



NAHANNI

NATIONAL PARK RESERVE OF CANADA

NAH?A DEHÉ

State of the Park Report

2009



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Parks Canada Mandate:

“On behalf of the people of Canada, we protect and present nationally significant examples of Canada’s natural and cultural heritage, and foster public understanding, appreciation and enjoyment in ways that ensure their ecological and commemorative integrity for present and future generations.”


Nahanni National Park Reserve is part of Canada’s system of national parks, and represents the Mackenzie Mountains Natural Region. Together with national historic sites and national marine conservation areas, national parks are part of a larger network of national protected heritage areas.

Visit Nahanni National Park Reserve online at www.pc.gc.ca/nahanni

**NAHANNI
NATIONAL PARK RESERVE OF CANADA
NAH7A DEHÉ**

State of the Park Report 2009

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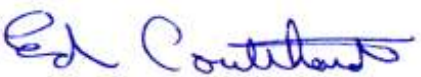

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Executive Summary

The condition of the lands and waters of Nahanni National Park Reserve (NNPR) is of great interest to the local people, Canadians, and Parks Canada. The State of the Park Report provides an assessment of this condition, and as such, is an integral component of Parks Canada's planning and reporting cycle.

This State of the Park Report, the first for NNPR, incorporates both scientific measurement of ecological integrity and the traditional knowledge of the Dehcho Dene to assess the current state of park ecosystems. Social science approaches are also used to assess the state of cultural resources, external relations and the experiences of visitors to the park reserve.

Perspectives of the Dehcho First Nations, not only on ecological condition, but also in regards to history, culture, and current park management, are an integral part of the assessment. The opinions expressed on ecological condition are generally favourable, although some issues are raised, including water quality and declining caribou populations; mining developments and outfitted big-game hunting are identified as specific concerns. The current park management arrangement is supported, but with certain areas in need of improvement, such as the incorporation of traditional Dene place names, and increasing park presence in the community of Nahanni Butte.

Of the five major indicators, or ecosystem types, in NNPR, Forests and Freshwater are assessed as being in **Good** condition, Alpine Tundra and Glaciers in **Fair** condition, and Wetlands are not rated at this time (Table 1). Assessments of Cultural Resources, External Relations and Visitor Experience follow in Tables 2, 3 and 4.

Seven Key Issues are identified in this report:

- Maintaining Water Quality;
- Incorporating Traditional Dene Names;
- Maintaining and Increasing Visitation;

- Infrastructure Supporting the Visitor Experience;
- Expanding Outreach Education;
- Establishing Monitoring Programs;
- Declining Northern Mountain Caribou Populations.

Results from the State of the Park Report will be instrumental in development of the next Park Management Plan for NNPR. As part of the management planning cycle, this report will help Parks Canada to achieve its goal of ensuring that:

Canadians have a strong sense of connection, through meaningful experiences, to their national parks, national historic sites and national marine conservation areas and these protected places are enjoyed in ways that leave them unimpaired for present and future generations.



Paddling through First Canyon (© Parks Canada / D. Haggarty).

Table 1. Condition of Ecological Integrity Indicators in NNPR.

INDICATOR	CONDITION	TREND	COMMENT
Forests			Forest monitoring is well developed with nine measures. Most forest measures are in good condition with a stable trend, although the timing and amount of primary productivity in forests may be declining, and caribou are assessed as poor condition with a declining trend.
Alpine Tundra			Alpine tundra monitoring is in development and currently has three measures. Two measures are assessed as good, but caribou, which use alpine tundra and forests, is assessed as poor with a declining trend.
Wetlands	N/R	N/R	Wetlands is the least developed indicator with only one measure; this indicator is not rated. The Trumpeter Swan measure is assessed as good with an increasing trend.
Freshwater			Five freshwater measures are reported and two are in development. All freshwater measures are rated as good condition with a stable trend.
Glaciers			Three glacier measures are reported. Glacier extent has decreased by 30% in the last 26 years and is assessed as fair with a declining trend. The other two measures, mass balance and river flow, are rated as fair with undetermined trend and fair with a stable trend, respectively.

Table 2. Condition of Cultural Resource Indicators in NNPR.

