has formed a large braided network before entering a similar feature on the White River. Mountain streams are fed by snow pack and alpine glaciers. These relatively short streams respond quickly to snow melt, with flow accelerating quickly in the spring and peaking in July or August (Smith et al. 2004). From west to east these include Kletsan Creek and Big Boundary Creek fed by the Natazhat Glacier, flowing directly into the White River, and Brooke Creek from the Brooke Glacier contributing to the Generc River. East of the Klutlan Glacier and also contributing to the Generc River are Count Creek draining glacial meltwater from Mount Constantine and the larger St. Clare Creek, and its small tributary Bull Creek, which drains numerous valleys from Mount McBride to Promenade Mountain. Flowing eastward into the Donjek River is Cement Creek, draining the southeast of the park. Wolverine Creek drains the mountains north of Cement Creek, flows northward, dissecting the Wolverine Plateau, then east into the Donjek River. Streams on the plateau south of the White River such as Soda and Little Boundary creeks receive contributions from snow melt, rainfall, and very likely from melting ground ice. Harris Creek drains Teepee Lake and flows northeast to the Generc River.

The largest lake is Teepee Lake, which occupies a depression in morainal till of McConnell age. Numerous small lakes dot the Wolverine and Harris creek valley. A series of small pothole and thermokarst lakes occur on the McConnell age lateral moraine of the White River glaciation and the terminal moraines of the Natazhat Glacier. The largest of these is Big Boundary Lake. Water levels in these lakes appear to peak in early spring and drop throughout the summer. One lake occurs in the Klutlan Glacier terminal moraines, along with numerous small ponds. Bright azure ponds occur seasonally on the surface of the Klutlan Glacier. Small impoundments are formed between the glacier and the contemporary lateral moraine creating silty brown ephemeral ponds.

8: Big Boundary Creek drains the Natazhat Valley. It is pictured here in mid-June prior to peaking in July when the melting of glacial ice and high elevation snow reaches its maximum.

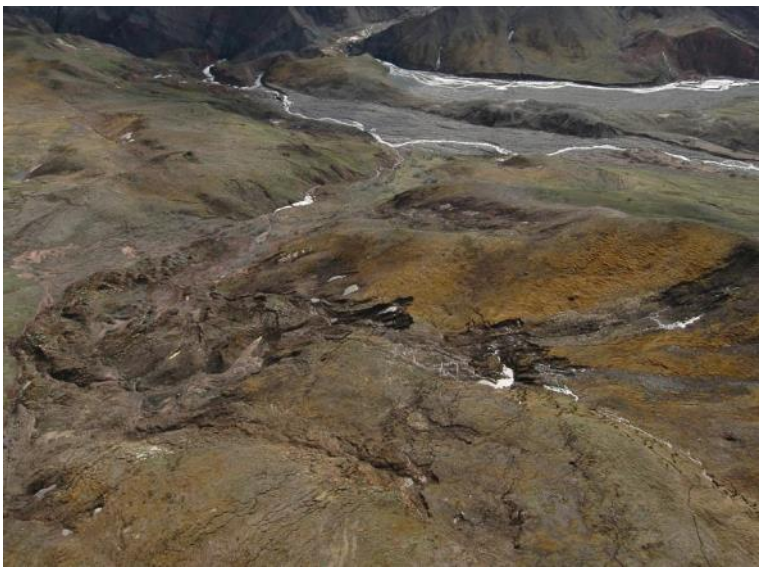
9: Ponds and small lakes on deep ash over till in the Big Boundary Lake area peak in spring with snow melt and drop in elevation through the summer.

2.5. Permafrost

Asi Keyi lies within the sporadic discontinuous permafrost zone. The occurrence of permafrost is related to elevation, aspect, surficial materials and moisture. In the mountains, outside of areas under ice and permanent snow, permafrost occurs above 1,600 m asl. Ablation till from the Little Ice Age glacial advances and prior glaciations are ice rich. Rock fall onto glaciers and medial morainal material insulates till, which in some cases contains remnant glacial ice. Thaw slumps in till, detachment slides, frost shattering induced slope failures in bedrock, sorted circles and felsenmeer fields are all evidence of high elevation permafrost.

The terminus of the Klutlan Glacier is insulated by debris and coarse ash, which insulates the stagnant glacial ice. This is also occurring on the terminus of the Natazhat Glacier. Ash insulates much of the plateau and lowlands. Evidence of permafrost includes small thermokarst ponds and lakes in the Big Boundary Lake area and the surface flow of streams where ash deposition has not been reworked.

In valleys organic material is ice rich. Ash from primary deposition, and in alluvial redeposition, also insulates substrates. Evidence of valley ice includes runnel drainage patterns, ice wedges and near-surface frozen material in soil pits.



10: Evidence of permafrost is found throughout the alpine. In this example from upper Brooke Creek, thermokarst and thaw slumps on till are sure signs of permafrost.

11: Level areas in the Teepee Valley and the plain west of the Generc River have extensive areas of ice rich soils. In this example west of Big Boundary Lake, the shallow active layer is seen overlying permafrost in deep ash.

12: Parallel drainage channels, with shallow slopes and little incising, occur on till and fluvial sediments over permafrost. Pictured is a perched alluvial fan formed by Wolverine Creek as it exists the plateau.

2.6. Soils

Soils development in Asi Keyi NEP has had to deal with short cool summers, numerous advances of valley glaciers, steep and rugged terrain, active geomorphic process, permafrost and the unique circumstance of a thick blanket of volcanic ash only 1200 years B.P. In the Alpine and Subalpine Bioclimate Zones, soils are dominated by Regosols and Cryosols, while in the Boreal Zones, Brunisols dominate, along with Organic soils (Gray 1987).

Regosols are the first stage of soil development. They include weathered bedrock in alpine and subalpine settings (colluvium), but not yet transported downslope by water, ice or wind, to recently deposited gravels and glacial silt in river beds (alluvium). Regosols have little structure or organic development. While nutrient poor and with little capacity to hold water, these soils do host a remarkable array of vascular plants in areas recently occupied by alpine glaciers.

Cryosols are soils that are affected by permafrost within 1-2 m of the surface. Static Cryosols, meaning the layering through profile of the frozen material has not been deformed by frost action, are common in Asi Keyi NEP. Much of the ash deposition fits in this category. Freeze thaw cycles on frozen soils that have a matrix of fine particles and the availability of moisture are active and destratify. These soils are termed Turbic Cryosols and occur in Asi Keyi NEP on level areas in the Kluane Ranges and on Wolverine Plateau.

In the lower or boreal portions of Asi Key NEP Brunisols are common. Brunisols have had time to develop and have an organic horizon, accompanied by a B horizon, in which parent material, a regosol, has been chemically altered. These occur on moraines and sediments deposited by temporary post glacial lakes in the Boreal ecozones (Smith 2004).

Organic soils develop in level and stable conditions where wetlands have formed. Sphagnum mosses and other organics in the wetlands become peat, which in the northern continental climate is not broken down rapidly, and so accumulates into deep layers. In Asi Keyi NEP, the organic soils are most often frozen, so are termed organic cryosols (Gray 1987). Most of these occur in the Teepee Valley and Solomon Ridge ecosections.

13: Organic soils have developed in drainage channels. These soils overly ash, suggesting that their development is relatively recent.

As mentioned above, the area was blanketed with ash less than 1200 years ago. In relative terms, this is a short time for the development of brunisols, organics or other soils. This is compounded by the glassy nature of the tephra, which does not weather quickly. This has had a pronounced effect on the level areas where the ash has not been moved downslope, such as the Boundary Creek, Solomon Ridge and Teepee Lake ecosections.

Glacial silt, that is the product of ice action grinding rock to a fine powder, is deposited in river beds such as the White, Generc, and Donjek. During seasonal periods of low flow, this material dries and is picked up by wind and deposited on the surrounding landscape where it is known by the term 'loess.' This material adds nutrients to soils adjacent to large icefields, and is presumed to be a contributor to soils within Asi Keyi NEP.

14: Stagnant ice at the terminus of the Klutlan Glacier, capped and insulated by ash supports soil development and vegetation growth.

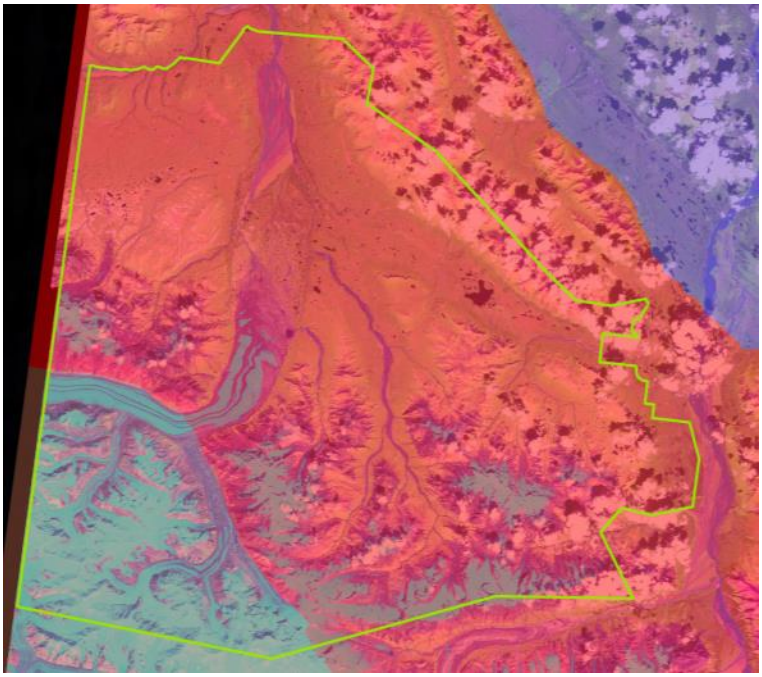
2.7. Climate

The climate is subarctic continental, though it is strongly modified by weather systems from the Pacific Ocean. Uplift of moisture bearing Pacific systems by the St. Elias Mountains results in heavy snowfall in the mountains, with a moisture shadow to the interior side, including Asi Keyi NEP. Summer temperatures are warmer in the valleys than in the alpine. With an elevational range in the park of 4000 meters, the summer temperature differential can be as much as 30^{o}C. During winter months temperature inversions, accompanied by cold air drainage and air flow from the arctic, can result in extremely cold temperatures in the valleys (Smith et al. 2004). Lows of sub -50^{o}C have been recorded in Burwash Landing and Beaver Creek in the months of December, January and February. The nearest weather data is from Burwash Landing. Based on climate normals from 1971-2000, the warmest month is July with daily average temperatures of 12.8^{o}C, while the coldest month is January, with daily average temperatures of -22.0^{o}C. The climate is dry with yearly precipitation just shy of 300mm (Environment Canada 2013).

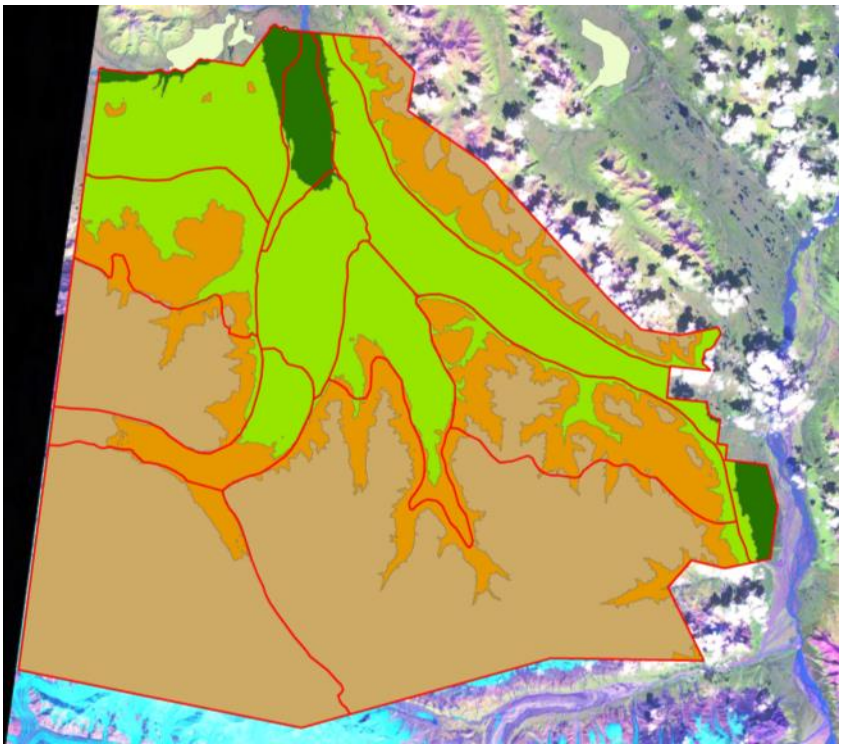
2.8. Ecology

The park lies within portions of the Mount Logan and St. Elias Mountains ecoregions. (Smith et al. 2004, Environment Yukon. 2013). The underlying geology is shared by these two ecoregions. The icefields of the Mount Logan Ecoregion is the distinguishing feature. This ecoregion receives most of its precipitation as snow. The limited vegetation is found on lateral moraines adjacent to active glaciers. It supports only a few species of mammals and birds, such as the Arctic Ground Squirrel and White-tailed Ptarmigan. The majority of the park is within the St. Elias Mountains Ecoregion. This ecoregion is comprised of high mountains, active glaciers and large streams and rivers with flashy water levels. It has been extensively glaciated recently and the Asi Keyi NEP portion has been strongly influenced by the deposition of White River Ash. These factors combine to make this landscape dynamic and the ecosystems on it relatively young.

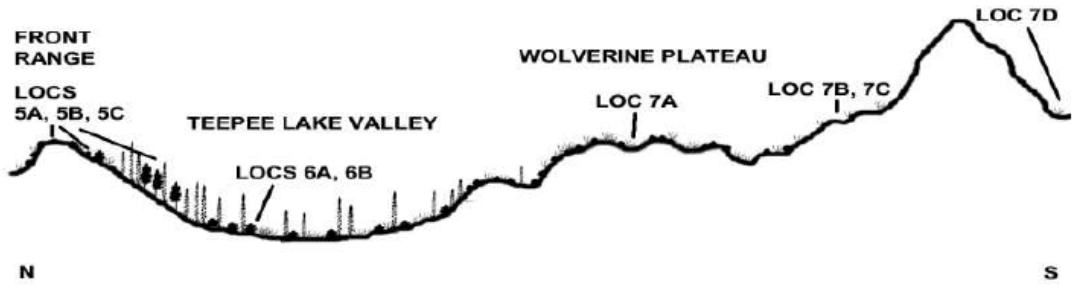
The valleys support forests of open White Spruce (*Picea glauca*), with willow and Shrub birch (*Betula glandulosa*) understory. The limited wetland area in this ecoregion occurs in the valleys and low plateaus on glacial till and on sediments from glacial lakes. Plateaus in the boreal zone support very sparse White Spruce, with extensive Shrub birch communities. On south facing slopes is a limited occurrence of open Aspen forests. The subalpine is extensive in the park. It is dominated by shrub communities that include willow, Shrub birch, alder and Labrador tea.

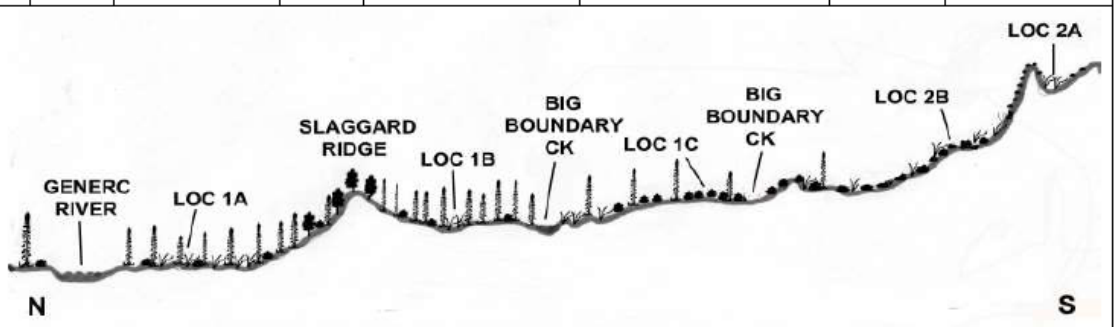


15: The Mount Logan ecoregion is dominated by high peaks, glaciers and icefields. To the interior is the St. Elias Mountain Ecoregion, which includes high peaks, valley glaciers, and vegetated plateaus.

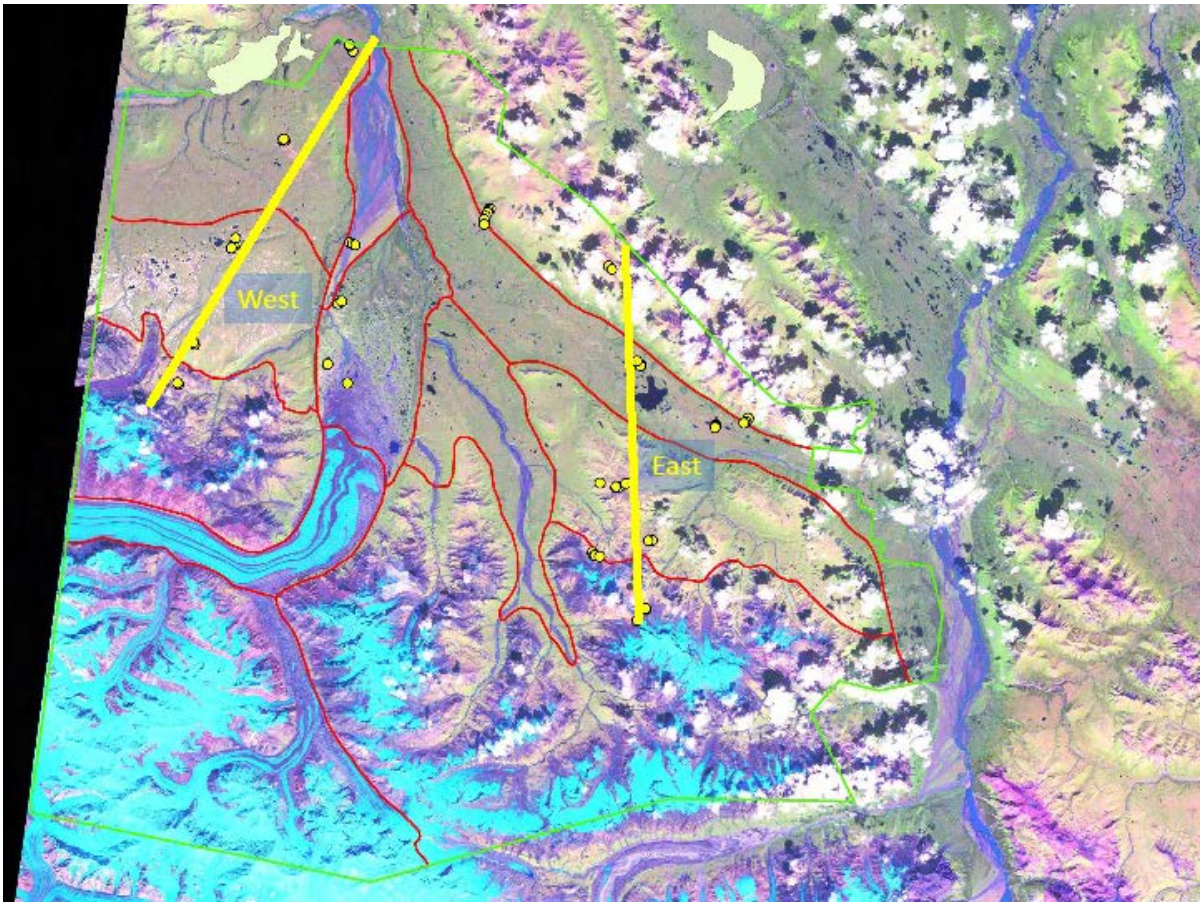


16: Four bioclimate zones are mapped for Asi Keyi NEP. The Boreal Low and Boreal High zones are limited to the Teepee Valley, St. Clare Creek and the plateau west of the Generc River. These zones are bounded by Subalpine. The majority of the park is Alpine.