HERITAGE RESOURCES CONSERVATION - CULTURAL RESOURCES			
Resource Condition			Archaeological sites are rated as fair, buildings and structures are in poor condition, objects are in good condition, landscapes and landscape features, and intangible heritage are not rated.
Selected Management Practices			NNPR does not have a cultural resource values statement in place. Selected management practices are rated under the following headings: inventory (good), evaluation (fair), cultural resource management strategy (fair), and monitoring program (poor).

Key to Symbols:

CONDITION				TREND			
			N/R				N/R
Good	Fair	Poor	Not rated	Improving	Stable	Declining	Not rated








Table 3. External Relations Performance Indicators and Results for NNPR.

INDICATOR (Performance)		TARGET	RESULTS
Public Outreach Education	<p>Canadians learn about the heritage of Parks Canada's administered places.</p> <p>Canadians understand that nationally significant places administered by Parks Canada are protected and presented on their behalf.</p>	N/A	National Standards for these targets are not yet developed, so this indicator is not rated for NNPR (see also Section 5).
Stakeholder & Partner Engagement	<p>Stakeholders & partners support the protection and presentation of Parks Canada's administered places.</p> <p>Stakeholders & partners feel that they have opportunities to influence and contribute to Parks Canada's activities.</p>	N/A	National Standards for these targets are not yet developed, so this indicator is not rated for NNPR (see also Section 6).

Table 4. Visitor Experience Performance Indicators and Results for NNPR.

INDICATOR (Performance)		TARGET	RESULTS
Personal Connection	<p>Visitors consider the place is meaningful to them.</p> <p>Visitors are satisfied with their visit.</p> <p>Visitors are very satisfied with their visit.</p>	<p>Increase by March 2014 (no % target)</p> <p>85%</p> <p>50%</p>	<p>Visitor comments are very positive; some describe their visit as the "trip of a lifetime".</p> <p>Overall visitor satisfaction, based on 2006 & 2007 surveys:</p> <ul style="list-style-type: none"> - 97% were <u>satisfied</u> with their visit - 83% were <u>very satisfied</u> with their visit.
Marketing and Promotion	Canadians visit Parks Canada administered places.	Maintain the number of visits	Annual visitation fluctuates; relatively stable over the last five years (2003-2008 avg. = 935) but recent data suggest a decrease may occur.
Interpretation	Visitors consider that they learned something about the natural or historical heritage of the place.	60% for National Parks	<p>In 2006, 95% of surveyed visitors were satisfied with their visit as a learning experience.</p> <p>In 2007, an average of 72% of visitors gave a positive rating for the impact of programs on their awareness or knowledge of the park.</p>
Visitor Service Offer	Visitors enjoy their visit.	85%	See overall visitor ratings above. Specific visitor service trip characteristics averaged 86% satisfaction rate (2006 survey). Condition of toilets is identified as needing to be addressed, but not a major visitor concern.

Table 5. Evaluation of Management Actions.

OBJECTIVES Over the last 5 years, what were the main objectives for which management actions were identified to maintain or improve the park’s state?	INDICATORS What indicator(s) will be maintained or improved by achieving the objective?	TARGETS What target(s) were set to achieve this maintenance or improvement?	RESULT ● Met ◐ Partially met ○ Not met
<ul style="list-style-type: none"> • Establish an ecologically-based park. 	<ul style="list-style-type: none"> • All Ecological Integrity (EI) Indicators • VE Indicators 	<ul style="list-style-type: none"> • Complete sub-watersheds, critical wildlife habitats, and movement corridors • Tlogotsho Plateau, Ragged Range, Nahanni Karst • Five ecoregions 	
<ul style="list-style-type: none"> • Mitigate impacts to the tufa mounds. 	<ul style="list-style-type: none"> • Wetlands • VE Indicators 	<ul style="list-style-type: none"> • No measurable net damage between years to the tufa on the interpretive access path 	
<ul style="list-style-type: none"> • Document and protect cultural resources. 	<ul style="list-style-type: none"> • Resource Condition 	<ul style="list-style-type: none"> • Maintain or improve condition of cultural resources 	
<ul style="list-style-type: none"> • Maintain opportunities for wilderness and spiritual experience. 	<ul style="list-style-type: none"> • Personal Connection 	<ul style="list-style-type: none"> • <3 planes at Náìlìcho (Virginia Falls) and Rabbitkettle Lake at a time • <25 overnight visitor arrivals at Náìlìcho per day • Visitor surveys indicate >85% satisfied with their experience 	
<ul style="list-style-type: none"> • Mitigate ecological impacts to campsites. 	<ul style="list-style-type: none"> • Forest • VE Indicators 	<ul style="list-style-type: none"> • Targets for acceptable impacts not yet developed • Impacts on monitored sites do not increase • Reported on annually • Close campsite if it receives a POOR rating for two consecutive years. 	
<ul style="list-style-type: none"> • Prevent hydrocarbon (fuel) contamination from fuel caches. 	<ul style="list-style-type: none"> • Forest • Freshwater 	<ul style="list-style-type: none"> • All fuel barrels in good condition • No leakage from fuel caches • Any spills are cleaned up as quickly as possible • Store all fuel in containment facilities (80% complete) 	
<ul style="list-style-type: none"> • Develop a partnership with Dehcho First Nations (DFN) for cooperative management of the park. 	<ul style="list-style-type: none"> • Stakeholder & Partner Engagement 	<ul style="list-style-type: none"> • Formalize DFN role in cooperative park management • Involve DFN in management plan development 	