EAST HALF OF ASI KEYI						
ZONE	ALPINE AND SUBALPINE	BOREAL		SUB-AL-PINE	ALPINE	
DOMINANT VEGETA-TION	Groundshrubs/ Forbs/Grami-noids on alpine ridgetops; open low shrubs on subalpine slopes	Dense White Spruce and Aspen-Poplar on lower and mid-slopes border-ing valley	Sparse White Spruce and dense Shrubs/Moss and Graminoids in moist and wet depressional sites on valley floor; White Spruce forests on lower and midslopes of north-facing front of Wolverine Plateau	Open low shrub	Extensive groundshrubs, graminoids and forbs	Sparse to no vegetation
ELEVATION RANGE : 1000 to >2300 m						
SITE FEATURES	Rounded ridges;steep rocky slopes and peaks in alpine; steep subalpine slopes	Steep slopes, many rock out-crops	Level to gently sloping valley floor; large alluvial fan on south side (near Wolverine Creek); colluvial aprons and alluvial fans along bases of mountains on both sides of valley; numerous shallow seepage tracks/runnels between small low hills and mounds on valley floor; numerous small lakes and ponds	Steep rocky north-facing slope	Extensive area of rolling alpine plateau and steep-sloped ridges; V-shaped valleys; small brooks	Steep rocky slopes and peaks; cirques, moraines and glaciers

WEST HALF OF ASI KEYI								
ZONE	BOREAL						SUBALPINE	ALPINE
DOMINANT VEGETATION	Sparse forbs, Grami-noids, shrubs, small Poplars	Open White and Black Spruce forests on better drained sites; shrubs and Graminoids in runnels and other wet sites	Dense White Spruce and Deciduous forests on north-facing slope and ridgetop	Open White Spruce on hills; Groundshrubs and Lichen on ash deposits; shrubs and Graminoids in moist sites	Open to sparse White Spruce on hills; extensive Shrub Birch on hills and along creeks; Graminoids in moist-wet depressions and along creeks; sparse vegetation on exposed ash		Open low Shrub Birch on drier sites; low Willow on moister sites	Groundshrubs/Lichen on windswept ridges; Graminoids on gentle moist to wet sites; sparse to no vegetation on rocky slopes
ELEVATION RANGE: 784 to >2300 m								
SITE FEATURES	Broad braided river, sand and gravel bars; many side channels; steep slopes bordering river	Level to gently sloping area; numerous seepage tracks (runnels) and brooks; a few ponds and small lakes; small patches of exposed ash	High bedrock ridge; steep north-facing slope	Hilly area, gentle to moderate slopes, rounded hilltops; higher hills in western part. Several large creeks; many small. Several large irregularly shaped depressional areas supporting shrub and sedge; a few ponds and small lakes; smalll patches of exposed ash	Low rounded hills; small shallow creeks and wetlands in depressions; many ponds and small lakes in southern part of area; many small and large patches of exposed ash		Gently sloping plateau; several creeks in v-shaped valleys; large patches of exposed ash, mainly In northern part of area	Rugged alpine; steep slopes, outcrops, stony ridgetops, cirques, solifluction lobes, frost boils, stone stripes, glaciers

17: Figures a and b are generalized illustrations of ecosystems and the landscape position they occupy. Locations of these cross-sections are shown in Figure 18.



18: The ecological cross-sections follow the yellow lines. Ecosystem plots investigated in 2004 are indicated by yellow dots. The light green polygons along the White River show the 1996 burn.

Alpine

Much of the Alpine Bioclimate Zone is rock and glacial ice. Four groupings of alpine vegetative communities are defined: Sparse Alpine Forbs; Alpine Ground Shrub; Alpine Low to Medium Shrub; and Alpine Graminoid. Recently exposed sites with bare soil, stones to boulders support colonizing plants. These Sparse Alpine Forb sites can have a remarkable diversity of flowering plants, with mosses and lichens following.

19: Forbs are the first to colonize exposed alpine sites. This site in Cement Creek is sprinkled with Northern Jacob's Ladder (*Polemonium boreale*).

The most common fully vegetated alpine types are Alpine Ground Shrub that are found on dry to moist, upper slopes and ridges. Most are exposed and windswept. These types are dominated by Mountain Avens, Mountain Heather, Dwarf Willow and Dwarf Blueberry. In the lower alpine on sloping sites with high moisture due to cool aspect, toe slope position or adjacency to streams the Alpine Low to Medium Shrub type is found. It is dominated by willows and grasses.

On level, poorly drained sites, with near-surface permafrost, Sedge/Moss and Cottongrass/Moss types are described.

Subalpine

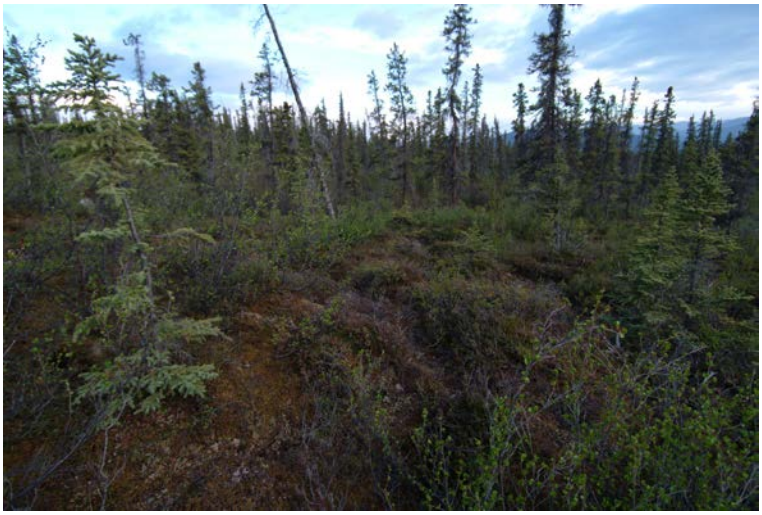
In the Subalpine Bioclimate Zone the vegetation types are dominated by medium height shrubs. To the west of the Generc River, the subalpine is influenced by a deep layer of volcanic ash. On account of the blanket of ash, gentle slopes are well drained near the surface despite overlying permafrost. An extensive sparse medium height Shrub Birch/Feather moss-Lichen type dominates this landscape. Lichens are poorly developed and are most commonly comprised of Sterocaulon sp. On till and colluvial sites in the Kluane Range, Wolverine Plateau and other subalpine east of the Generc River, a Shrub Birch-Willow type is common, with understory shrubs such as Blueberry.

20: Subalpine shrub types are extensive within the park. Most types are comprised of medium open height shrub birch and willow.

Boreal

The Boreal Low and Boreal High bioclimate zones forests are dominated by open White Spruce with Shrub Birch understory and Feathermoss dominated ground cover. On mesic southfacing slopes mature White Spruce forests occur, with understories of alder and Labrador tea. Steeper and drier sites have small patches of Balsam Poplar and Trembling Aspen types, with juniper being the most common understory shrub.

On level to depressional sites, moist shrub types are common. These grade into wetland shrub and sedge types. These are most common in the Teepee Valley and Solomon Ridge ecosections on ash blanketed till and fluvial deposits over permafrost.



21: Open to sparse White and Black spruce forests dominate the lowlying areas of the park. These open forests have a strong Shrub Birch and willow component.

The only record of a fire is as small 18 km^2 burn adjacent to the park either side of the White River canyon from 1996.

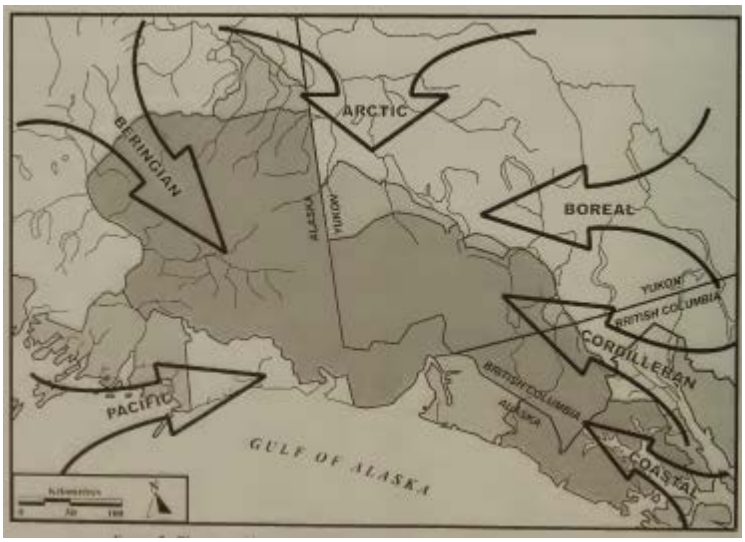
22: Sparse forests combined with infrequent lightning generating thunderstorms result in few forest fires. On the upper elevations of the plateau west of the Generc River, copses of White Spruce have likely grown from layered branches of older trees, the decaying remains of which are found in the centre of the standing trees.

A notable element of Asi Keyi NEP ecology is the convergence of several distinctive biogeographic influences. These include boreal, cordilleran, coastal and beringian (Danks et al. 1997, Danby 2003). These influences are seen in birds and mammals, and clearly in plants and insects found within the park. For example, boreal species such American Beaver, Herring Gull along with White spruce and Trembling aspen are common. In addition are some species at the western edge of their range such as Woodland caribou and Greater Yellowlegs. Moose in this area are considered to be the subspecies 'Alaska Moose' (Alces alces gigas) which are at the eastern edge of their range. The Alaskan Tiny Shrew has been observed 12 km west of Asi Keyi in Wrangell-St. Elias National Park and Preserve, also at the eastern edge of its range (Slough and Jung 2009). Cordilleran species at, or near, their northern limit include Mountain Goat, Barclay's Willow and White-tailed Ptarmigan, Golden-crowned Sparrow and Barrow's Goldeneye (Godfrey 1986).

The coastal influence is seen through birds such as and possibly through Pale Poppy (Papaver alboroseum), which is known from coastal Alaska into the alpine. The beringian influence is seen through through birds such as Surfbird which nest in unglaciated Yukon alpine and winter along the Pacific Coast. Wandering tattler has a similar distribution. Plants associated with beringia found in Asi Keyi NEP include Macoun's Poppy (Papaver macounii)

and Pincushion plant (Diapensia lapponica). The park also has species more common in the arctic, such as Long-tailed Jaeger and Whimbrel, at the southern limit of their breeding ranges. Tundra Shrew are likely within Asi Keyi NEP, at the southern edge of its range (Slough and Jung 2009).

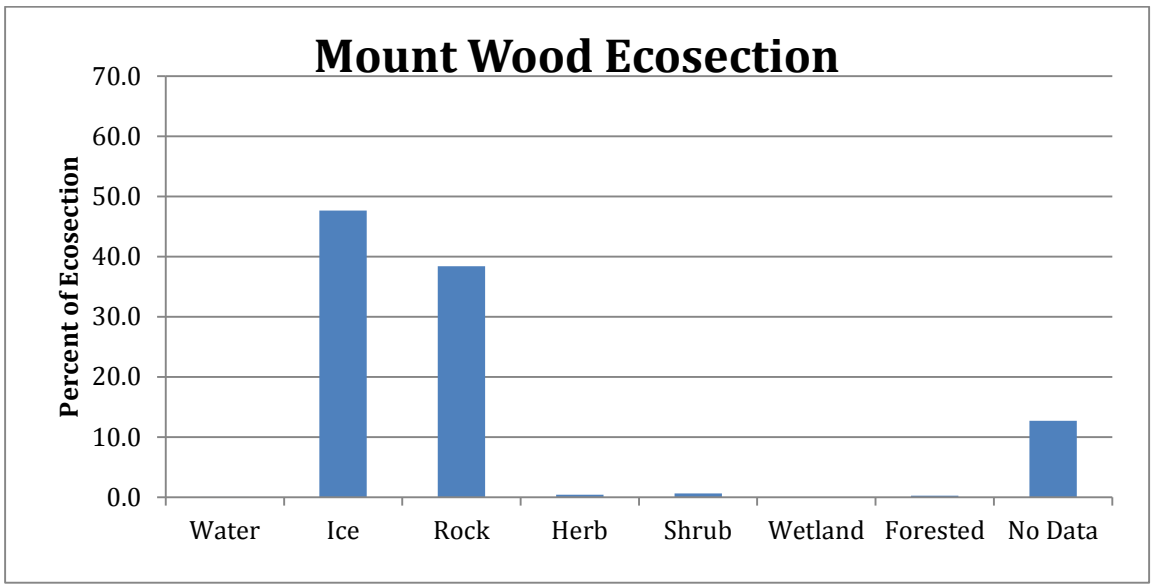
Proximity to the ocean, elevation ranges from 770 to 4845 m asl, adjacency to unglaciated areas, and latitude contribute to this mix. Rather than being a zone of transition between two bioregions, the factors listed above enable these multiple biogeographic influences to coexist.



23: Asi Keyi NEP is influenced by Pacific, Beringian, Arctic and Boreal biogeographic zones. Source: Danby 2003.

3.10. Mount Wood Ecosection

Summary



Physiography

This landscape is part of the Icefield Ranges. Tall peaks tower over the southern edge of the Ecosection, including Ice Fall Peak, Mount Craig, Solomon Peak, and Mount Wood, the highest peak in the park at 4,845 m asl. (15,741'). This ragged mountainous landscape has extensive ice caps and steep valley glaciers. After the Klutlan Glacier, the Brabazon Glacier is the largest in the park; it is fed by the Mount Wood Glacier. To the west is the Nesham Glacier, which is fed by the extensive icefields and deeply incised and steep side valley glaciers. The Brabazon and Nesham glaciers flow northward into the Klutlan Glacier. Elevations range from 1419 m asl. at the Klutlan Glacier to 4845 m asl. at Mount Wood.

Bedrock Geology

The mountains immediately south of the Klutlan Glacier from the Brabazon Glacier west to the boundary, including Crag Mountain, are comprised of volcanic rocks. To the south are metamorphosed sedimentary rocks, including mica schist, amphibolite, greywacke and quartzite accompanied by limestone toward the boundary with Kluane Park. These rocks are intruded by resistant granodiorite of the Mount Steele Pluton, of which Mount Wood is part.

Surficial Geology & Glaciation

This Ecosection is dominated by glacial ice, both capping mountains and in numerous small to medium sized valley glaciers. The largest being the Brabzon and Nesham glaciers, which flow northward into the Klutlan Glacier.

Ecosystems

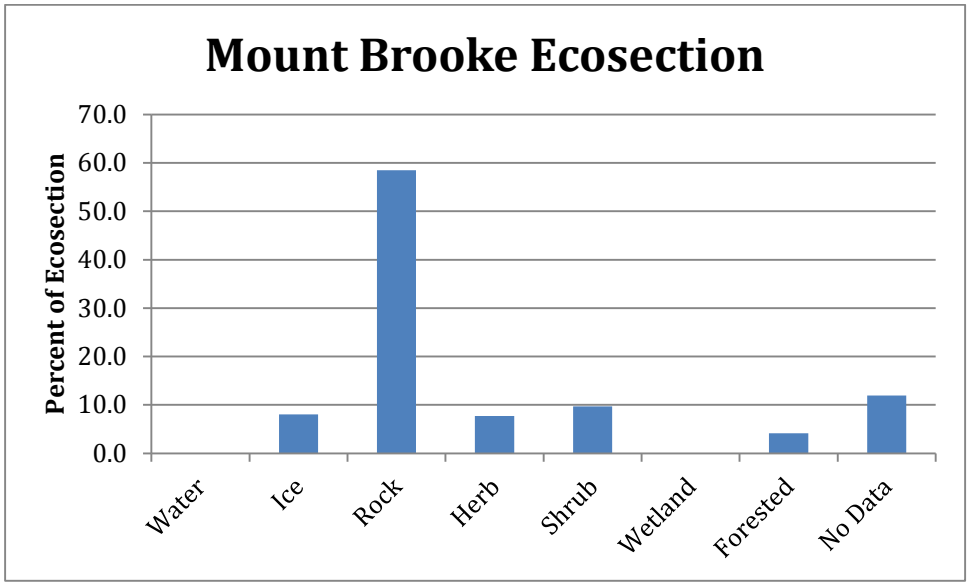
Vegetation is confined to perched terraces on stabilized lateral moraines and at the bases of retreating valley glaciers. Vegetation is sparse, with a diversity of forbs, ground shrubs, and some graminoids. Ground shrubs are dominated by Mountain Avens (Dryas spp.) anf dwarf Willows (Salix spp.).

Water and Wetlands

All of the valleys in this ecosection are occupied by glacial ice. There are no permanent streams or lakes in this Ecosection.

3.11. Mount Brooke Ecosection

Summary



Physiography

After the Mount Wood Ecosection to the south, this Ecosection has the highest elevations, with Mount Brooke, reaching 3285 m asl. followed closely by Mount Lambert to the north. It is

overshadowed to the west, just inside Wrangell-St. Elias National Park, by the towering Mount Natazhat, which reaches 4095 m asl. This peak rises close to 2000 m when viewed from the north, from sites such as Big Boundary Lake and close to three vertical kilometers from the Ecosection low point of 1126 m asl. at the Klutlan Glacier. A dominate feature of the Ecosection is the Natazhat Glacier and the wide, steep-walled valley it occupies.

Bedrock Geology

This Ecosection lies to the north of the Duke River Fault. The southwestern portion, including the peak north of the Brabazon Glacier, at the inner bend of the Klutlan Glacier, and west to Mount Brooke and Mount Lambart are comprised of dark greenish grey basalt to andesite oceanic lava flows. This group includes Mount Natazhat, just west of the park in Wrangell-St. Elias National Park and Preserve. These rocks have been highly metamorphosed. To the north are younger rocks that also formed as marine lava flows.

Surficial Geology & Glaciation

As with the Klutlan Glacier, the Natazhat Glacier reached is glacial limit after the fall of White River Ash (Rampton 1970). This alpine valley glacier has also built up terminal moraines through a series of surge events. The oldest of these has been dated to 500 y B.P., with the youngest estimated to be only 25 y B.P. (Rampton 1970). Since the advance creating the youngest moraine, the glacier has retreated up valley, leaving stagnant ice under a deep mantle of till.

At the towering steep walled cirque east of Mount Natazhat, the glacier appears to be accumulating ice and flowing. Within a short distance down valley, it is entirely debris covered and stagnating.