1. Introduction

The powerful and dynamic South Nahanni River, Nah 7a Dehé in the local Dene language, originates in the rugged and remote mountains near the border between the Northwest Territories and Yukon, and terminates at its confluence with the Liard River near Nahanni Butte more than 500 km downstream. The river is the central feature of Nahanni National Park Reserve (NNPR), and the surrounding Greater Nahanni Ecosystem (GNE).

The river grows in size as it traverses the land, with contributions from snowmelt, surface water runoff, glacier meltwater and groundwater from numerous mineral springs. The river, along with its tributaries and lakes, provides water for terrestrial wildlife, habitat for aquatic wildlife, traditional travel routes for Dene harvesters and a corridor for the more recent explorers of the land. Nah 7a Dehé figures prominently in local oral history.

Protecting the South Nahanni River (specifically Náìlìcho, or Virginia Falls, and the spectacular canyons) from hydroelectric development was the catalyst for establishment of a national park reserve.



Náìlìcho (Virginia Falls), the centrepiece of Nahanni National Park Reserve (© Parks Canada / D. Tate).

Regional Context

NNPR is situated in the southwest corner of the Northwest Territories (Figure 1) and is located in the traditional homeland of the Dehcho First Nations (DFN). Land withdrawals for a park occurred in 1971 & 1972 totalling 4,766 km², and formal entry into the Canada Gazette as a park reserve took place in 1976.

A legendary icon of Canadian wilderness, NNPR provides visitors with world-renowned white-water river travel opportunities, and some of the most celebrated rock climbing sites in Canada are found in the Ragged Range mountains. The park reserve was designated a World Heritage Site by UNESCO in 1978, and that portion of the South Nahanni River which flows through the park was designated a Canadian Heritage River in 1987.

The immediate area around NNPR is sparsely populated, with approximately 2000-2500 people in the five communities within 160 km. Nahanni Butte (pop. ~100) is the closest community to the park reserve, situated about 30 km downstream of the southeast boundary.

Park administration and operations are based out of Fort Simpson (pop. ~1200), approximately 120 km northeast of the east boundary and 320 km from the west boundary by air. Fort Simpson is the main gateway community, and can be reached by road or on scheduled air service. Access to NNPR is almost exclusively by float plane, because there are no roads into the park reserve. It is, however, possible for the experienced adventurer to access the headwaters of the Flat and Little Nahanni rivers by road, and travel downstream into NNPR.