Ecosystems

Vegetated solifluction lobes and bare stony and rocky patches are common features on the steep mountain slopes. Ground shrubs and graminoids provide the dominant vegetation cover on the slopes. Two graminoid vegetation types (Cottongrass and Sedge) were documented on moist seepage sites in a concave to gently sloping basin area. An adjacent bouldery exposed rocky alpine ridge supports Dryas spp., a community type characteristic of such sites.

On high ridges and plateaus, slopes here are gentle, of mixed morainal till with a thin ash layer. Dominant vegetation on moist slopes is open low willow, low graminoids, and mosses. Ground shrubs and lichens are more common on north-facing slopes. Downslope, large ash deposits, frost boils, and

hummocky ground are common. Vegetation in this area is dominantly low Shrub Birch and lichens, with low willow in the many shallow, moister, drainage ways.

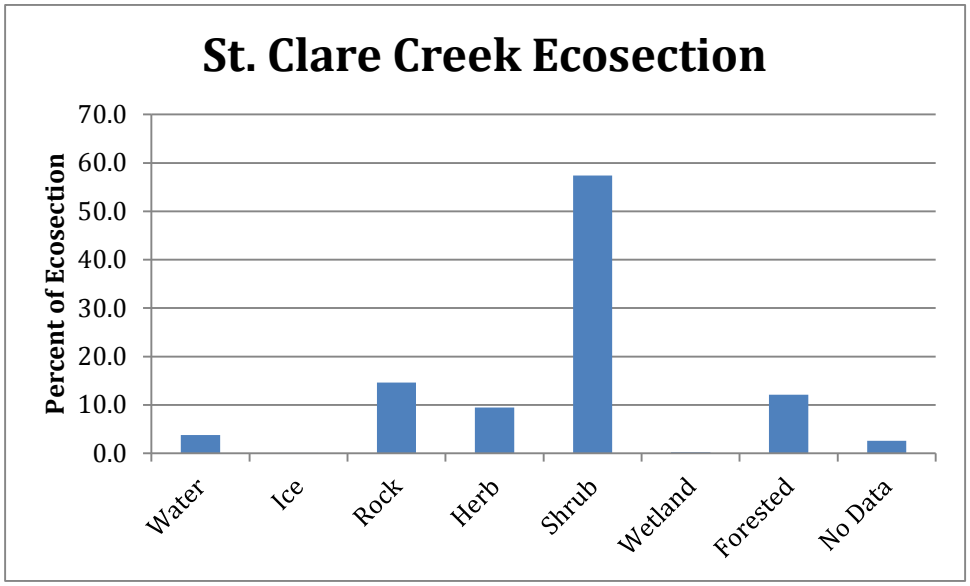
Water and Wetlands

There are no lakes in this Ecosection. Brook Creek is fast moving and flashy, with unvegetated gravel to boulders. Wet seeps on the plateaus comprise the only wetland element.

24: Erosion of deep ash exposes trees that were buried at the time of the volcanic explosion or soon after by drifting ash.

3.12. St. Clare Creek Ecosection

Summary



Physiography

This Ecosection is comprised of the lower reaches of Contact and St. Clare creeks. The creeks flow in a north to northwesterly direction into a meltwater channel that joins downstream with Harris Creek before entering the Generc River. The reaches of these creeks are actively downcutting the glacial till deposited by the Klutlan and other valley glaciers during the last ice age. Elevations range from 917 m asl. at the Klutlan Moraines to 1585 m.a.s.l. up St. Clare Creek.

Bedrock Geology

The lower portion of this unit is entirely overlain by till. Exposures in the Count and St. Clare Creeks are andesite from lava flows.

Surficial Geology & Glaciation

The majority of this ecodistrict is covered with glacial till, which is deep where St. Clare Creek exists the mountains. Higher and steep areas are colluvial. Much of this is blanketed with ash, while the lower areas have fluvial deposits generated by the high energy streams moving and depositing glacial silts and gravels in the lowlands east of the Klutlan Glacier.

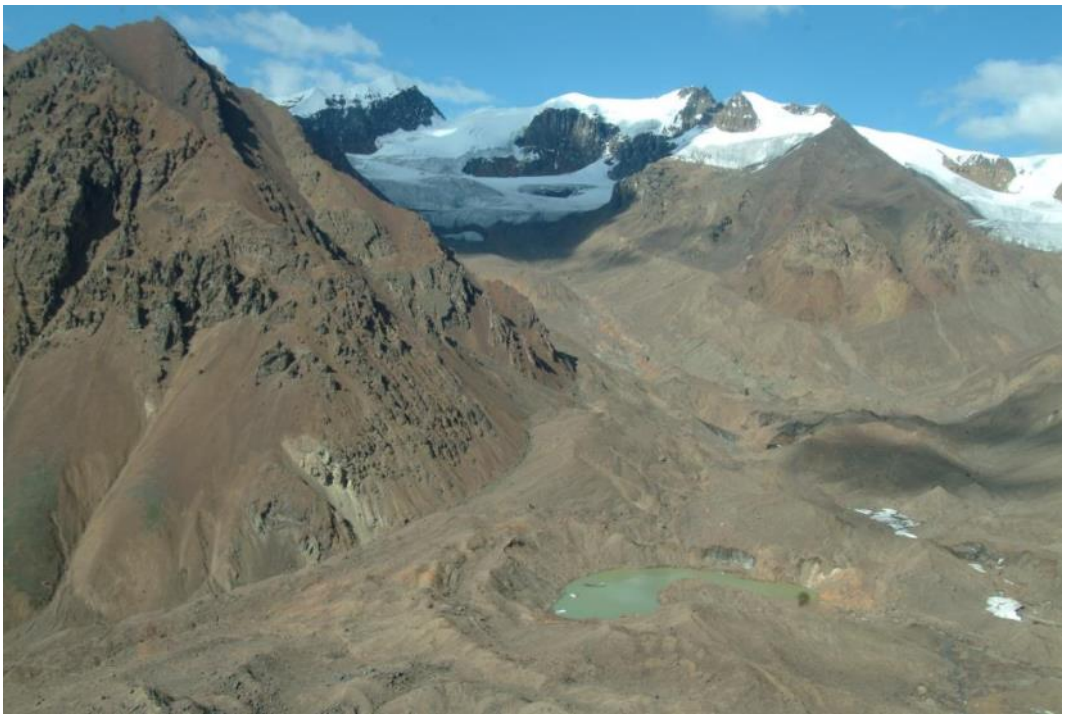
Ecosystems

Ground shrubs, such as Mountain Avens (Dryas spp.) and Mountain Heather (Cassiope tetragona) dominate the upper and north-facing slopes of ridges, with dwarf Willows (Salix spp.), graminoids, forbs and mosses on moist, hummocky, lower slopes. Dry south-facing slopes support a mix of ground shrubs, graminoids, and forbs, interspersed with patches of gravel and bare ground and occasional small detachment slumps. A diverse mix of forbs occurs in small, moist, meadow-like depressions on the slopes. Mountain Heather (Cassiope tetragona), Mountain Avens (Dryas spp.), and dwarf Willows (Salix spp.) dominate on upper slopes and crests.

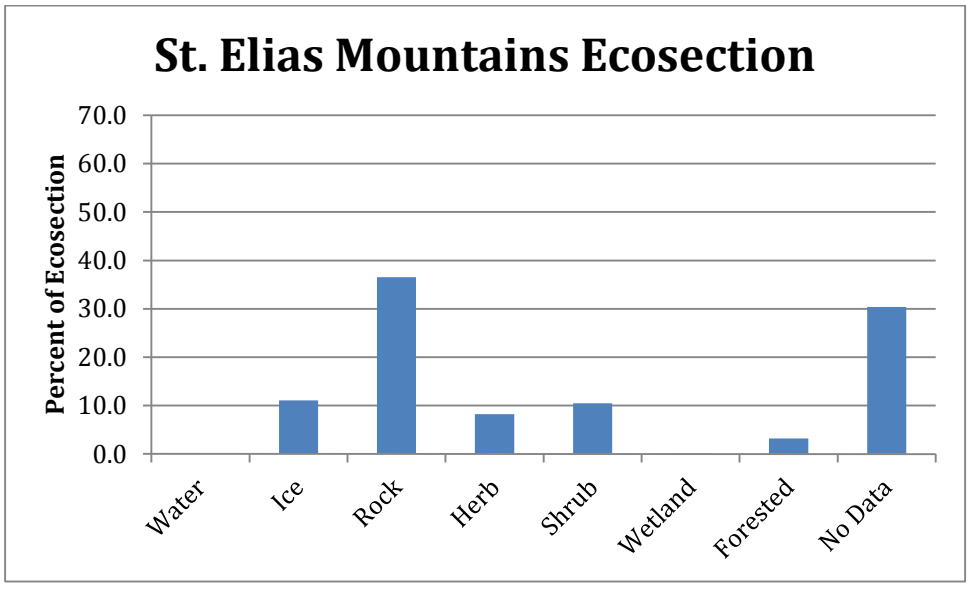
Water and Wetlands

Flashy streams, with rocky to bouldery floodplains up high, to gravelly floodplains on the plateau, drain numerous high glaciated valleys. There are no lakes or wetlands in this Ecosection.

3.13. St. Elias Mountains Ecosection



Summary



Physiography

Elevations range from 917 m asl. at the Klutlan Moraines to 3119 m asl. at a glacier capped unnamed mountain that drains north and south into Wolverine and St. Clare creeks.

Bedrock Geology

The rocks in this Ecosection are mapped as the St. Clare Province. They are dominated by lava flows of basalt and basaltic andesite, along with consolidated ash, called tuff. Thicknesses of St. Clare Province rocks reach 2000 m in this Ecosection (Souther and Staniciu 1975). A grouping of intrusive rocks known as the Constantine Complex and Count Glacier Pluton comprise the Mount Bompas and Mount Constantine area just north of the Duke River Fault. This group is dominated by hornblende, with other igneous rocks such as rhyolite and felsite. Complex erosion and redeposition history is evident during the volcanic period, creating volcanic sandstones and conglomerates that have been uplifted and tilted.

Surficial Geology & Glaciation

This ecosection has active glaciers that continue to erode high elevation valleys. Extensive deposits of unstablized till indicate rapid and recent glacial retreat.

During the Little Ice Age impoundments appear to have formed adjacent to advanced alpine glaciers into which White River Ash was redeposited. Glacial retreat, lake drainage and subsequent erosion by meltwater and summer rain has resulted in sculpted ash, in the case of Figure__.

25: White River Ash has been redeposited to a depth of over 10m in a saddle in the Wolverine Creek headwaters.

Ecosystems

Sites that have been vacated by glacial ice within the past few years are unvegetated, with rough surfaces comprised of silts to coarse boulders. While vegetation cover can be less than 1%, there are a remarkable number of early colonizing plant species. At one such site at the head of Wolverine Creek, over 40 species of vascular plants were identified. These include common colonizing forbs such as Epilobium latifolium, Erigeron purpureus, and Polemonium boreale, along with ground shrubs such as Salix polaris and S. reticulata. These sites also include less common plants, such as Draba species, and some Caryophyllaceae. One species, Pale Poppy (*Papaver alboroseum*), collected in this Ecosection is a

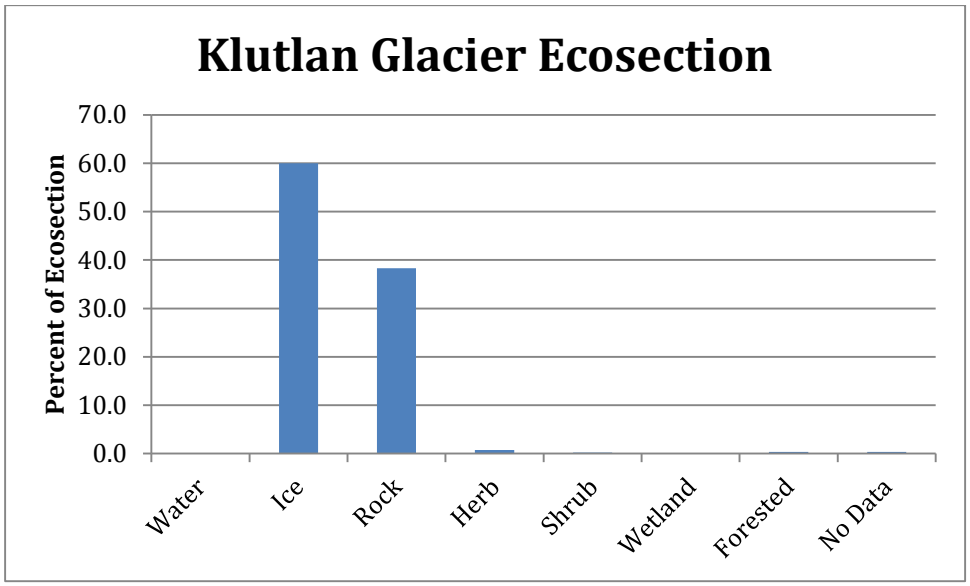
second occurrence for Yukon. Its distribution is coastal Alaska from the Copper Delta and interior north of Anchorage.

Water and Wetlands

There are no lakes or wetlands in this ecosection. Steep headwater streams drain snowpack and glacial melt.

3.14. Klutlan Glacier Ecosection

Summary



Physiography

Klutlan Glacier is 3 km wide, on average, and 27 km in length in Yukon and a further 45 km in Alaska for a total length of 60 km. It is a long outlet glacier that begins in the icefields east of the

volcanic Mount Bona. 5005 m asl., and Mount Churchill, 4766 m asl. The terminus of the Klutlan Glacier is 1120 m asl. It is 1816 m asl. at the Alaska / Yukon boundary.

Bedrock Geology

The Klutlan Glacier, from the Alaska/Yukon boundary to the Brabazon Glacier, is underlain by the Duke River Fault.

Surficial Geology & Glaciation

Terraces adjacent to the glacier include deep deposits of ash, and coarser volcanic material. These may have been consolidated after initial deposition in impoundments adjacent to the glacier. The Klutlan Glacier is a surging glacier with two recent events having been recorded, including a surge in 1905 (Tarr and Martin, 1914, in Krinsley 1965) and a second surge between 1960 and 1963 observed by A. Post (Rampton 1970). The glacier has two prominent medial moraines owing to its source in two large feeder glaciers with a smaller intermediate glacier beginning north of Mount Jordan. The contribution from the icefield east of mounts Churchill and Bona is the flow on the left or north side of the glacier.

Ecosystems

There is no opportunity for the development of soils or plant life on the active glacier.

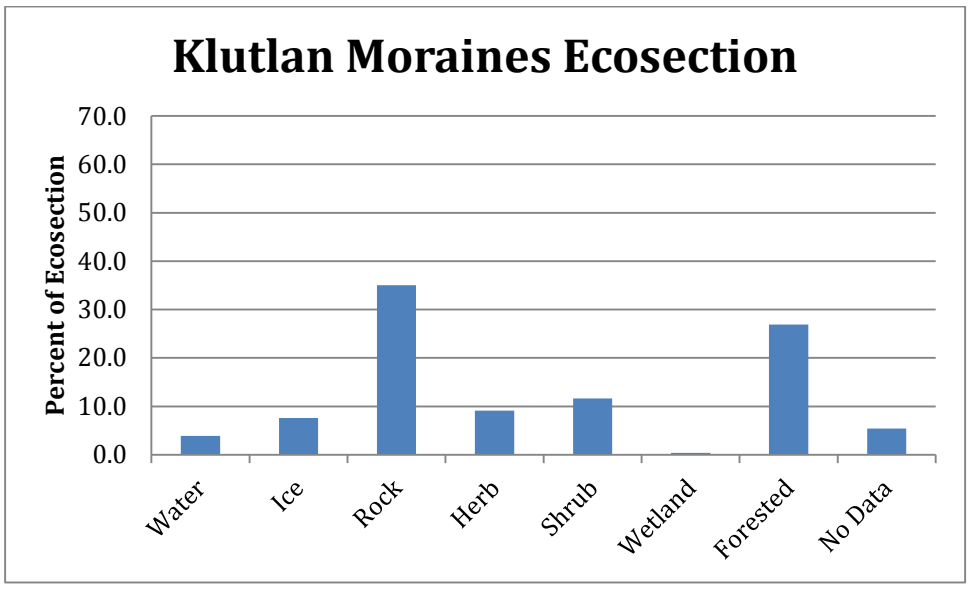
Water and Wetlands

Following the melting of snow from the glacier surface, azure seasonal ponding develops. Adjacent to the glacier, side slope runoff and glacial melt create impoundments of brown silty water.

26: The Klutlan Glacier is a surging glacier that flows from the icefields adjacent to Mount Bona and Mount Churchill; the source peaks for the White River Ash.

3.15. Klutlan Moraines Ecosection

Summary



Physiography

This small Ecosection is 891 m asl. at the Generc River and 1120 m asl. where the moraines give way to glacial ice. Valley sides included in this unit are up to 1281 m asl.

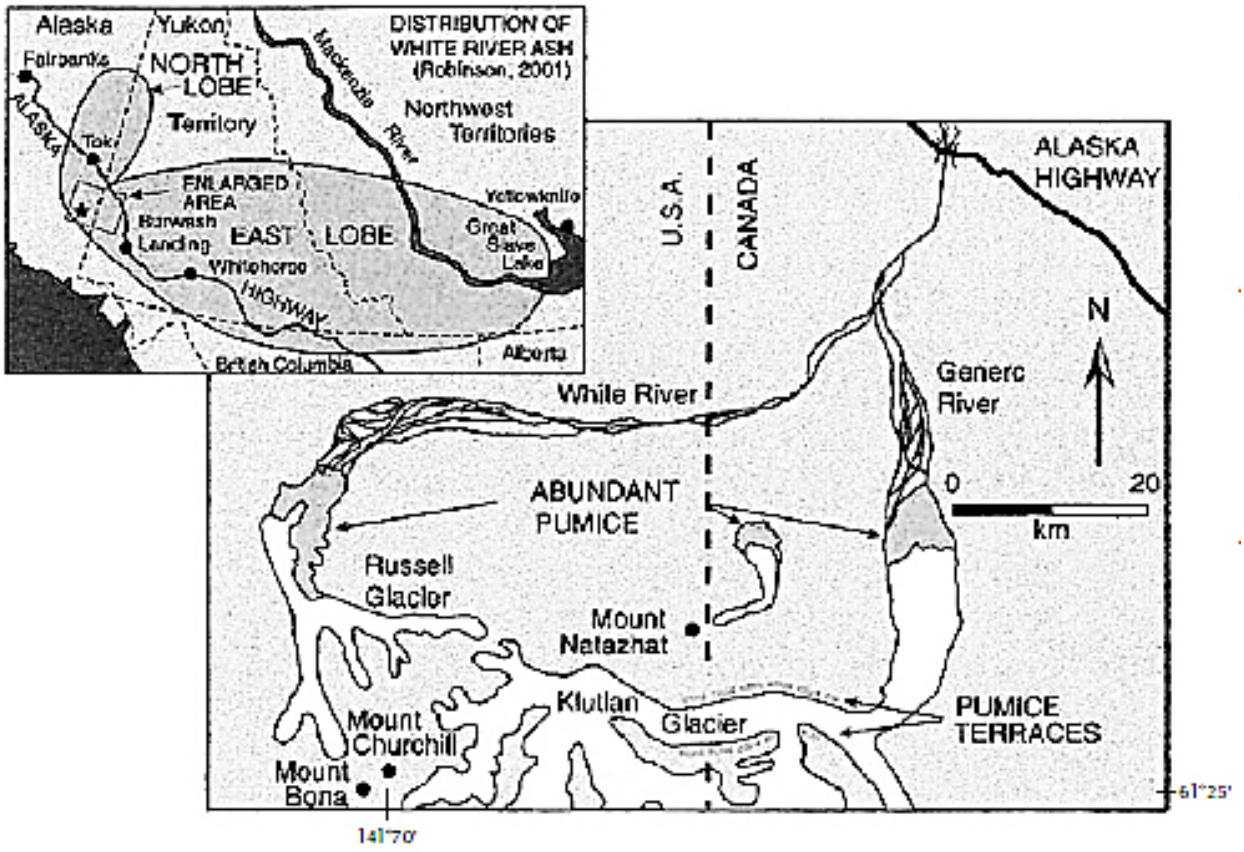
Bedrock Geology

There are no bedrock outcroppings in this Ecosection.

Surficial Geology & Glaciation

The Klutlan Glacier advanced to its post-McConnell maximum after the fall of White River ash (Rampton 1970). Work done elsewhere in the St. Elias Mountains suggest that alpine glaciers reached their maximum extent in the early to mid-1700s during the 'Little Ice Age,' (Reyes, et al. 2006). Distinct breaks in this Ecosection suggest the existence of six terminal moraines. Since advances eradicate older features, the ages of the remaining terminal moraines increase toward the terminus. It appears that the Klutlan is a surging glacier. The moraines then are formed in pulses, the most recent of which occurred between 1960 and 1963 (Rampton 1970).

White River ash blankets stagnant ice at the lower part of this Ecosection. This ash is not an original air borne deposit, but has been reworked by glacier ice and flowing water (Rampton 1970). This is supported by observations of layering in the ash and material depths greater than one metre. Ash has insulated the ice from complete decay and has permitted the development of soils and vegetation over glacial ice, creating a unique ecosystem. This situation also occurs to the west, on the terminus of the Natazhat Glacier. It occurs in Wrangell-St. Elias National Park on the Russell Glacier, though the source of ash is most likely from the earlier eruption.



27: Volcanic ash and coarser lapilli insulates stagnant terminal glacial ice on the Russell, Natazhat and Klutlan glaciers, creating conditions for the development of unique ecosystems.

Ecosystems

The development of vegetation follows the age sequence of the moraines, from south to north or youngest to oldest. Following the work on moraine aging by V. Rampton, a detailed plant succession study was undertaken by H. Birks in July 1971. Plant communities were described from the southernmost, or youngest moraine, where there was no plant growth at the time of the inventory, through earliest colonizing herbs, such as Dwarf Hawksbeard (*Crepis nana*) on material exposed 2-6 years, through shrub phases between 24-58 years, and White spruce beginning at 58 years to old growth White Spruce forest on the Harris Creek Moraine adjacent to the open Generc River (Birks 1979).

This unique ecosystem was first described in National Geographic in 1892, having been observed by C.W. Hayes in 1891 on an expedition through the area on a route from Selkirk up the White River to Skolai Pass. The First Nations' name for the glacier, as well as Mount

Natazhat, was recorded by Hayes on this trip (Coutts 2003). Hayes surmised correctly that the eruption was a few hundred years prior, sourced near the source of the Klutlan Glacier, and was the first to map the fall-out plume (Hayes 1892).

Near the end of the moraine erosion has subdued the rugged terrain somewhat, but many steep sided depressions are still present; some with ice walls, exposed ash, or ponds. Open to dense White Spruce forests form the dominant vegetation, with shrubby understories and thin Feathermoss carpets. In some places, melting ice has resulted in large slumps, with abundant forest debris in the depression. Moss mats and leaning trees overhang the ice wall at the edge of the remaining intact forest. Alder and Labrador Tea are the dominant shrubs and also form closed stands on many slopes.

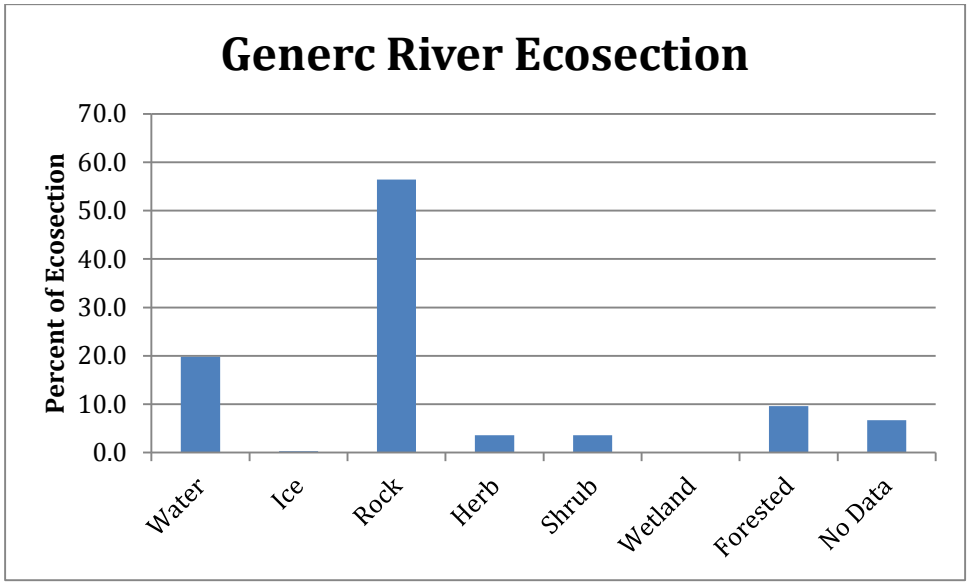
Water and Wetlands

Thermokarst ponds are common. On decay sites were the melting ice has not broken the overlying ash and till layer, small sedge wetlands occur. The Ecosection is drained on the east by St. Clare Creek and to the west by the beginnings of the Generc River.

28: An insulating layer of volcanic ash and till slows the melt of stagnant ice, meanwhile supporting an open White Spruce forest.

3.16. Generc River Ecosection

Summary



Physiography

The Generc River is 808 m asl. at its confluence with the White River. The Ecosection is up to 1021 m asl. on the valley sides included in the unit.

Bedrock Geology

There are no bedrock exposures in this Ecosection.

Surficial Geology & Glaciation

Harris and St. Clare creeks run parallel to each other as they enter the Generc River. These streams occupy glacial meltwater channels that were created during the maximum advance of the Klutlan Glacier following the McConnell Glaciation. Between these channels is the easternmost remnant of the Harris Creek Moraine. These moraines contain remain ice-cored and, while insulated by debris, have ongoing evidence of decay in the form of active slumping (Rampton 1970). The moraines are not covered with ash, and so post-date the eruption. Dating of trees and other organics suggest that the age of this moraine is 800 to 1000 year B.P. The river channel is braided, with a wide exposed active and inactive floodplain.

Ecosystems

Most of the lowest part along the river channel is bare sand and gravel. Vegetation is sparse, consisting mainly of scattered shrub-height Poplar (*Populus balsamifera*), scattered Soapberry (*Shepherdia canadensis*), the groundshrub *Dryas drummondii*, the grass *Hordeum jubatum*, and several forbs, of which Locoweed (*Oxytropis sericea*) is the most abundant.

Back about 400 m from the main channel of the river, and several meters above the current water level, sands and gravels still dominate the site, but vegetation is somewhat greater, consisting of scattered low Poplars, low willow, more Dryas drummondii, and a number of forbs, with Locoweed again being most abundant.

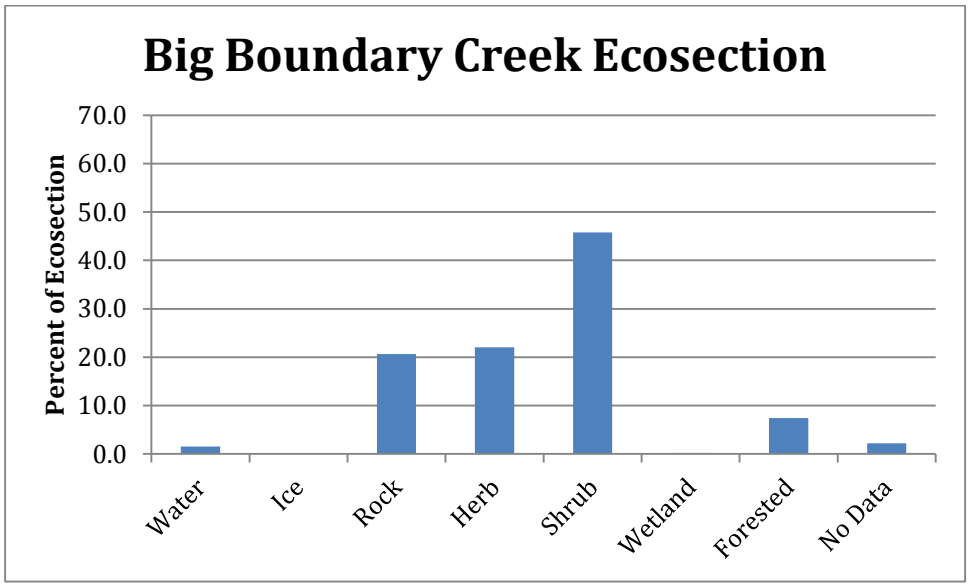
The oldest part of the floodplain, farther from the river and above the seasonal flood level, supports more Poplar saplings, much more Dryas drummondii, Locoweed and other forbs, and various terricolous mosses.

Water and Wetlands

This Ecosection is dominated by the braided channels of the Generc River.

3.17. Big Boundary Creek Ecosection

Summary



Physiography

This unit is comprised of the morainal portion of the glacially carved White River valley bottom. Its elevations range from 962 m asl. to 1835 m asl.

Bedrock Geology

The only bedrock exposure in this Ecosection is the prominent stepped ridge between Big Boundary and Brooke creeks near the Generc River. While the steps are comprised of till, the small outcropping is comprised of lava, either basalt or andesite.

Surficial Geology & Glaciation

Coarse ash blankets this Ecosection and has been reworked in many places by flowing water, with deposits locally many meters in depth. The ash overlies morainal till from the large White River valley glacier and more recent terminal moraines of the Natazhat Glacier.

> Hayes 1892 in National Geographic: From the divide the upper White River valley was seen stretching forty miles to the westward, and appeared almost completely covered with drifts of snow. On reaching the valley the drifts proved to be tufa, which forms a deep mantle over the country north of the St. Elias mountains, and for twenty miles west of the Klutlan forms a desert of drifting snow-white sand into which one sinks from four to twelve inches in walking.

Ecosystems

Open to dense medium height Shrub Birch dominates most of the area, with low shrubs and ground shrubs such as Blueberry and Crowberry, scattered forbs, and a ground cover of Feathermosses and various lichens. Tops and upper slopes of hills also support White Spruce trees scattered throughout the shrub stands. Open White Spruce forests also occur in other parts of the area, of similar species composition but with denser tree cover.

Less well-drained areas on lower slopes and along creek channels support scattered Shrub Birch, willow, and Shrubby Cinquefoil, groundshrubs such as Crowberry and dwarf Willow (*Salix reticulata*), graminoids, and variable amounts of mosses such as Drepanocladus spp., Aulacomnium spp., and sometimes Sphagnum spp. Lichens are generally sparse to absent. Wetter sites along creeks support stands of mainly sedges and other graminoids.

The ash deposits are sparsely vegetated, with species such as Kinnikinnick, various forbs, grasses, mosses and lichens. *Rumex beringensis*, new to Canada, was collected in this area, as well as elsewhere on ash deposits.

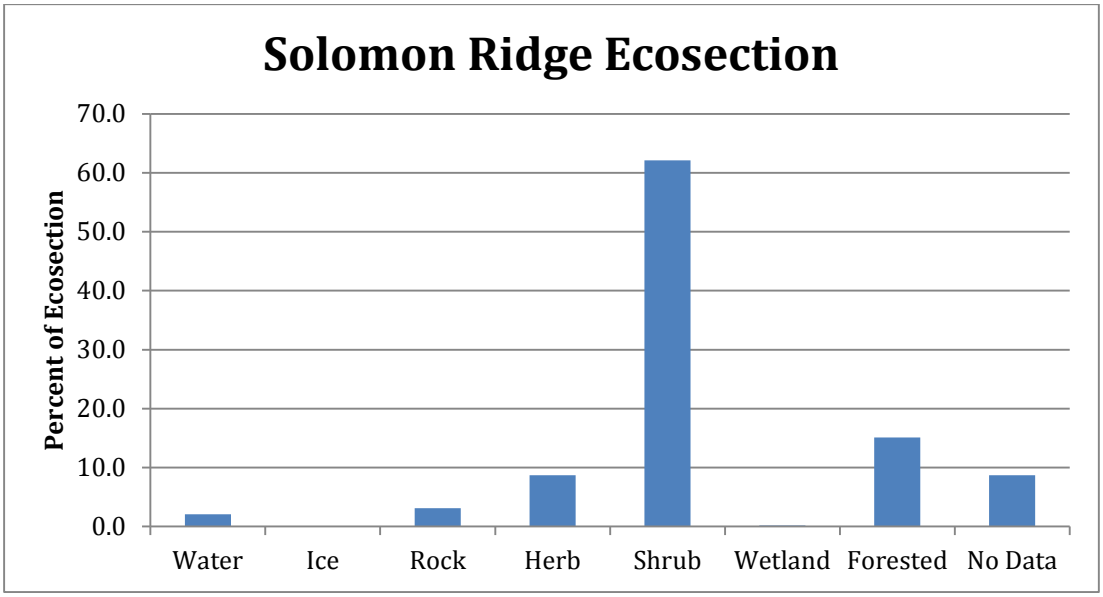
Water and Wetlands

Big Boundary Creek flows out of the mountains and is restricted from flowing northward by the large lateral moraine deposited alongside the glacier that occupied the White River valley during the McConnell glaciation. Yet, its northeasterly flow was blocked at some point causing it to abruptly turn northwest without any obvious barrier. It is likely that this deflection occurred in response to the Klutlan Glacier at some point following the McConnell glaciation. A small tributary to the creek from the south and other streams and ponds on terraces west of the Generc River occupy meltwater channels formed adjacent to the Klutlan Glacier.

29: Ash deposits, such as this one northeast of Big Boundary Lake, have been reworked by flowing water and exceed four meters in depth.

3.18. Solomon Ridge Ecosection

Summary



Physiography

This Ecosection is 816 m asl. at the White River, and is punctuated by three bedrock ridges immediately south of the White River, of which Kletsan Hill is highest, reaching 1431 m asl.

Bedrock Geology

This Ecosection is blanketed in till overlain by a deep layer of ash. The three bedrock outcroppings, from west to east are Kletsan Hill, comprised of comprised of lava, either basalt or andesite; Solomon and Slaggard ridges are also of volcanic origin, but older. They may include pillow lavas and flows, interbedded with other intrusive rocks, such as greenstone and greywacke, with some sedimentary layers such as limestone.

Surficial Geology & Glaciation

Coarse ash blankets the level portions of this Ecosection. It overlies morainal till from the large White River valley glacier and, northeast Slaggard Ridge, stream sediments from the Generc and White rivers.

Ecosystems

In the northern portion of this ecodistrict, between the White and Generc Rivers just south of their confluence, numerous small creeks drain most of this area southeastward into the Generc River from higher ground along the west side and along the base of Slaggard Ridge in the south. About 20 small lakes and ponds are scattered throughout. Conspicuous features of this area are the many shallow, linear runnels which alternate with level, slightly higher ground. Toward the southern part of the area, low hills parallel the base of Slaggard Ridge, with small creeks and wetlands lying between them. Open all-aged White and Black Spruce forests, to 10 m or somewhat more in height, with an open shrub understory underlain with a carpet of feathermoss, dominate the higher, moderately well-drained areas between the runnels. Down and standing dead trees with branches still intact are common. The north-facing slope of Slaggard Ridge, as well as some of the low hills along the west side of the Generc River support dense White Spruce-Deciduous forests

The southern portion of the ecodistrict is bounded on the north and northwest by Slaggard Ridge and Kletsan Hill. To the south it extends past Big Boundary Creek as far as the Big Boundary Lake area. Open White Spruce is the dominant vegetation, with canopy cover to 25% in places, and heights to 10-15 m. Forests are all-aged, have an open shrub layer of mainly Shrub Birch, and a continuous Feathermoss carpet. In the central depressional sites and partway up the surrounding slope, dense low Shrub Birch with a moss understory of Rhytidium rugosum forms the dominant cover, with occasional scattered White Spruce. In the wettest parts of the depression, sedges and dense low Willow dominate.

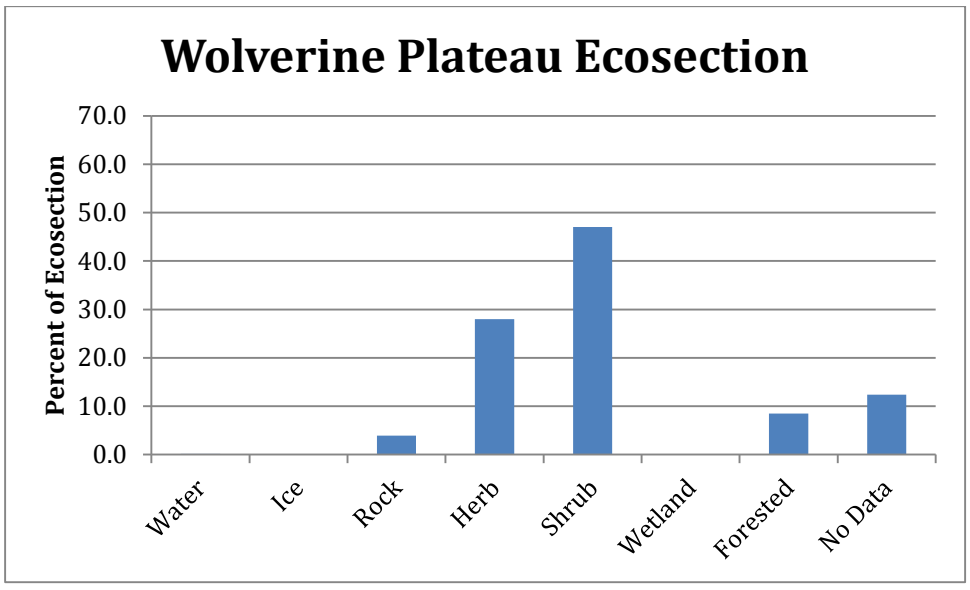
Exposed volcanic ash deposits support mats of Kinnikinnick (*Arctostaphylos uva-ursi*), various forbs, lichens, and mosses.

Water and Wetlands

This Ecosection has numerous small lakes. Many have shallow water with emergent vegetation such as pond lily (Nuphar sp.) and are fringed by sedges, horsetails and other forbs. The runnels support graminoid marshes dominated by sedges and scattered low Shrub Birch and sometimes Willow.

3.19. Wolverine Plateau Ecosection

Summary



Physiography

The Wolverine Plateau rises 1000 m from the Donjek Valley to the east at 913 m asl. to a high point of 1954 m asl. It has a mean elevation of 1468 m asl.