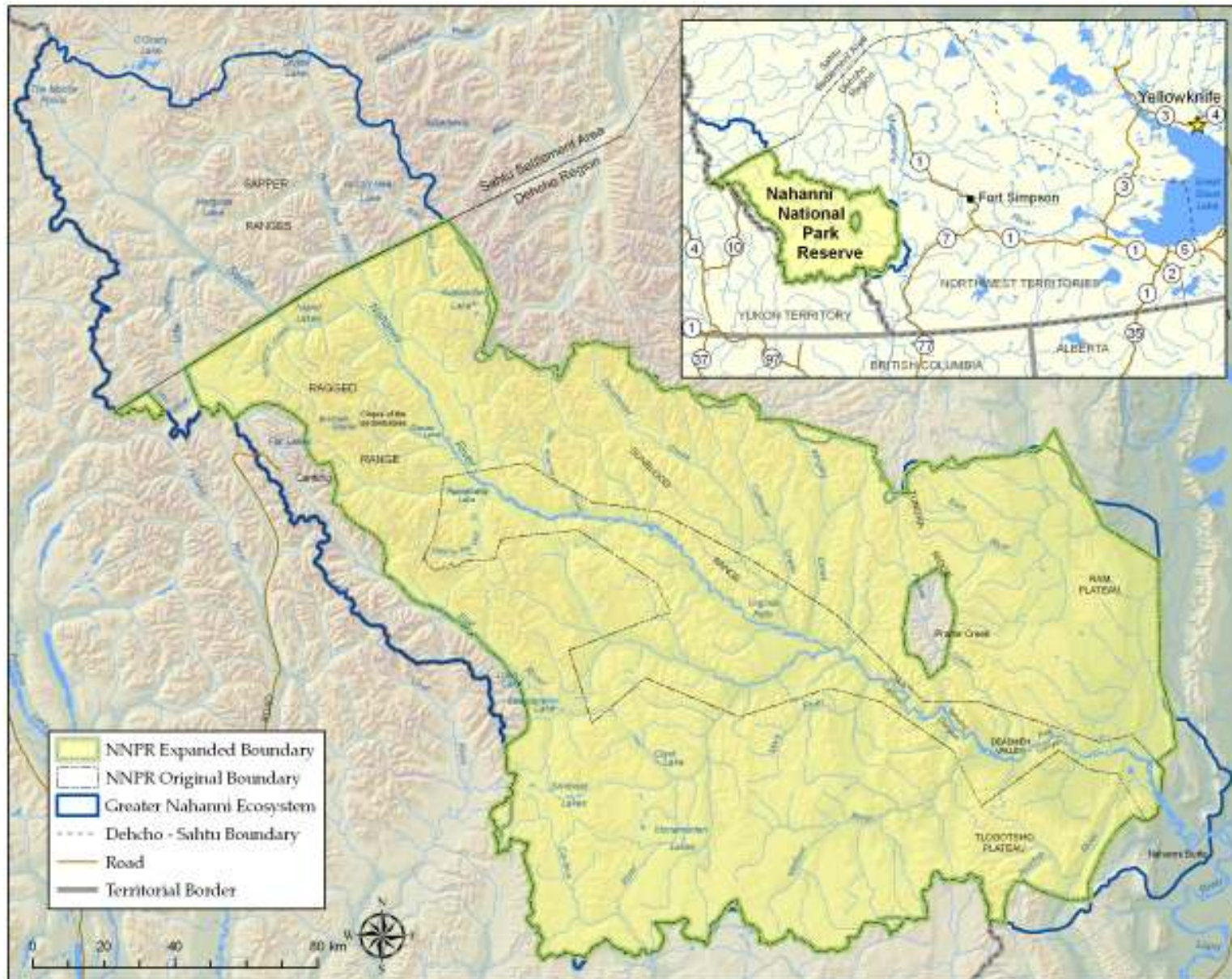


Figure 1. Location of Nahanni National Park Reserve (NNPR) and the Greater Nahanni Ecosystem (GNE).

Visitors to the park reserve can experience a remarkably diverse geological landscape, and a biologically diverse area for its northern latitude. Interpretation of these natural features, cultural history and ongoing Aboriginal traditions of the region, is provided to visitors on site by park staff; these presentations have often been cited as a memorable experience of a Nahanni trip.

The ecological vision statement for Nahʔa Dehé (below), based on input from participants at the Ecological Integrity Statement Workshop in 2000, and restated in the Park Management Plan (2004), recognizes the natural and cultural diversity of the place.

An Ecological Vision for Nahʔa Dehé

Nahʔa Dehé will protect a wilderness watershed in the Mackenzie Mountains where natural processes such as fires and floods will remain the dominant forces shaping the park's ecosystem. Special features of the park, including waterfalls, hot springs, glaciers, plateaux, canyons, karst landscapes and cultural/spiritual sites will be preserved. Naturally-occurring plant communities will thrive and native animal species, including Woodland Caribou and Grizzly Bears, will be sustained at viable population levels.

Dene are inseparable from the land. Traditional subsistence harvesting will continue to be an integral and sustainable part of the ecosystem and will occur in accordance with Dene law and principles. Nahʔa Dehé will continue to be revered as a place of mystery, spirituality and healing.

Nahʔa Dehé will be a model of cooperative management with First Nations of the Deh Cho where ecological and cultural integrity is protected, visitor access and enjoyment is encouraged within the limits of ecological integrity and wilderness experience, and messages of natural and cultural heritage are communicated with excellence. Nahʔa Dehé will also serve as a national long-term ecological research and monitoring site, and will promote excellence in the conduct of science and cooperative resource protection.

Park Expansion & Watershed Protection

Since the first management plan in 1987, it was recognized that NNPR was not large enough to protect all of the significant natural features of the area (in fact, feasibility studies prior to 1972 recommended a much larger park). In particular, it did not provide adequate habitat for long-term protection of wide-ranging species such as Grizzly Bear¹ and Woodland Caribou. Alpine

areas, the habitat of species such as Dall's Sheep, Mountain Goat and Hoary Marmot, were only minimally represented within the protected area boundaries.

Public consultation for the Park Management Plan, beginning in 2000, indicated strong local support among Dehcho First Nations communities for protection of the entire South Nahanni River watershed. In 2003, a Memorandum of Understanding respecting park expansion was signed by DFN and Canada; interim land withdrawals for the purpose of park

¹ Proper names of wildlife species names are capitalized throughout this report; a full listing of common and scientific names can be found in the Technical Compendium document.

expansion were also signed by Order in Council in 2003.

To study feasibility of expansion and new boundary options, the Nahanni Expansion Working Group (NEWG) was formed in 2004. Following extensive research including natural features, wildlife values, oral history, mineral and energy potential, the NEWG presented three boundary options for public review and comment. A final boundary recommendation¹ was developed and presented to DFN and Parks Canada in 2007, and an adapted boundary option was accepted at a DFN leadership meeting in April 2009.

The process culminated on 18 June, 2009, with the official expansion of Nahanni National Park Reserve to more than six times its original size: a protected area now encompassing 30,055 km², making it the third largest national park in Canada. Nahanni will remain a park reserve until conclusion of the Dehcho Process.

State of the Park Report

The condition of the lands and waters of Nah ʔa Dehé (depending on context, the term can refer to the river, or the whole watershed) is of great interest to the local people, as well as to Parks Canada. The State of the Park Report is an integral component of Parks Canada's planning and reporting cycle.

This State of the Park Report, the first for NNPR, incorporates both scientific measurement of ecological integrity and the traditional knowledge of the Dehcho people to assess the current state of park ecosystems. Social science (analytical and opinion-based) approaches are also used to assess the state of cultural resources, external relations and the experiences of visitors to the park reserve.

¹ The NEWG studies assessed the entire Greater Nahanni Ecosystem, but boundary recommendations were limited to the portion within the Dehcho region. A similar study & consultation process is underway for the Nááts'ihch'oh protected area proposal, the upper watershed in the Sahtu Settlement Area.



The highest peak in the Northwest Territories, standing 2773 m, is within the newly expanded Nahanni National Park Reserve. It has no official name (© Parks Canada / D. Tate).

Parks Canada has adopted a system of coloured symbols to show at a glance the assessed condition of different components of the park reserve. A green circle for Good condition, a yellow triangle for Fair condition, and a red square for Poor condition represent status. Components which remain undetermined are shown as N/R, for Not Rated; this is usually due to insufficient information at this time.

An arrow pointing up for Improving, down for Declining, or horizontal for Stable represents the trend in condition.

Results from the State of the Park Report will be instrumental in development of the next Park Management Plan for NNPR. As part of the management planning cycle, this report will help Parks Canada to achieve its goal of ensuring that:

Canadians have a strong sense of connection, through meaningful experiences, to their national parks, national historic sites and national marine conservation areas and these protected places are enjoyed in ways that leave them unimpaired for present and future generations.