Bedrock Geology

The Wolverine Plateau is separated from the high mountains to the south by a secondary fault that runs south of Bull Creek toward the Donjek River at the confluence with Cement Creek. The plateau is an anticline, comprised of St. Clare Province volcanic rocks, folded along its length. Rocks include basalt to andesite flow lavas, ash flows, tuff along with volcanic sandstone and conglomerate. Cross-sections of the rock layers can be seen along the scarp overlooking the Teepee Valley (Souther and Stanciu 1975).

30: Rocks underlying the Wolverine Plateau are exposed to the north, overlooking the Teepee Valley.

Surficial Geology & Glaciation

The plateau rises up steeply from the valley floor to over 2000 m, and is about 6-8 km wide from north to south. Ridges on the plateau generally have rounded crests, while those farther south are rocky and rugged. Valleys are V-shaped, with moderate to steep slopes. Solifluction lobes, frost boils, and stone stripes are common features. South of the plateau, steep slopes, high rocky peaks, hanging glaciers, and cirques are common features. Most of the plateau surface is colluvial, with some fluvial deposits in small basins or adjacent to former glaciers. Bedrock exposures are extensive, particularly on the scarp along the northeast side of the plateau.

Ecosystems

Mountain Avens (Dryas spp.), Mountain Heather (*Cassiope tetragona*), and patches of gravel and bare ground dominate the upper and north-facing slopes of ridges, with dwarf Willows (Salix spp.), graminoids, forbs and mosses on moist, hummocky, lower slopes. Dry south-facing slopes support a mix of groundshrubs, graminoids, and forbs, interspersed with patches of gravel and bare ground and

occasional small detachment slumps. A diverse mix of forbs occurs in small, moist, meadow-like depressions on the slopes.

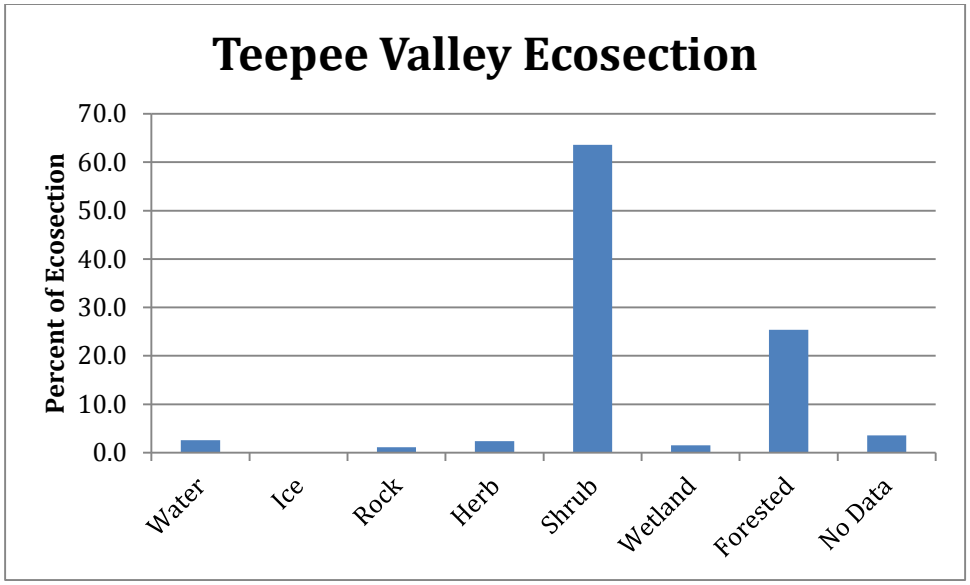
Vegetation along creek floodplains consists of open willows and scattered forbs and grasses. Scattered medium height willows, Dryas spp., grasses and forbs, grow on the lower slopes of eroded ridges. On seepages adjacent to floodplains are clumps of medium height willows, along with Dwarf Willow (*Salix reticulata*), sedges, grasses and forbs, form the dominant vegetation.

Water and Wetlands

There are a handful of ponds on the Wolverine Plateau. Streams such as Wolverine and Bull creeks and their tributaries are actively downcutting the plateau. Level areas support a few small and poorly developed sedge fens.

3.20. Teepee Valley Ecosection

Summary



Physiography

This Ecosection is 770 m asl. at the Donjek Valley and is mapped as high as 1372 up the slopes of the Kluane Ranges and Wolverine Plateau. Teepee Lake is approximately 1040 m asl.

Bedrock Geology

There are no outcroppings of bedrock in the Teepee Valley.

Surficial Geology & Glaciation

At times during the McConnell glaciation, the Teepee Valley was filled with ice. It is now blanketed with Quaternary sediment, that is, glacial till. On the north margin of the valley, at the north edge of Teepee Lake is a surface that is described as a lacustrine (lake) deposit from the time of the McConnell glaciation. Given that this valley, parallel to the mountain ranges, is bounded at both ends by larger valleys perpendicular to the mountains, it is likely that during times of glacial advance in the Klutlan and Donjek valleys that the Teepee Valley was ice free and flooded by temporary glacial lakes. Overlying glacial tills are fluvial deposits that have been washed off of the Kluane Range to the northeast and the Wolverine Plateau to the southwest.

Where Wolverine Creek enters the Teepee Valley a large alluvial fan has formed. Underlying the fan is glacial till. The surface material is largely ash that has been relocated by water from the high country to the south. The effects of permafrost and the buoyancy of the ash have resulted in a unique low angle fan with a runnel drainage pattern on the surface. At some point in recent history, the Wolverine Creek abandoned its route through Teepee Lake and Harris Creek, and cut a channel to the southeast into the Donjek Valley.

Ecosystems

The tops and upper slopes of the low hills support open White Spruce, usually with an understory of Shrub Birch, Blueberry, and Labrador Tea, and a well-developed Feathermoss layer. Lower slopes have less tree cover or none, and support Shrub Birch and Blueberry, with a hummocky moss layer.

The many runnels and seepage sites are dominated by wet tussocky Sedges and Rushes, and scattered Shrub Birch. Areas between the runnels are slightly higher and very hummocky, and support Shrub Birch, Blueberry, and various mosses. Large Sedge marshes are found in drained pond basins, and a closed Willow/Sedge swamp was noted in a poorly drained site.

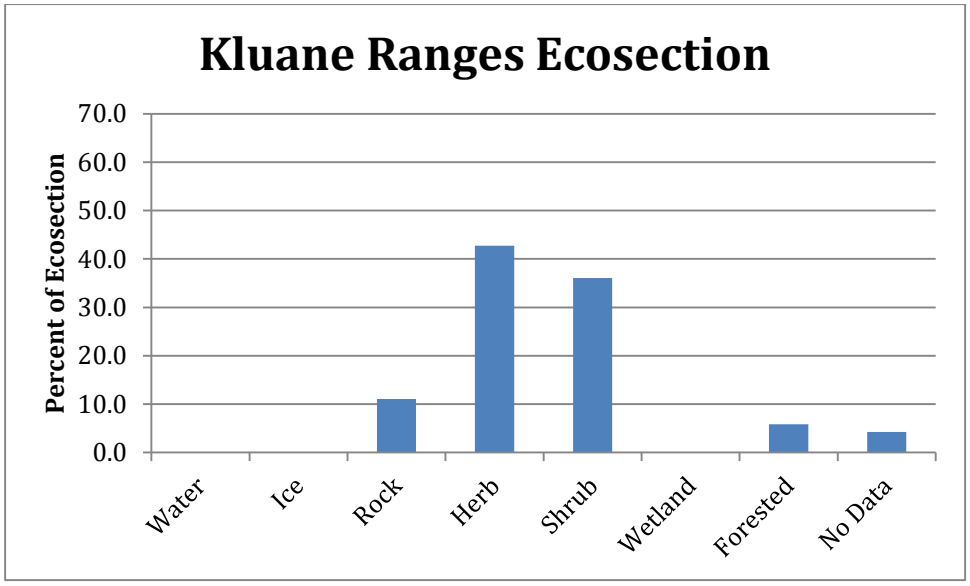
Water and Wetlands

The Ecosection is drained to the southeast by Wolverine Creek, which flows into the Donjek River, and to the northwest by Harris Creek, a tributary of the Generc River. There are many small

creeks, ponds and lakes, some drained ponds, and irregular-linear wetlands in the many seepage tracks and runnels seen on the gently sloping fans and throughout much of the valley.

3.21. Kluane Range Ecosection

Summary



Physiography

The Kluane Ranges Ecosection is mapped down into the Teepee Valley as low as 927 m asl. Its highest point is 2291 m asl. at Teepee Peak, followed closely by Lynx Peak, 3 km to the south.

Bedrock Geology

The northern half of the Kluane Ranges, north of Harris Creek and east of the Generc River is comprised of volcanic rock, known as the Harris Creek Batholith. These rocks are mostly a granitic rock called diorite (Isreal and Cobbett 2007). Older rocks overlying the Harris Creek Batholith on the east side of the Generc and White rivers confluence are Wrangellian rocks of the Station Creek formation, mostly volcanic breccia and tuff (Israel and Cobbett 2007). East of the White River fault are sedimentary rocks of the Hasen Creek Formation. These rocks are deeply incised by streams and contain one or more large slope failures. Southeast of Teepee Lake, the Kluane Ranges are comprised of older volcanic rocks of the Wrangellian Nikolai Formation. These basaltic rocks are dominated by greenstone, with occurrences of conglomerates and other weathered volcanics.

Surficial Geology & Glaciation

These mountains rise to over 2000 m in elevation, with steep slopes, many cirques, and rounded and narrow rocky ridges. Solifluction lobes, frost boils, and hummocky ground are common features in the alpine. The south-facing slopes along the Teepee Lake valley rise up steeply from the valley floor, with many rocky outcrops on the slopes. Colluvial aprons and alluvial fans are common at their bases.

Ecosystems

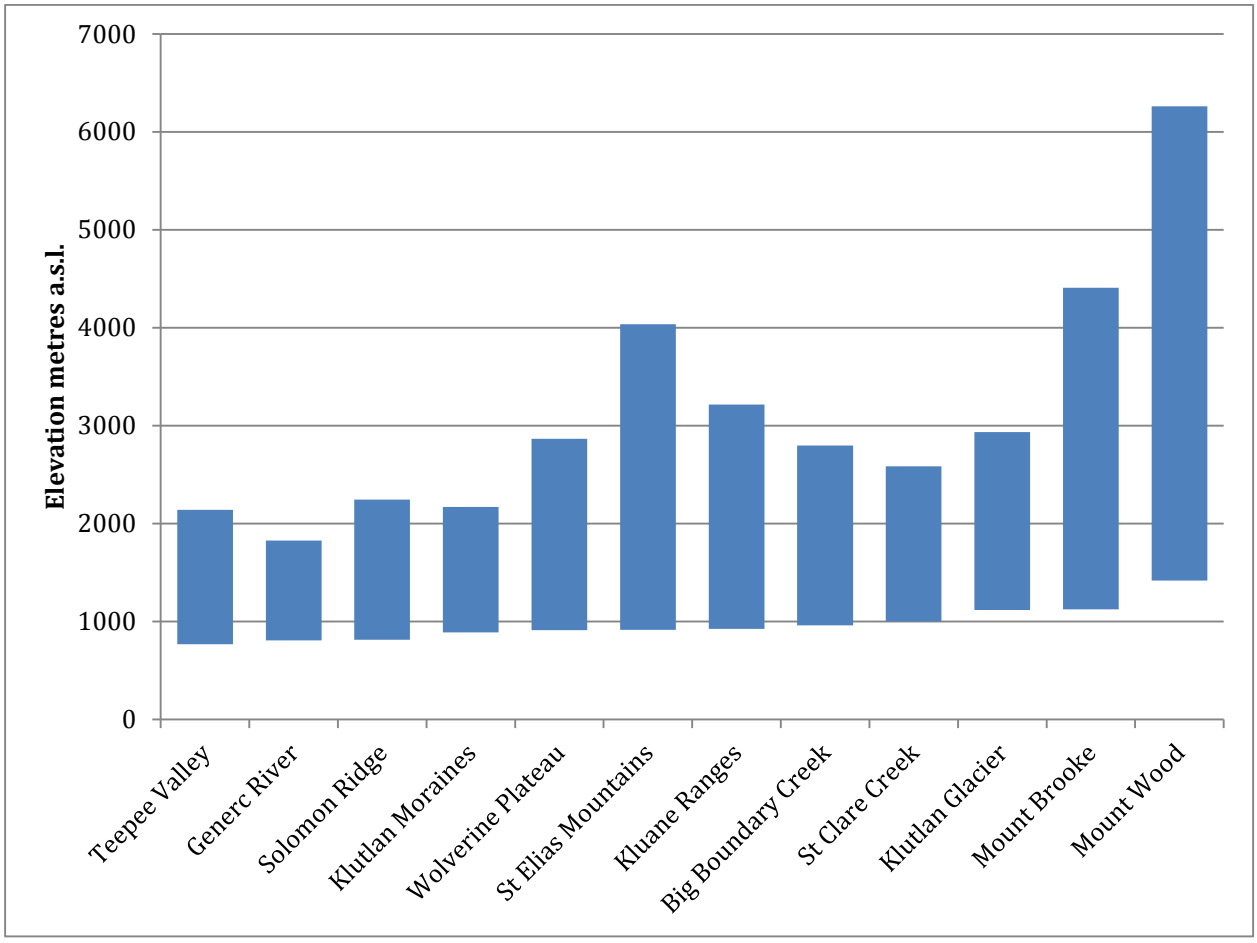
The northwestern portion of the ecosection, contains alpine ground shrub and low shrub communities on slopes and rounded ridgetops. Gently-sloping and concave areas on the alpine tundra, at about 1425 m, support low Shrub Birch and Blueberry, with willow associated on moister sites. Groundshrubs and mosses are abundant below the shrubs. On north-facing slopes, where deep snow accumulates and melts late in the growing season, Mountain Heather (*Cassiope tetragona*) is the dominant groundshrub. Subalpine shrub types occur on upper slopes facing the Teepee Lake Valley. Downslope at about 1397 m, low and medium Shrub Birch, Blueberry, and willow, with a well-developed moss layer, dominates the southwest facing subalpine slope. Below the subalpine zone, beginning at about 1380 m, is open White Spruce forest with understories of Shrub Birch, Blueberry, and mosses. The slope levels off farther down, becoming an undulating plateau dominated by open White Spruce forests. Several large wetlands occur in depressions on the plateau, supporting stands of Willow, Shrub Birch and Willow, and sedges.

The southeastern portion of the ecosection includes the south-facing mountain slope from the alpine zone at 1978 m, downslope to about 1129 m near the Teepee Lake Valley floor. Large rocky outcrops and stony patches are common on this slope. The upper slope supports extensive low alpine Sedge, Mountain Avens (Dryas spp.), Dwarf Willow (*Salix polaris*), and patches of moss, on slightly higher ground between narrow, shallow, stony drainage runnels and patches of stony soil. A band of low and medium height willow, Shrub Birch, Blueberry, and scattered White Spruce, dominates the subalpine zone, at about 1337 m. Kinnikinnick and the grass Festuca altaica are prominent on drier parts of the slope. The boreal zone on the mid and lower south-facing slopes supports open to dense forests of White Spruce with a well-developed Feathermoss carpet. A stand of closed low Poplar and Aspen was documented on the steep lower slope. Many trees in the stand have scars from rockfall from outcrops above the site.

Dominant vegetation on the high alpine ridges is Mountain Avens (Dryas spp.) and lichen, with patches of stony ground. On the adjacent north-facing slope, Mountain Heather (*Cassiope tetragona*) and Mountain Avens share dominance. On the south-facing slope below the crest, Mountain Avens gives way to a mix of dwarf willows, sedges and various forbs, and farther downslope to a sedge and forb meadow.

Water and Wetlands

Small streams drain the Ecosection to the Teepee Valley to the southwest and to the Koidern River on the northeast. There are no wetlands in this Ecosection.


Elevation metres a.s.l.
7000
6000
5000
4000
3000
2000
1000
0
Teepee Valley
Generc River
Solomon Ridge
Klutlan Moraines
Wolverine Plateau
St Elias Mountains
Kluane Ranges
Big Boundary Creek
St Clare Creek
Klutlan Glacier
Mount Brooke
Mount Wood

4.22. Plants

An inventory of vascular plants was undertaken in 2004 (Bennett 2005). A comprehensive list of the plants has been assembled, along with information on the distribution and conservation status. In total, 328 species have been identified within the park. A plant located alongside ponds and in moist areas growing on ash west of Big Boundary Lake known as Bering Sea dock (*Rumex beringensis*) is the only known occurrence of this plant in Canada. It is the easternmost extension of its range. A second plant observed in 2004 is a new record for Yukon, *Arabis lyrata*. Some plants in Asi Keyi NEP are endemic to the region, with a global distribution restricted to central Alaska and Yukon. This includes Gorman's dwarf primrose (*Douglasia gormanii*), found occasionally in the alpine throughout the park, and Scorpion-weed (*Phacelia mollis*) found in the subalpine and boreal on open gravel and ash.

Along with the Tombstone Park area in the South Ogilvie Mountains and the Richardson Mountains in northern Yukon, Asi Keyi NEP is a centre for plants associated with Beringia. This includes species such as Northern Kitten-tails (*Synthyris borealis*) and Forget-me-not (*Myosotis alpestris*). Further study is likely to find additional species as there are 191 plant species known within 50km of Asi Keyi NEP that were not observed prior to or during the 2004 inventory.

31: Asi Keyi NEP is a hot spot for plants related to Beringia that are at the southeastern edge of their range. An example is Northern Kitten-tails (*Synthyris borealis*) which is found in rock alpine sites.

32: Scorpion Weed (*Phacelia mollis*) is one of a handful of plants that have a global distribution that is restricted to Yukon and Alaska.

33: Bering Sea dock (Rumex beringensis) is an example of a Beringian plant. It is known in Canada only from the ash rich lake margins west of Big Boundary Lake.

4.23. Fish

Asi Keyi NEP is within the Yukon River basin, and so the assemblage of fish species expected in the park will be a subset of those known for the basin. There have been no studies of fish species or populations within Asi Keyi NEP. A list of fish species known for the interior of Wrangell-St. Elias National Park and Preserve, combined by a list from the upper Yukon River basin comprise Table _ and are suggestive of the species likely found within the park ( ). It is presumed that the silt load in the White and Generc Rivers, along with the Donjek to the east, would be limiting to anadromous fish, those salmon that migrate to the sea. There are no known reports of salmon species within the park.