2. Aboriginal Perspectives¹

Historical Background

Aboriginal people of the Dehcho territory have used the Nahanni water since time immemorial. Dene used to migrate into the top end of the watershed and harvest the area, throughout the fall, winter and spring. The watershed was vibrant with groups of families who settled in the area for the winter. Hunters and travellers would be constantly passing each other at different locations of the watershed seeking game or a good location to settle down for the long winter.

The watershed was a haven for people and game. For centuries, the Dene of the north like the Dehcho and Sahtu people, would migrate to the top end of the Nahanni and in the winter, they would live off the fat of the land. In the spring, they would begin constructing a frame for a large moose skin boat. Some boats would be made of ten moose hides and framed with white spruce wood. The boats were over thirty feet long and would take about a month to construct. Then came the day when the boat was put in the water.

A ceremony would take place to thank the land and animals for taking the people this far. A fire would be lit early in the morning – the families would gather around the fire. An elder, a woman and a child would take a basket full of dry meat, moose fat and sheep meat. It would be held until a leader spoke and thanked the Creator for the land, animals and water for them. They also asked for safety when they travelled down the torrential Nahanni River until they got back down to their summer gathering along the mighty Dehcho river. Then the journey would begin.

It would take four days to get to the big falls, Nájl̄icho (Virginia Falls). There, everything would be portaged around the falls; this would

take two full days. The moose skin boat would also be hauled over hand made slips, which were made of medium sized spruce poles that were peeled and laid down on the ground and sprinkled down with water. Then everyone helped in sliding the boat down around the falls until it was brought down to the river below. The journey would continue down the river. It would be about ten days to get to the mighty Dehcho (Mackenzie) River.



Moosehide Boat, circa 1920s (© Jackson/NWT Archives/N-1979-004: 0022).

By this time, the mosquitoes would be out. They would paddle, drift and sail from time to time depending on the weather. There were no set schedules as long as they got to the North Nahanni River, Root River and Redstone River areas. When they arrived at these locations, the boat would be dismantled and the moose hide could be used for clothing and other uses. These families would stay at these summer gathering locations until late summer.

It would be late fall when the Dene would once again begin the trek back into the mountains through the Redstone or North Nahanni watersheds. Once settled in the upper reaches of the South Nahanni watershed, the winter would begin and life of the moose skin boat people would start all over again.

¹The Aboriginal Perspectives section of this report is taken from Norwegian & Cizek (2009).

2.1 Aboriginal Context

Nahanni National Park Reserve exists within the Dehcho, part of the traditional home of the Dene. The tradition of Aboriginal use continues to this day in the park reserve and is provided for under the *Canada National Parks Act*, Section 40. The lands that are now within NNPR have benefitted from the past and ongoing stewardship of the First Nations people.



*A traditional harvester's camp in Nahʔa Dehé
(© Parks Canada / D. Tate).*

The Dehcho First Nations (DFN) is the Aboriginal government organization which represents the communities of the Dehcho. Since 1999, the DFN has been negotiating with Canada on lands, resources and self-government through the Deh Cho Process.

Until the establishment of the Nahʔa Dehé Consensus Team (NDCT), NNPR was managed by Parks Canada officials, with some local help from Nahanni Butte. The Nahʔa Dehé Consensus Team came about as a result of the *Deh Cho First Nations Interim Measures Agreement*, which was signed between Canada, Dehcho First Nations and Government of the Northwest Territories (GNWT) in 2001. Out of the Interim Measures Agreement came the Interim Land Withdrawals in 2003 where approximately 36% of the lands in the Dehcho territory, including lands around the Park, were

temporarily protected from industrial development.

The NDCT consists of representatives from Parks Canada, Dehcho First Nations, and two aboriginal harvesters from Nahanni Butte, the nearest community to the park. One additional member is usually affiliated with a non-governmental organization such as the Canadian Parks and Wilderness Society (CPAWS). In 2003, an Interim Park Management Arrangement was also signed between Parks Canada and the Dehcho First Nations, which formalized the co-operative management of the park.

Since the work of the NDCT began, it has looked at involving more Aboriginal people in running the Nahanni National Park Reserve. The Park Management Plan (2004) was cooperatively written and reviewed by the team members.

NDCT also began working on ways of protecting the whole watershed through a fully expanded park. This work carried out by the Nahanni Expansion Working Group (NEWG). Jonas Antoine, a Dene harvester, is a member of NEWG and NDCT.



Jonas Antoine, a member of the NDCT and NEWG teams, enjoys the crisp fall weather and colours at Nahanni Butte (© Parks Canada / D. Tate).

2.2 State of the Land, and Dene Relationships with the Land

There has been a long-standing belief that the Nahanni Watershed, and the Nahanni River, is a place of prayer and meditation. The one who walked the great shoreline, Yamba Deja¹, was said to have passed through this sacred area. He left behind places where he stayed, like the Rabbitkettle Tufa Mounds which the Dene call Gahníthah or "The house of Yamba Deja".



Gahníthah, the Rabbitkettle Hotsprings Tufa Mounds (© Parks Canada / D. Tate)

This location is where travellers would pay homage. It's an altar between the Creator and all beings. For thousands of years, the Dene would pass through and make offerings at the Tufa Mounds like Abraham did in the Old Testament of the Bible. Nah ʔa Dehé was blessed by the Creator and sanctioned by Yamba Deja. The watershed was a place where all living things would feel protected and be safe.

Today, people from around the globe, who come to visit Nah ʔa Dehé, receive a warm welcome from the Dene who live near there. When visitors leave Nah ʔa Dehé, they leave feeling

¹ Yamba Deja is the name used in the local Nahanni Butte dialect; this figure is also known by different names & spellings, such as Yamoria (Sahtu) and Yamozha (Tlicho).

cleansed and rejuvenated by the power of the Nah ʔa Dehé spirit.

With today's ever-changing world, the watershed is also trying to adjust itself to these changing times. Elders today compare the extreme winter climate changes from 80 degrees below zero over 50 years ago to the current mild winters where temperatures go as high as plus 10 degrees. As a result of the warm temperatures, people are witnessing landslides into the rivers along the various sub-watersheds causing the clear mountain rivers to become muddier. This affects the water habitat, the fish and waterfowl.

The ever-increasing big game hunting in the top end and west end of the watershed is also affecting the migration of caribou, grizzly bears and Dall's sheep. Occasionally, people would see a strange bird like the grey heron and some Elders and harvesters have noticed new birds such as magpie and new animals such as elk.

The elders say that the existing mines are also taking their toll on the landscape and environment. The things that could affect the health and well-being of the Park are the existing mines in the watershed of Prairie Creek and Flat Rivers. The closure of these mines and the removal of the big game outfitters from the watershed would prolong the life of the Park.



Known unofficially as Gozóo (Nighthawk) Creek, this is one of many tributary streams whose headwaters are now protected in the expanded Nahanni National Park Reserve (© Parks Canada / D. Tate).

Overall, the elders and harvesters who were interviewed think that the Parks Officials are doing a good job in taking care of the Park and the watershed. They believe that the old cabins and the rich cultural resources and old sites are being preserved properly. Information such as the publications and the interpretive programs, including the Nahʔa Dehé traditional harvester protocol, are all well received.

There is much interest in local communities in reviving local language and traditions. The harvester protocol was a good initiative in this respect; people would like to see more. In particular, increasing use of Dene names in park and other literature, and formal naming or re-naming of landscape features with the traditional Dene names is of great importance.

The elders and harvesters who were interviewed think that the buildings [park infrastructure] are an important part of managing and accommodating officials who work in the Park. They have also noticed that in the last four years, there has been a decrease in the number of visitors to the Park.

There is good support for the Nahʔa Dehé Consensus Team, which oversees the cooperative management of the Nahanni National Park Reserve. However, people in Nahanni Butte would like to see a Parks Office and facility re-established in the community.



Elder Elsie Marcellais of Nahanni Butte instructs youth on preparation of a Moose hide (© Parks Canada / D. Tate).

3. State of Ecological Integrity

3.1 Ecological Context

Nahanni National Park Reserve lies partly within the Taiga Plains and Taiga Cordillera Ecozones, with a very small extension into the Boreal Cordillera. Within the National Parks System Plan, the park reserve protects a representative example of the Mackenzie Mountains Natural Region.