Species likely to be found in Asi Keyi NEP, compiled from a list of fish known within Wrangell-St. Elias, and from Yukon Freshwater Fishes (Environment Yukon 2010) include:

- Lake trout
- Lake whitefish
- Round whitefish
- Arctic grayling
- Northern pike
- Burbot
- Longnose sucker
- Slimy sculpin
- Lake chub
- Inconnu

4.24. Large mammals

A wildlife survey in 1951 by A.W.F. Banfield of the Canadian Wildlife Survey is the first known, and last reported comprehensive wildlife survey that includes Asi Keyi NEP. Banfield's summer route "led up the Donjek River, Wolverine Creek, Teepee Lake, St. Clare River, Klutlan Glacier, White River, and the highway was reached again via Edith Creek" (Banfield 1959). While conducting botanical surveys during the summers of 1965-1968 in the St. Elias Mountains, B.M. Murray and D.F. Murray made incidental recordings of wildlife. Two of their sites are adjacent to the Steele Glacier, just south of Asi Keyi NEP, while three sites were west, the nearest being the Guerin Glacier, which flows directly north from Mount Natazhat. Their observations are mostly of large mammals, though they made detailed observations of Arctic Ground Squirrels and notes Singing Voles (Murray and Murray 1969). Considerable work has been done on wildlife in Kluane National Park and Preserve, some of which includes portions of Asi Keyi (Gray 1987). A recent paper has been prepared for Asi Keyi NEP on mammals within the park (Slough and Jung 2009). The report describes mammals known and likely to be in the park, includes discussion of species' conservation status and makes a number of management suggestions. While not well studied, the mammalian fauna of this area is diverse and is considered to be analogous to the steppe environment of much of Europe and Beringia during the last glacial age (Geist 1977).

With the exception of caribou, survey data is limited for large mammals, and even less study has focused on small mammals. Over half of the 37 species of mammals thought to be within Asi Keyi have not been

observed within the park, while an additional 12 species are hypothetically possible. Their listing as 'confirmed,' 'probable,' and 'hypothetical' is based on survey records, species range mapping and expert opinion (Slough and Jung 2009). As with other biota, such as plants, the authors note that:

> Danby (2003) reviewed the bird and mammal species richness of the St. Elias Mountain parks and concluded that, as a biogeographic convergence zone (arctic, boreal, cordilleran, coastal ecosystems, as well as Beringian species); it had a particularly rich fauna. However several southern immigrant and Beringian species remain unverified for Asi Keyi Territorial Park. Several species occur at their northern, southern or western limits of range. (Slough and Jung 2009, p6).

Management suggestions include species useful to monitor as indicators of ecosystem health, baseline inventory, measures important for maintaining healthy populations, and specific requirements of species or their sensitivity to human activity.

Chisana Caribou Herd:

From 1976 to 1978 the Kluane National Park and Preserve Warden Service surveyed caribou on either side of the Klutlan Glacier, in what was then called the St. Clare Herd (Gray 1987). Subsequent work recognized these groups as part of the Chisana Caribou Herd, a relatively small woodland caribou herd. It ranges west past its namesake river in Wrangell-St. Elias National Park and Preserve and into Yukon west of the Donjek River. The Wildlife Key Areas program identifies key habitat for woodland caribou as those habitats used for winter range, fall rut and migration corridors (Environment Yukon 2009d). The Chisana Herd has three centres of winter range. The first is in the Harris Creek and lower St Clare Creek valleys, or the Teepee Valley and St. Clare Creek ecosections. The second is immediately west of the Klutlan and covers most of the Solomon Ridge and Big Boundary Creek ecosections. The third is in Wrangell-St. Elias National Park, also on the plains south of the White River (T. Hegel, pers com). These habitats, in addition to the surrounding uplands are key habitats during the fall rut (Environment Yukon 2009b).

34: The Chisana Caribou enclosure operated from 2003-2006. A total of 136 calves were reared here, being released in June when they were capable of outrunning predators.

Woodland caribou are vulnerable to human activities, such as roads, through increased access to hunting and vehicle mortality, and through habitat loss through logging, mining, agriculture and urbanization. Woodland caribou in Canada have been grouped by distribution and behavior into five populations from Newfoundland to Yukon. The Chisana caribou herd is part of the Northern Mountain Caribou population. Following the recommendation by COSEWIC in 2002, this population has been designated as a species of 'Special Concern' through the *Species at Risk Act* in 2005. As a requirement of the Act, a management plan has been prepared for Northern Mountain Caribou (Environment Canada 2012). Asi Keyi NEP contributes to the management of this population through plan objective #6: "Manage and Conserve important habitats to support caribou herds." In addition to this population-wide management concern and plan, a decline in the Chisana caribou herd was documented from a high of 1900 animals in 1988 to an estimated 312 animals in 2002 (Chisana Caribou Herd Working Group 2012). An innovative approach to increasing herd numbers was undertaken within Asi Keyi from 2003-2006. In late winter, pregnant cows were live captured and placed in a large pen adjacent to Big Boundary Lake. By early June, when calves were strong enough to outrun predators the cows and calves were released. A total of 136 calves were released from the pen, assisting in slowing or halting the decline (Chisana Caribou Herd Working Group 2012).

In addition to the predation of young calves, habitat limitations are thought to have potential to impact the herd. Possible factors are severe winter weather and high later winter snow, uptake of ash and resultant premature tooth erosion, and limited high quality lichen. An attempt was undertaken to map lichens preferred by caribou through the Canadian portion of the range. The study found that the herd's range is low in 'caribou lichen' resulting in caribou relying on Foam lichens (*Stereocaulon* spp.), which are

considered to provide a poorer nutritional benefit (Clarke and Waterreus 2011). An inventory of lichens in the Sheep Mountain area to the southeast of Asi Keyi was undertaken in conjunction with Dall's sheep studies (Heofs and Thompson 1972). Ecosystem plot work in 2004 within Asi Keyi included the identification of lichens by botanists Rhonda Rosie and Greg Brunner. Monitoring of this herd, and other management activities, will continue with participation from First Nations, national parks, and governments of Alaska and Yukon.

35: Upon release from the compound, cows and their calves headed south to spend summer months in the alpine.

The historic range of the Fortymile Caribou herd extends southward to the Kluane Ranges within Asi Keyi, the lower Generc River and possibly the Solomon Ridge area south of the White River (McDonald 1991). This is confirmed by Clark (1943) who reported the occurrence of 'Stone's Caribou' in the Kluane Game Sanctuary in the winter of 1936-1937 (in Banfield 1959).

Moose: Key habitat for moose in southern Yukon is considered to be those areas used in late winter, when movement and access to shrubs becomes limited by deep snow (Environment Yukon 2009d). The Teepee Valley and Solomon Range ecosections conform closely to the Wildlife Key Areas mapping of key

moose habitat (Environment Yukon 2009c). These areas have open White spruce forests with considerable shrub understories, along with streams and wetlands where shrubs will be available. The dense shrub communities on, and adjacent to, the terminus of the Klutlan Glacier has been observed to be used as winter habitat by moose (Geist 1977).

36: A large bull moose feeding on aquatic vegetation in the Harris Creek valley.

In summer months, moose feed on a wide range of plant material including aquatic vegetation. In winter they browse on willow, aspen and shrub birch.

Thinhorn sheep have been observed in greatest number in the St. Elias Ranges and Kluane Ranges ecosections. They are also observed in the Mt. Brookes Ecosection facing the Klutlan Glacier and the Wolverine Plateau (Environment Yukon 2009a). Their distribution appears to be related to bedrock geology as they show preference for basaltic flows and associated rocks over granitic intrusive rocks. While the Mount Wood Ecosection has not been surveyed for sheep, it is expected that the extensive ice and heavy snow load is limiting to sheep in this alpine region. The eastern portion of the park was surveyed for sheep most recently in 2011. Rapid sheep population declines have been observed in Alaska and south of Asi Keyi following severe winters, particularly the winter of 1981-1982 (Sumanik

1987) and to the west in Wrangell-St. Elias National Park and Preserve (Terwilliger 2005). It is likely that the sheep within Asi Keyi are similarly affected. The most detailed study of sheep in the region was undertaken by Manfred Hoefs beginning in 1969 at Sheep Mountain within Kluane National Park and Reserve. One of the key observations is that subarctic sheep populations are under uniformly severe conditions, including extreme weather events and predations, such that the populations are relatively constant at a level below carrying capacity (Hoefs 1984). While proximity to the icefields contributes to relatively cool summer conditions, one benefit to sheep habitat is the finely ground rock dust that is blown off the glacial till and silty river beds. This wind-blown dust, or loess, fertilizes the mountain slopes, creating productive sheep habitat. Densities of sheep in portions of Asi Keyi, such as the Kluane Ranges is high relative to apparently more hospitable habitats in Alaska or British Columbia that are not downwind of this large icefield system (Geist 1977).

37: Sheep in Asi Keyi NEP have not been hunted since the creation of the Kluane Game Sanctuary in 194_. These stately rams were photographed in the Kluane Ranges.

Mountain Goats are found in steep terrain in areas with heavy winter snow. Key habitat identified in the park is centred in the St. Elias Mountains Ecosection in upper St. Clare and Cement creeks (Environment Yukon 2009b). An extensive key area is identified by survey south of Asi Keyi in Kluane National Park and Preserve, southwest of Mount Wood.

Grizzly Bear: The low densities at which Grizzly bears use the land make the identification of key seasonal habitats difficult. The Wildlife Key Areas database lists the foraging habitats along the Generc River at the north of the park, and the terraces adjacent to the Donjek River as important (Environment Yukon 2009b). Observations made from Big Boundary Lake during the spring seasons that the Chisana Caribou

enclosure was operating, suggest that grizzly bear move from the forested lowlands to the subalpine and alpine in the early spring, possibly following the spring movement of caribou (Grant Lortie, pers. com.). Information from radio collared grizzly bears in the Kluane Region up to the eastern boundary of Asi Keyi, demonstrates that the large valleys and adjacent uplands are preferred habitat for family groups and single females (Maraj 2010). These areas have the greatest biological productivity. This confirms the Key Areas Database mapping. Along with Caribou and Wolverine, Grizzly bear have been rated as being of 'Special Concern' by COSEWIC, and 'Sensitive' in the Yukon General Status ranking (Slough and Jung 2009). Grizzly bear have been observed south of Asi Keyi NEP pursuing Mountain Goats and Arctic Ground Squirrels, but aside from opportunistic harvest prey animals, they are largely vegetarian (Murray and Murray 1969).

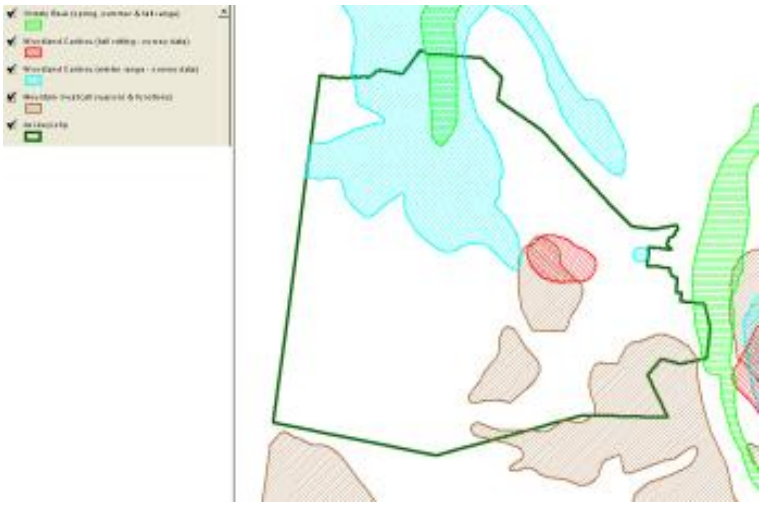
38: Asi Keyi NEP appears to have a healthy population of grizzly bears. In summer they make their living in valleys and the subalpine, where they augment their vegetarian diet with ground squirrels and other carrion.

Wolf

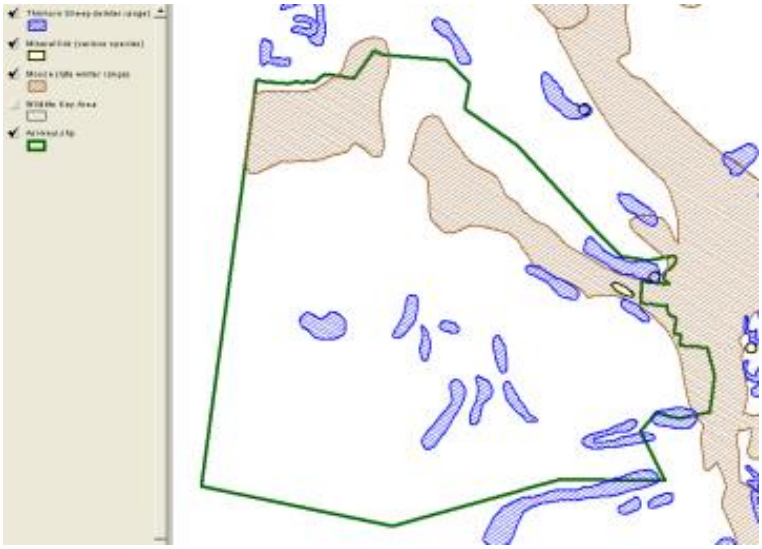
In 1944, A. Murie documented wolves preying on Dall sheep in Mount McKinley Park, now Denali National Park and Preserve (Theberge and Cottrell 1977). In a wolf study in the proposed Kluane National Park, Theberge and Cottrell observed wolf predation on sheep. They also found that wolves at

den sites in this region had a varied and opportunistic diet, that included ungulates, but also smaller available species such as Arctic ground squirrel and other small mammals (Theberge and Cottrell 1977). During Dall sheep research in the Sheep Mountain area of Kluane National Park and Reserve by Hoefs, wolf predation on sheep was also observed (see Sumanik 1987).

The Asi Keyi NEP supports the ranges of approximately five to six wolf packs and a wolf density of approximately 6.7 wolves/1000 km^2 (Sumanik 1987). During this study, carcasses of 14 sheep were located that were utilized by wolves, along with five caribou, four moose, and one horse (presumably a free winter ranging horse in the Donjek River valley). Wolf packs were identified as the Cement Creek Pair, Teepee Lake Pack, Generc River Pack, Donjek River Pack and St. Clare Pair. The Generc River Pack and Teepee Lake Pack were observed to hunt moose, caribou and sheep. While the alpine centred packs focused largely on Dall's sheep. Packs that were sheep focused were smaller (3.2 wolves/pack) than were packs to the northeast and elsewhere in Yukon where moose and caribou are available (Sumanik 1987). It appears that sheep focused packs are only marginally successful, and will seek alternate prey opportunistically.



39: The Wildlife Key Areas database identifies these as key habitats for grizzly bear, mountain goat and caribou.



40: The Wildlife Key Areas database identifies these as key habitats for moose and sheep.

4.25. Small mammals

Small mammals on the list include: six shrews; two bats; two lagamorphs, Snowshoe Hare and Collared Pika; 14 rodents, including North American Porcupine, American Beaver, Common Muskrat, Red Squirrel, Northern Bog Lemming and various voles and mice. There are seven small carnivores, including Red Fox, American Marten, Ermine, Least Weasel and American Mink. Of the mammals that have been observed or are probable in the park no small mammals are listed by COSEWIC. The collared pika is listed by Yukon as being 'Sensitive,' owing to potential range contraction with climate change.

41: This ground squirrel has dug its burrows in till comprised of volcanic source material. Ground squirrels are common from valleys to low alpine areas of the park.

42: A family of foxes has created its nursery dens in volcanic ash that has been redeposited and accumulated by water flowing adjacent to the Klutlan Glacier.

4.26. Birds

Remoteness has limited bird studies in this area. The Birds of the Yukon Territory (Sinclair et al. 2003) includes records from a trip into the Teepee Lakes area by Bob Frisch in 1985, and has records from adjacent areas such as the Burwash Uplands and Pickhandle Lakes. Manfred Hoefs reported on bird sightings from the Sheep Mountain and Slims River area, with a summary of other records for the Kluane region (Hoefs 1973). Observations by Grant Lortie at the Big Boundary Lake Caribou Camp in 2006 and prior, along with observations by Jennifer Line in 2006 and John Meikle in 1995, and 2004-2006 round out the current bird observation record. The bird list for the interior of Wrangell-St. Elias National Park also hints at birds that should be expected in Asi Keyi. These records are compiled in a spreadsheet that accompanies this report.

In the boreal portion of the park, American Robin, Fox Sparrow, White-crowned Sparrow, Dark-eyed Junco, Yellow-rumped Warbler, Gray Jay, Common Raven, Black-billed Magpie and Boreal Chickadee are abundant. Less commonly observed are Common Nighthawk, Three-toed Woodpecker, Northern Flicker, Black-capped Chickadee, Ruby-crowned Kinglet, and Gray-cheeked Thrush. Adjacent to wetlands and in shrubby habitat along streams, Wilson's Warbler, Lesser Yellowlegs, Spotted Sandpiper and Solitary Sandpiper are common. Bohemian waxwings, Violet-green Swallow, Cliff Swallow and other are frequent. In ponds and small lakes, Mew Gull, Common Loon, Green-winged Teal, Scaup sp, and Mallard

are common. In subalpine shrub, White-crowned Sparrow, American Tree Sparrow, Savannah Sparrow, American Robin and Willow Ptarmigan are common. In alpine tundra, Horned Lark, American Pipit, Rock Ptarmigan and Upland Sandpiper are often seen.

43: Numerous forest birds, water birds and waterfowl nest in Asi Keyi NEP. One of the most commonly observed nesting species in lowland forests is the Dark Eyed Junco, pictured here near the Chisana Caribou compound.

44: Horned Lark and American Pipit, pictured, are the most common alpine nesting birds. Nesting behaviour has been observed for Surfbirds and Smith's Longspur.

The following birds have been confirmed to breed in the park: Rock Ptarmigan; White-tailed Ptarmigan; Dark-eyed Junco; Mallard; Mew Gull; American Robin; Horned Lark; Yellow-rumped Warbler; Wilson's

Warbler; White-crowned Sparrow; Common Raven; Long-tailed Jaeger; Surfbird; and Semipalmated Plover.

Uncommon birds observed include: Wandering Tattler, Smith's Longspur, Surbird, Whimbrel and Long-tailed Jaeger in the alpine, Wilson's Phalarope in the lowlying ponds and Blackpoll Warbler in old white spruce forest.

Birds that migrate from Siberia and beyond to breeding grounds in Alaska and Yukon such as Arctic warbler, Northern wheatear should be looked for.

4.27. Insects

As with mammals, plants and other biota, specialists in the various groupings of insects have noted that Yukon, including Asi Keyi, occupy a zone of convergence of Beringian, boreal, coastal and grassland habitats. Given this convergence, and particularly the influence of Beringia, Yukon has a disproportionate percentage of Canada's insect species, with an estimated 6,000 species (Danks et al. 1997). Insects have been studied to the south in Kluane National Park and Preserve (Gray 1987). Findings there and expert opinion on insect ranges may be suggestive of the insects expected in Asi Keyi NEP. The only focused study of insects in Asi Keyi was a brief study of butterflies and moths undertaken in by Gary Anweiler in July 2006. Four days were spent in the alpine of St. Clare and Cement creeks. The year prior, in July 2006, parks staff collected butterflies and some moths in a variety of habitats. Identification of the 2005 collection was completed by Andres Langois. A total of 33 species were collected. Most species are known throughout North America and northern Europe and Russia. One species observed, Margined White, is at the northern edge of its range, while another species, Four-dotted Alpine, is endemic to Alaska, Yukon and northwestern NWT (Anweiler 2006). Two species of butterflies have their type localities in, or adjacent to, Asi Keyi. The type locality for Polixenes Arctic is the Klutlan Glacier area, where it was first collected by Gibson in 1920. The Beringian Fritillary (Boloria natazhati) was also collected by Gibson in 1920 in the alpine north of Natazhat Mountain. It is known into northernmost British Columbia and across northern Canada east to Victoria Island (Troubridge and Wood 1990). Anweiler suggests that the volcanic origin of the rocks in Asi Keyi may limit the numbers of species of macromoths (Anweiler 2006). This may also be the case for butterflies, as species known elsewhere in Yukon are often associated with limestone or other carbonate rocks. One interesting feature of many species of Lepidoptera, such as butterflies in the *Boloria, Erebia* and *Oeneis* genera, in

Yukon, is that they emerge only every second year. This may be due to severe weather events in the past that eradicated an odd or even year cohort of these biennial species (Danks et al. 1997) More extensive study of moths and butterflies that explores subalpine shrub, forests and wetland habitats on even and odd years is likely to uncover many additional species.

Genus species	Common Name	2005	2006
Agriades glandon	Arctic Blue		2
Boloria chariclea	Arctic Fritillary	2	1
Boloria eunomia	Bog Fritillary	1	15
Boloria improba	Dingy Fritillary	4	2
Boloria napaea	Mountain Fritillary		12
Coenonympha tullia	Common Ringlet	1	1
Colias chippewa	Chippewa Sulphur	4	5
Colias hecla	Hecla Sulphur		11
Colias nastes aliaska	Arctic Sulphur	1	
Colias pelidne pelidne	Blueberry Sulphur	1	
Entephria kidluitata			1
Entephria polata			2
Erebia fasciata	Banded Alpine		2
Erebia lafontainei	Lafontaine's Alpine	2	
Erebia pawlowski	Yellow-dotted Alpine		2
Erebia rossii	Ross's Alpine	3	6
Erebia youngi	Four-dotted Alpine	1	2
Lycaena phlaeas	American Copper		2
Oeneis bore	White-veined Arctic	2	7
Oeneis jutta alaskensis	Jutta Arctic	1	
Oeneis polixenes yukonensis	Polixenes Arctic	1	
Papilio machaon aliaskus	Old World Swallowtail	3	
Pieris angelika	Arctic White	4	
Pieris marginalis	Margined White		1
Platarctia parthenos	St. Lawrence Tiger Moth	1	
Polygonia gracilis	Hoary Comma	1	
Pontia occidentalis nelsoni	Western White	3	
Rheumaptera hastata gothicata	Spear-marked Black Moth	2	
Scopula frigidaria			2
Scopula sentinaria			2
Sympistis zetterstedtii			4
Syngrapha ignea			1
Vacciniina optilete	Cranberry Blue	1	2

45The Dingy Fritillary (Boloria improba) is common in alpine habitats in Asi Keyi. A male is shown here, resting on Mountain Avens (Dryas octopetala).

5.1. Recreation

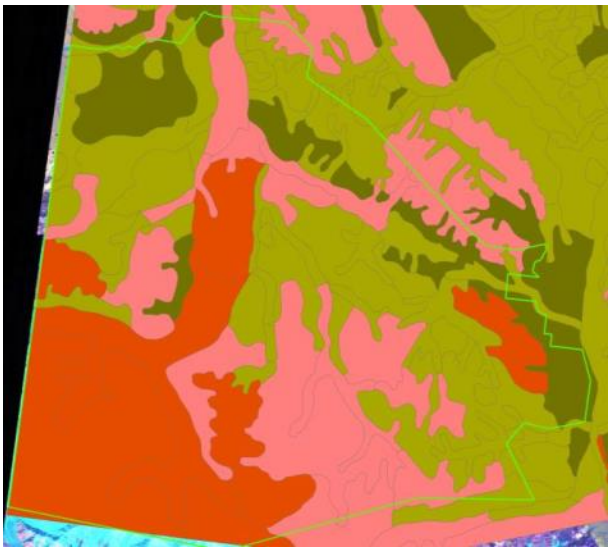
3.1.1 Features

Asi Keyi NEP contains a wide range of features that are very attractive for recreational experiences. These include: visible wildlife in a wilderness setting, including grizzly bear, mountain caribou, and Dall's Sheep; spectacular alpine with dramatic glaciated summits, the highest of which is Mount Wood, the seventh tallest mountain in Canada at 4,845 m asl. (15,741'), and small alpine glaciers; large glaciers, including Nesham, Brabazon, Natazhat and Klutlan; and extensive subalpine to alpine hikeable terrain.

The Recreation Features Inventory lists the following specific features:

- White River: upper canyon scenic, but no apparent rapids. (RFI 115 F&G #6). (northern boundary of Asi Keyi).
- Copper nuggets off Generc River, from Natural Features Inventory, NFI. (RFI 115 F&G #7).
- Harris Creek: caribou migration route. (RFI 115 F&G #9).
- Glacial outwash features (south of Harris Creek). (RFI 115 F&G #10).
- Teepee Lake: angling and wildlife viewing; sheep in area to north and south, NFI. (RFI 115 F&G 11).
- Attractive peaks of Kluane Ranges; good hiking and climbing potential. (RFI 115 F&G #12).
- Mounts Lambert and Brooke: tallest peaks north of Kluane National Park and Reserve: heavily glaciated area is most significant in Yukon outside of Kluane. (RFI 115 F&G #19).
- Klutlan Glacier: largest glacier in Yukon outside Kluane National Park and Reserve; spectacular scenery; examples of mountain glaciation; viewing and climbing potential in entire area. (RFI 115 F&G #20).
- St. Clare Creek: sheep concentrations, NFI. (RFI 115 F&G #21).
- Wolverine Plateau: important caribou habitat; thunder eggs, NFI. (RFI 115 F&G #22).

- Examples of heavily glaciated mountainous terrain and superb climbing and scenery. (RFI 115 F&G #23 & 24).



46: The Recreation Features Inventory for Asi Keyi NEP shows mountainous areas as desirable for hiking and mountaineering, along with unique features, such as the Klutlan Glacier.

4.1.1 Use

The remoteness of Asi Keyi NEP and its proximity to major peaks in Kluane National Park and Preserve and Wrangell-St. Elias National Park and Preserve, results in Asi Keyi having seen very little mountaineering activity. Mount Wood was first ascended in 1941 by a team led by Walter Wood (not mountain namesake). Their first attempt in 1939 was unsuccessful. Both expeditions were supported out of Burwash Landing on horseback. For the 1941 attempt, Wood employed the innovation of air dropping supplies at high camps; a technique that is now standard (Scott 2000). In 1913 a boundary mapping party travelled the winter trail from Whitehorse and set up camp at the 'foot' of the Klutlan Glacier. They successfully ascended Mount Natazhat on June 18, 1913 with the hope of a clear view and photographs to Mount St. Elias in order to conclude the survey through the mountains (Green 1982). Immediately adjacent to Asi Keyi, a peak on the northeast flank of Mount Natazhat was first ascended in 2000. It was dubbed Mount Schou after the grandfather of one of the two climbers (Burch 2001). Outside of these records, there is little information on climbing or mountaineering in Asi Keyi.

Over the past twenty five years there have been two hiking parties into the park, one helicopter supported in the Cement Creek area, and another in and out from the Alaska Highway into the Teepee Lake area. In addition, one party flew to St. Clare Creek in late winter for a ski trip. Access was by a fixedwing aircraft on skis. There are likely to have been other trips into the area, though very few.

5.1.1 Potential

Summer hiking opportunities exist throughout the park. Long round trips from the Alaska Highway through the Kluane Ranges, Teepee Valley and up to Wolverine Plateau are possible. Helicopter supported trips into Wolverine Plateau, Cement Creek area, Upper St. Clare Creek and the Mount Brooke area would all be possible. Float plane access is only possible at Teepee and Big Boundary lakes.

47: Asi Keyi NEP is remote and difficult to access. Once there, the hiking and mountaineering opportunities are world-class.

Mountaineering in the spring is possible for all of the high country in the south, southwest and western portions of the park. While not as high as mountains in Kluane or Wrangell-St. Elias parks, many of the peaks have not yet been climbed.

Winter ski travel has potential in the park. Two road to road options are: the route from the White River lodge, up the south side of the White River, across the Generc River and on to Big Boundary

Lake, returning by the same route; and from the northwest side of the Donjek River bridge up to Wolverine Creek, on to Teepee Lake and down through Harris Creek to the Generc and White River route back to the highway at the White River lodge. Air supported ski options include the St. Clare Creek area and possibly the upper Klutlan Glacier.

Guided recreation, with a focus on nature interpretation could be developed out of Teepee and Big Boundary lakes. The camp developed to support the Chisana caribou calving pen has left some facilities, but more importantly has shown that a basic camp is manageable. Both lakes are in the lowlands, with the interpretive opportunities the lakes, wetlands and forests afford, and are within two to four hours hiking to alpine.

48: A few facilities have been left at the Big Boundary Lake caribou camp. There is potential to establish recreational support facilities here and at Teepee Lake.

Some parties have rafted the White River north of the park. There are no river travel opportunities within Asi Keyi NEP.

The recreation features inventory rates the mountains and active glaciers, along with the Generc River as having high (+) and very high (++) recreational potential.

Attributes that make Asi Keyi NEP attractive for recreation also create limitations. The wilderness character is a function of remoteness. As such, private trips are costly as they require air support. For

the same reason, commercial guided trips are likely to be at the high end (Afan Jones pers. com.). While the subalpine and alpine are relatively passable, glaciers are formidable barriers to hikers and mountaineers. Hiking from or back to the Alaska Highway is possible by way of the Koidern River valley cut through the Kluane front ranges, but extensive and steep alder thickets along the Koidern River and Sergeant Creek take hikers approximately 12 hours from road to the subalpine at the park boundary.

5.2. Fish and Hunting

Since the establishment of the Kluane Wildlife Sanctuary, formerly the Kluane Game Sanctuary, in 1942 and 1943, licensed fishing and hunting has not been permitted in Asi Keyi. From the establishment of the Sanctuary, at least until the 1970s, poaching of large game species was an issue. Numerous illicit air strips were identified that were thought to be used mostly by American outfitters. The Warden Services from Kluane NPP and the St. Elias National Monument, precursor to the National Park and Preserve, have curbed this activity (Gray 1987). During the mid-1980s some hunting has been allowed for First Nation members within the Sanctuary (Gray 1987).

The Kluane First Nation Final Agreement, Chapter 16.4.12, limits the provision of consent to hunt to other first nation individuals to White River People, for KFN R-7B and KFN R-8B within Asi Keyi NEP. A Special Provision pertaining to Total Allowable Harvest includes Asi Keyi NEP in the formulation, 16.9.0. Teepee Lake falls under a special provision, 16.9.10.1, with respect to the allocation of fish harvesting, in recognition of the special importance of this, and other water bodies, to Kluane First Nation (Kluane First Nation Final Agreement 2003).

5.3. Trapping and Outfitting

Since the establishment of the Kluane Wildlife Sanctuary, formerly the Kluane Game Sanctuary, in 1942 and 1943 outfitting not been permitted in Asi Keyi. In 1950 some trapping by First Nation members has been permitted (Gray 1987).

6.4. First Nation Settlement Lands

Kluane First Nation has two small Category B Rural parcels within Asi Keyi. They are KFN R-07B, on the north side of Teepee Lake and KFN R-08B at the confluence of St. Clare and Harris creeks.

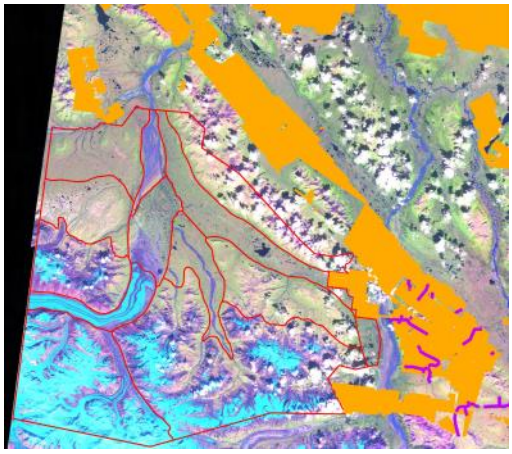
White River First Nation has three interim protected parcels in the park. One is a small Category B Rural parcel, WR R-19B, east of St. Clare Creek approximately seven km upstream from the Generc Valley. Two are Site Specific Selections on the west shore of Teepee Lake, WR S-85B and WR S-150B.

6.5. Fee Simple Land

There are no private land holdings within the park.

6.6. Leases, Licenses and Permits

The park boundary was drawn so as to exclude quartz mineral claims in Cement Creek in the southeast, Lynx Creek at the east, and in the White River Canyon area to the north. In the past few years these areas have been staked up to the park boundary.



49: Quartz and placer claims have been staked adjacent to the park boundary.

A small reserve at the north end of Big Boundary Lake, #2006-0186, was granted to the Department of Environment, Fish and Wildlife Branch for the purposes of developing the Chisana caribou herd pen and associated camp. Following the conclusion of the program in 2006, the reserve was assigned to Yukon Parks.

50: Land reserve at Big Boundary Lake.

7. Regional Management Context

The designation of Asi Keyi as a Natural Environment Park by the Yukon Government is a requirement of the Kluane First Nation Final Agreement, Chapter 10, Schedule 10.3.2.2. It replaces a portion of the Kluane Wildlife Sanctuary, first established in 1943 as the Kluane Game Sanctuary. Adjacent to the park, the northern portion of the Kluane Wildlife Sanctuary remains in effect. This designation is enabled by the Yukon *Wildlife Act*. Their sole legislative restriction in the prohibition on wildlife harvest:

> 'Wildlife sanctuaries 37(1) A person shall not hunt or trap wildlife in a wildlife sanctuary.'

The Sanctuary is created by Order in Council and is a regulation pursuant to the *Wildlife Act* (Yukon Regulations 2002).

A second designation was created through the Kluane First Nation Final Agreement. Pickhandle Lakes Habitat Protection Area is established through the preceding schedule, Chapter 10, Schedule 10.3.2.1. Habitat Protection Areas in Yukon are also enabled by the *Wildlife Act*.

To the immediate south of Asi Keyi NEP is the Kluane National Park and Preserve. It is enabled and managed pursuant to the *Canada National Parks Act*. Section 71, Schedule 1, Part 11 (3):

> (3) KLUANE NATIONAL PARK OF CANADA
> In Yukon;
> Such portion of the Kluane National Park Reserve of Canada described in Schedule 2 as is identified as lands for a national park in the Champagne and Aishihik First Nations Final Agreement, given effect by the Yukon First Nations Land Claims Settlement Act.
> And such other portions of the said reserve as are identified as lands for a national park in final agreements with other first nations that are given effect under the Yukon First Nations Land Claims Settlement Act.

Adjacent to Asi Keyi NEP along the international boundary is Wrangell-St. Elias National Park and Preserve. This area was initially proposed for protection in 1939 (Deans 2007). In 1971 the United States Congress passed the *Alaska Native Claims Settlement Act* (ANCSA). This Act authorized the United States Federal government to withdraw lands for national protection, which it did in 1980 through the passage of *Alaska National Interests Land Conservation Act* (ANILCA). Wrangell-St. Elias National Park and Preserve was established through ANILCA in 1980. It is administered pursuant to the *National Parks Service Organic Act*, 1916, by the National Park Service, a division of the United States Department of the Interior (Drazkowski et al. 2011). The Act allows for designation has a Park, which is normally fully protected, and a Preserve, which is managed like a national park with the exception that sport and

subsistence hunting and trapping is allowed. According to ANILCA directed that there be an exception and that hunting be allowed in Wrangell-St. Elias National Park as well as the Preserve. It also directs a level of access in the Wilderness Area of Wrangell-St. Elias National Park and Preserve that is above what the designation normally permits (Deans 2007). Wilderness Areas are designated pursuant to the 1964 *Wilderness Act* in National Parks and other federally administered lands.

Other protected areas form a contiguous block with the designations listed above, excepting Pickhandle Lakes HPA. They are the Tetlit National Wildlife Refuge and Glacier Bay National Park in Alaska and Tatshenshini-Alsek Provincial Wilderness Park in British Columbia. Together these are a UNESCO World Heritage Site Designation.

The primary function of the World Heritage Committee of the United Nations Educational, Scientific and Cultural Organization (UNESCO) is to 'identify, on the basis of Tentative Lists and nominations submitted by States Parties, cultural and natural properties of outstanding universal value which are to be protected under the (World Heritage) Convention and to inscribe those properties on the World Heritage List;' (UNESCO 2005). Following application by Canada and the United States of America, the Committee inscribed Wrangell/St.Elias/Kluane as a World Heritage Site in 1979. Two extensions were added to the inscribed area, with Glacier Bay National Park in 1992 and Tatshenshini-Alsek Provincial Wilderness Park in 1994 (UNESCO 1995). The area is now known as Kluane/Wrangell-St. Elias/Glacier Bay/Tatshenshini-Alsek World Heritage Site.

Criteria for which this site was selected are (UNESCO 2005):

> vii: contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
>
> viii: be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
>
> ix: be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities ofplants and animals;
>
> x: contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Asi Keyi NEP is geographically central to this World Heritage Site. Yukon has the option of recommending that Canada put Asi Keyi NEP forward for consideration on its 'Tentative List' for consideration as a third extension to the World Heritage Site. These protected areas share a range of ecosystems in a relatively natural setting. There are advantages to the important attributes of each protected area to managing them and the surrounding lands through interagency cooperation (Danby and Slocombe, 2005). There is a rare opportunity to manage Asi Keyi NEP with a view to the greater ecosystem concept.

TABLE 1. Protected areas in the St. Elias region greater than 100 km².

Protected area	Management agency	Area (km²)	IUCN class†	Year of establishment
Wrangell–St. Elias National Park and Preserve	U.S. National Park Service	53 420	I/II/V‡	1978, National Monument 1980, National Park and Preserve
Glacier Bay National Park and Preserve	U.S. National Park Service	13 287	I/II/V‡	1925, National Monument 1980, National Park and Preserve
Kluane National Park and Reserve	Parks Canada	22 013	II	1943, Territorial Game Sanctuary 1976, National Park Reserve 1994, National Park and Reserve
Tatshenshini-Alsek Provincial Park	British Columbia Parks	9580	II	1993, Class A Provincial Park
Chilkat Bald Eagle Preserve	Alaska Department of Fish and Game	199	II	1982, State Critical Habitat Area
Kluane Wildlife Sanctuary	Yukon Department of Environment	6368	IV	1943, Territorial Game Sanctuary
Tetlin National Wildlife Refuge	U.S. Fish and Wildlife Service	3739	IV	1980, National Wildlife Refuge
Chugach National Forest	U.S. Forest Service	27 959	VI	1907, National Forest
Tongass National Forest§	U.S. Forest Service	70 606	VI/I	1902, Forest Reserve 1907, National Forest
Tongass National Forest, Russell Fiord Wilderness	U.S. Forest Service	1411	I	1980, National Forest Wilderness
Tongass National Forest, Endicott River Wilderness	U.S. Forest Service	400	I	1980, National Forest Wilderness

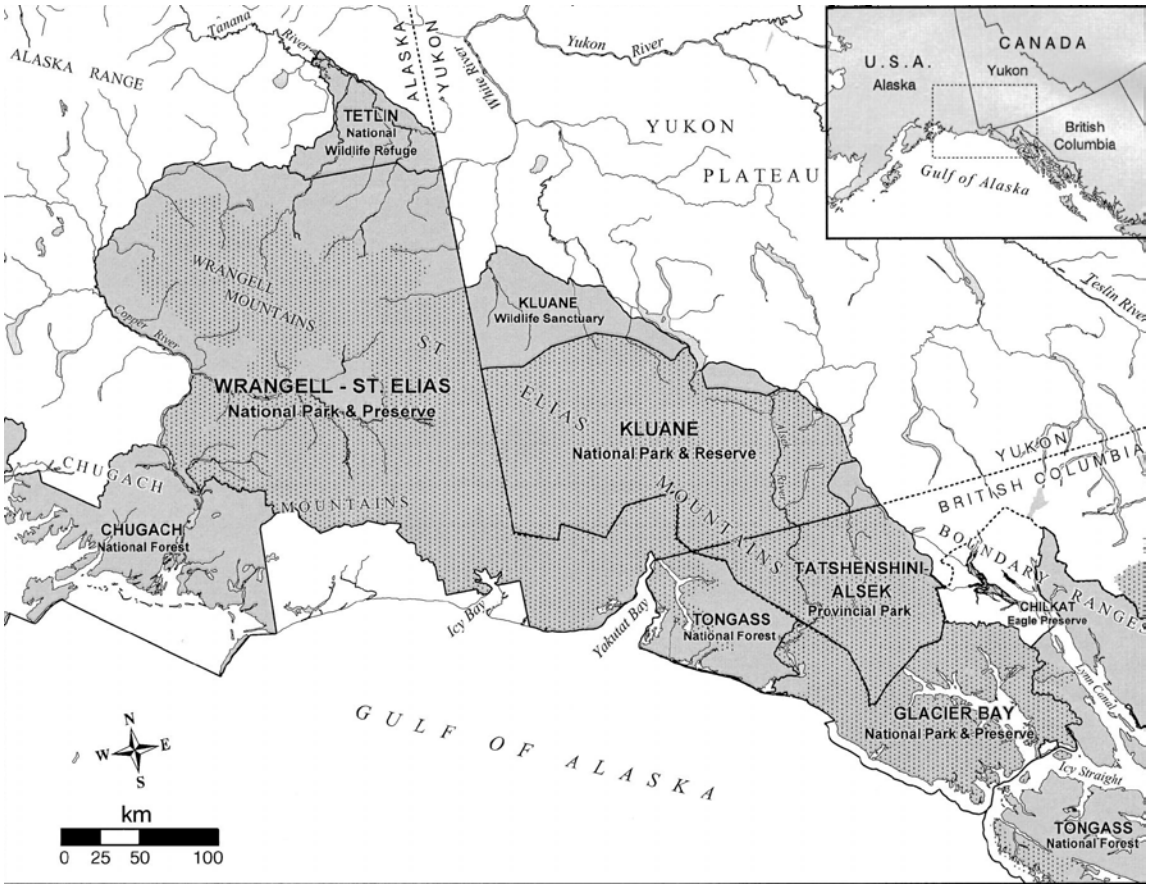
Note: Three main categories are defined in this study: IUCN classes I and II (managed for ecosystem and/or wilderness protection), III and IV (managed for natural feature and/or species conservation), and V and VI (managed for sustainable resource use).

† Based on the United Nations List of Protected Areas (Chape et al. 2003).

‡ The IUCN's designation of Wrangell–St. Elias and Glacier Bay National Preserves as class V is incongruent with other designations in the region. For consistency, we consider the two national preserves as components of the contiguous core and equivalent to class II reserves.

§ Tongass National Forest contains 19 wilderness areas. Only those in the St. Elias region are listed.

51: Protected Areas in the Pacific Northwest of which Asi Keyi NEP and Pickhandle Lake HPA are now part. Source: Danby and Slocombe, 2005.


ALASKA RANGE
Tanana River
ALASKA
YUKON
White River
Yukon River
YUKON PLATEAU
TETLIN
National Wildlife Refuge
WRANGELL MOUNTAINS
Copper River
KLUANE
Wildlife Sanctuary
WRANGELL - ST. ELIAS
National Park & Preserve
ST. ELIAS MOUNTAINS
KLUANE
National Park & Reserve
CHUGACH MOUNTAINS
CHUGACH
National Forest
YUKON
BRITISH COLUMBIA
BOUNDARY RANGES
TATSHENSHINI-ALSEK
Provincial Park
CHILKAT
Eagle Preserve
Icy Bay
Yakutat Bay
TONGASS
National Forest
GLACIER BAY
National Park & Preserve
Icy Straight
TONGASS
National Forest
GULF OF ALASKA
Teslin River
Lynn Canal
N
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S
km
0 25 50 100
U.S.A.
Alaska
CANADA
Yukon
British Columbia
Gulf of Alaska

8. Suggestions for further research

The effects of climate change will be dramatic in this dynamic landscape. Monitoring could look at ongoing impacts on glaciers and on permafrost. Updating studies such as Rampton's 1970 mapping of the Klutlan and Natazhat moraines using updated aerial photography would be informative. The most recent air photos for Asi Keyi are 1989. Acquiring new photography, or other high resolution imagery, to compare to 1960s may indicate recent surges.

In central Alaska, ecologists are predicting the replacement of White Spruce forests with deciduous forests (Drazkowski et al. 2011; Loya, et al. 2011). Monitoring forest sites for species composition change would be of value, accompanied by observations on the impact on wildlife habitats.

Background inventories of small mammals, birds, invertebrates and other biota should be carried out.

Detailed geology mapping and along with interpretation and studies on the relationship to habitat quality for various species would be informative. Asi Keyi NEP has opportunity for studies of earth processes related to permafrost, mountain building, glaciation, and processes related to the movement of glacial ash.

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10. Specialist Contact List

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Marcus Waterreus: Wildlife Key Areas

Cameron Eckert: Birds

Rose Cobbett & Steve Israel: Bedrock Geology

Jeff Bond: Surficial Geology

Richard Janowicz: Hydrology

Appendix 1

Kluane / Wrangell-St. Elias / Glacier Bay / Tatshenshini-Alsek World Heritage Site

Brief Description

These parks comprise an impressive complex of glaciers and high peaks on both sides of the border between Canada (Yukon Territory and British Columbia) and the United States (Alaska). The spectacular natural landscapes are home to many grizzly bears, caribou and Dall's sheep. The site contains the largest non-polar icefield in the world.

Statement of Significance

The Kluane/Wrangell-St. Elias/Glacier Bay/Tatshenshini-Alsek national parks and protected areas along the boundary of Canada and the United States of America are the largest non-polar icefield in the world and contain examples of some of the world's longest and most spectacular glaciers. Characterized by high mountains, icefields and glaciers, the property transitions from northern interior to coastal biogeoclimatic zones, resulting in high biodiversity with plant and animal communities ranging from marine, coastal forest, montane, sub-alpine and alpine tundra, all in various successional stages. The Tatshenshini and Alsek river valleys are pivotal because they allow ice-free linkages from coast to interior for plant and animal migration. The parks demonstrate some of the best examples of glaciation and modification of landscape by glacial action in a region still tectonically active, spectacularly beautiful, and where natural processes prevail.

Criteria

(vii) The joint properties encompass the breadth of active tectonic, volcanic, glacial and fluvial natural processes from the ocean to some of the highest peaks in North America. Coastal and marine environments, snow-capped mountains, calving glaciers, deep river canyons, fjord-like inlets and abundant wildlife abound. It is an area of exceptional natural beauty.
(viii) These tectonically active joint properties feature continuous mountain building and contain outstanding examples of major ongoing geologic and glacial processes. Over 200 glaciers in the ice-covered central plateau combine to form some of the world's largest and longest glaciers, several of which stretch to the sea. The site displays a broad range of glacial processes, including world-class depositional features and classic examples of moraines, hanging valleys, and other geomorphological features.
(ix) The influence of glaciation at a landscape level has led to a similarly broad range of stages in ecological succession related to the dynamic movements of glaciers. Subtly different glacial environments and landforms have been concentrated within the property by the sharp temperature and precipitation variation between the coast and interior basins. There is a rich variety of terrestrial and coastal/marine environments with complex and intricate mosaics of life at various successional stages from 500 m below sea level to 5000 m above.
(x) Wildlife species common to Alaska and Northwestern Canada are well represented, some in numbers exceeded nowhere else. The marine components support a great variety of fauna including marine mammals and anadromous fish, the spawning of which is a key ecological component linking the sea to the land through the large river systems. Populations of bears, wolves, caribou, Dall sheep and mountain goats that are endangered elsewhere are self-regulating here. This is one of the few places remaining in the world where ecological processes are governed by natural stresses and the evolutionary changes in a glacial and ecological continuum.

Long Description

A unique area with high mountain peaks, foothills, glacial systems, lakes, streams, valleys and coastal landscapes. The Wrangell-St Elias region represents the most extensive array of glaciers and ice fields outside the polar region. These features and the high mountains of the Wrangell-St Elias, Chugach and Kluane ranges have resulted in the region becoming known as the 'Mountain Kingdom' of North America. Geologically the mountains are included in the Pacific mountain system and include the 130 km long Bagley ice field, the second-highest peak in the USA (Mount St Elias) and the largest piedmont glacier on the North American continent (Malaspina Glacier). Extensive lowlands are found only in the centre and along north-western fringes of the region. Elsewhere lowlands are sandwiched between mountains and sea or occur as narrow valleys and

plateaux grading into upland and serrated peaks. Principal drainages include the Copper, Chitina, White, Alsek and Donjek rivers and tributaries. The Malaspina foreland coastal area comprises mainly long, straight piedmont glacial beaches cut through by numerous often sizeable glacial-melt drainage-ways.

The wide ranges of climatic zones and elevations in the region have resulted in a great variety of ecosystems representing three major biomes or broad vegetational subdivisions: the coastal coniferous biome; the northern coniferous biome; and the alpine tundra biome. The coastal coniferous biome includes coastal spruce-hemlock forests, tall shrub thickets and bogs and marshes.

The northern coniferous biome includes closed tall spruce and deciduous forests, open, low mixed evergreen and deciduous forests, tall shrub thickets and low shrub thickets.

The alpine tundra biome includes moist sedge and grass alpine tundra and dry alpine tundra: moist sedge and grass alpine tundra at 900-1,500 m on gradual slopes, meadow-like tundra composed of sedges and grasses interspersed with low shrubs such as blueberry and Labrador tea; and dry alpine tundra, on steeper mountain slopes and exposed ridges from 900 m to the elevation of perpetual ice and snow comprising low, matted alpine plants dominated by mountain avens.

There is a great variety of fauna reflecting the habitat diversity. Carnivores include coyote, grey wolf, red fox, short-tailed weasel, mink, wolverine, river otter, lynx and the more easily visible brown bear and black bear. A rare bluish colour phase of the black bear, known locally as the glacier bear, is centred in the vicinity of Yakutat. Other mammals include pica and snowshoe hare, arctic ground squirrel, beaver Castor, muskrat and porcupine. Rodents include the hoary marmot. Moose and caribou range in lower elevations and mountain goat and Dally sheep occupy high mountainous areas. Bison were introduced in 1950 and again in 1962. Black-tailed deer may occur along coastal fringes.

The avifauna includes spruce grouse, ruffed grouse, willow ptarmigan, rock ptarmigan, white-tailed ptarmigan, trumpeter swan and many song birds.

All five species of Alaskan Pacific salmon including red salmon, chum, silver salmon, pink salmon and king salmon spawn in park or preserve waters. Freshwater fish species include Dolly Virden, lake trout, steelhead, cutthroat trout, arctic grayling, turbot, round whitefish and humpback whitefish.

Mount Wood (4842 m)

In 1939 Walter A. Wood was back in the Yukon leading his third expedition sponsored by the American Geographical Society. This time he hoped to climb Mount Wood, located just north of Mount Steele. As previously, the expedition approached the mountain with packhorses from Burwash Landing and ten days later established Advanced Base Camp at the turn in the Steele Glacier. Across the glacier stood Mount Wood, "massive and majestic."

By August 12 the team of Walter Wood, his wife Foresta, Anderson Bakewell and Roger Drury had established Camp 3 at the base of the steep climbing on the northeast flank. Plagued by storms, they descended and didn't return to Camp 3 until the 20th. Two more nights of snow confined them to their tents but on the third day they reconnoitered 450 metres above the camp. Again the weather worsened and for two more days and nights they lived in a world of mist and snow.

Finally it dawned clear and they were on their way to the summit. It was gruelling work breaking trail in the intense cold. Foresta Wood described the "ice-axes creaking in the snow" and "mittens stiffened with ice." Several times they stopped to remove their boots and rub their feet. "And then we noticed the snow beginning to plume away from the top of the mountain. The wind had gradually increased in velocity and soon we were bending our heads into the gale."

At about 550 metres below the top they turned around. The weather had been poor throughout their 60 day expedition and had thwarted their summit attempt. Two years later they would return to the mountain and the weather would treat them much better.

Wood's second expedition in 1941 was blessed with excellent weather. In fact, in August they had fourteen consecutive days of sunshine and light winds. For the first time Wood experimented with the technique of dropping supplies from the air, not only at Base Camp, but also at 2375 metres and 3050 metres on the mountain. In the midst of the Second World War, he was also testing equipment for the military.

In early July the whole team was assembled at Base Camp: Walter Wood and his wife Foresta, Anderson Bakewell, Bob Bates, Robert Sharp, Frank Bee and Captain Albert Jackman representing the U.S. military. The expedition made rapid progress, and by the evening of the 24th were perched at Camp 3 above a vast sea of clouds through which emerged the summits of Walsh, Steele and Wood. The summit team went to bed filled with confident anticipation for the morrow.

By 4:00 am the little Primus stove was roaring in the tent, preparing hot drinks, and at 7:30 am the climbers set off for the top. They moved quickly, and within a few hours had passed their high point of 1939. The day was cold, and soon Foresta Wood was having trouble with her feet which had been frostbitten two years earlier. Reluctantly she chose to go down, and Bob Bates, generously relinquishing his chance at the summit, offered to accompany her back to camp.

The other three, Jackman, Bakewell and Walter Wood, carried on. Using snowshoes in the deep snow made the going easier, but it was still a long slog and it wasn't until 3:15 pm that they scrambled over the last snow wall onto the summit. There was no view, a northwest wind was blasting across the ridge, and the thermometer registered -19°C. After a very short stay on this cold and inhospitable summit they turned back down the mountain.

136 Above: Anderson Bakewell and Walter Wood on the summit of Mount Wood in 1941. Photo Albert Jackman. Courtesy Arctic Institute of North America.

136/137: Mount Walsh from the south. Photo Tim Styles.

Source: Scott, C. 2000. Pushing the Limits: The Story of Canadian Mountaineering. Rocky Mountain Books.

Appendix 3: Mammals Known or likely in Asi Keyi.

Family	Genus species	Common Name	WRST	Banfield	Slough & Jung	National Conservation Status (COSEWIC)	Yukon Conservation Status
Soricomorpha	Sorex cinereus	Cinereus Shrew	y	y	p	Not Assessed	Secure
	Sorex hoyi	American Pygmy Shrew	y		p	Not Assessed	Secure
	Sores monticolus	Dusky Shrew	y		p	Not Assessed	Secure
	Sorex palustris	American Water Shrew	y		p	Not Assessed	Secure
	Sorex tundrensis	Tundra Shrew	y		h	Not Assessed	Secure
	Sorex yukonicus	Alaskan Tiny Shrew	y		h	Not Assessed	Not Assessed
Chiroptera	Myotis lucifugus	Little Brown Bat	y		p	Not Assessed	Secure
	Eptesicus fuscus	Big Brown Bat			h	Not Assessed	Not Assessed
Lagomorpha	Lepus americanas	Snowshoe Hare	y		c	Not Assessed	Secure
	Ochotona collaris	Collared Pika	y	y	p	Not Assessed	Sensitive
Rodentia	Glaucomys sabrinus	Northern Flying Squirrel	y		p	Not Assessed	Secure
	Marmota caligata	Hoary Marmot	y	y	p	Not Assessed	Secure
	Marmota monax	Woodchuck			h	Not Assessed	Sensitive
	Spremophilus parryii	Arctic Ground Squirrel	y	y	c	Not Assessed	Secure
	Tamias minimus	Least Chipmunk			h	Not Assessed	Secure
	Tamiasciurus hudsonicus	Red Squirrel	y	y	c	Not Assessed	Secure
	Castor canadensis	American Beaver	y	y	c	Not Assessed	Secure
	Lemmus trimucronatus	Nearctic Brown Lemming			h	Not Assessed	Secure
	Microtus longicaudus	Long-tailed Vole			p	Not Assessed	Secure
	Microtus miurus	Singing Vole	y		p	Not Assessed	Secure
	Microtus	Root Vole	y		p	Not	Secure

	oeconomus					Assessed	
	Microtus pennsylvanicus	Meadow Vole	y		p	Not Assessed	Secure
	Myodes rutilus	Northern Red-backed Vole	y	y	p	Not Assessed	Secure
	Neotoma cinerea	Bushy-tailed Woodrat	y		h	Not Assessed	Secure
	Ondatra zibethicus	Common Muskrat	y		p	Not Assessed	Secure
	Peromyscus maniculatus	North American Deermouse	y	y	h	Not Assessed	Secure
	Peromyscus (arcticus)	Undescribed Deermouse species			h	Not Assessed	Not Assessed
	Phenacomys ungava	Eastern Heather Vole			h	Not Assessed	Secure
	Synaptomys borealis	Northern Bog Lemming	y		p	Not Assessed	Secure
	Zapus hudsonius	Meadow Jumping Mouse	y		p	Not Assessed	Secure
	Erethizon dorsatum	North American Porcupine	y	y	c	Not Assessed	Secure
Carnivora	Canis latrans	Coyote	y	y	p	Not Assessed	Secure
	Canis lupus	Gray Wolf	y	y	c	Not at Risk	Secure
	Vulpes vulpes	Red Fox	y	y	c	Not Assessed	Secure
	Ursus americanus	American Black Bear	y	y	c	Not at Risk	Secure
	Ursus arctos	Grizzly Bear	y	y	c	Special Concern	Sensitive
	Gulo gulo	Wolverine	y	y	c	Special Concern	Sensitive
	Lontra canadensis	North American River Otter	y		p	Not Assessed	Secure
	Martes americana	American Marten	y	y	c	Not Assessed	Secure
	Mustela erminea	Ermine	y	y	p	Not Assessed	Secure
	Mustela nivalis	Least Weasel	proba ble		p	Not Assessed	Secure
	Neovison vison	American Mink	y	y	p	Not assessed	Secure
	Lynx canadensis	Canadian Lynx	y	y	c	Not at Risk	Secure
	Puma concolor	Cougar	possi ble		h	Not Assessed	Undeter mined
Artiodact yla	Alces americanus	Moose	y	y	c	Not Assessed	Secure

	Odocoileus hemionus	Mule Deer			h	Not Assessed	Sensitive
	Rangifer tarandus	Caribou	y	y	c	Special Concern	Sensitive
	Oreamnos americanus	Mountain Goat	y		c	Not Assessed	Sensitive
	Ovis dalli	Dall's Sheep	y	y	c	Not Assessed	Secure