The geology of NNPR is extremely varied, with different mountain ranges having unique bedrock strata and soil types. The area's geomorphological history is equally varied, with successive glaciations of parts of the region, massive glacial lakes and their subsequent drainage all leaving their impressions on the landscape. The variable weather patterns created by the mountainous environment, the location at the meeting point of three ecozones, and unique habitats such as waterfall mist zones, caves and thermal springs have all combined to produce a remarkably biologically diverse area relative to its northern latitude. The park reserve hosts over 700 vascular plant species, a few hundred more non-vascular plants and lichens, over 180 bird species, over 40 mammal species, two amphibian species, and an undetermined number of insect and other invertebrate species.



Wildmint Hotsprings hosts an unusual assemblage of plant species, including the rare Nahanni Aster (© Parks Canada / D. Tate).



Third Polje, seen here fully flooded in July 2006 (© D. Ford, McMaster University).

Greater Nahanni Ecosystem

The Greater Nahanni Ecosystem is the area having the most influence on the park reserve, and vice versa. The GNE is defined on the basis of natural features, hydrology, and wildlife ranges; it includes the entire South Nahanni River watershed, plus the North Nahanni Karstlands, - an area of fascinating geomorphological features such as caves, canyons, arches and poljes¹. Although surface topography would suggest waters flow north, most of the karstland drains underground; it re-emerges at two large and dramatic clusters of springs at the southern and northern ends of the main karst belt. Whitespray Springs emerges in First Canyon and enters into the South Nahanni River; Bubbling Springs, to the north, is a major source for the Ram River, which then flows into the North Nahanni River.

¹ Poljes are a type of steep-walled, flat-bottomed dissolutional landform; they are typically dry, but may be temporarily inundated with heavy rains. At these times, the solution action can erode the enclosing limestone walls and thus enlarge the floor area. There are three world-class examples within the Nahanni karst.

The recent expansion of NNPR included approximately 75% of the GNE, including much of the karstlands. Other long-standing areas of conservation interest, such as the Tlogotsho Plateau and the Ragged Range mountains, are also within the new park boundaries. Some areas of the GNE in the vicinity of existing mineral interests and in areas of known high mineral or energy resource potential, were excluded to allow future exploration of their resource extraction feasibility. The area of the upper South Nahanni River watershed within the Sahtu Settlement Area has been put forward by Tulita district land management organizations as a proposal under the NWT Protected Areas Strategy.

Ecosystem-based Management

As a remote wilderness park, NNPR is a relatively undisturbed area. Fires and floods are primary ecological drivers of the system, and these forces are allowed to proceed naturally in the majority of the park. There are no water retention or diversion structures within the park, and fire management consists of a let-burn policy for forest fires in the majority of NNPR.

Fires east of Yohin Ridge that could threaten the community of Nahanni Butte are subject to management action through an agreement with the Government of the Northwest Territories.

Active fires are monitored and some mitigation and prevention activities may be implemented to protect visitors and significant park infrastructure.

A conceptual ecological model of NNPR (Figure 2) was developed by the Nahʔa Dehé Consensus Team, using the results of a partner and stakeholders workshop to develop an Ecological Integrity Statement for the park reserve. The model incorporates the hierarchical design of scientific models with the Dene holistic world view, including Dene as an integral part of the functional system.

Stressors on the system are also represented, with industrial activities (i.e. mining & associated roads) and climate change identified

as the main potential and existing threats to ecological integrity.

Two advanced mining operations in the watershed include an operational tungsten mine (North American Tungsten Ltd) on the upper flat River, and a lead-zinc-silver advanced exploration property on Prairie Creek (the latter, Canadian Zinc Corp., has recently applied for full mine operation). Both sites draw water from and release effluent to major South Nahanni River tributaries, and both companies maintain tailings ponds on their sites.



*Forest fire near Jorgenson Creek, July 2006
(© Parks Canada / R. Antoniak).*

Climate change is expected to have dramatic impacts in the Northwest Territories. In the NNPR area, an increase in the frequency and intensity of forest fires is predicted to be one of the most significant ecological impacts.

Ecological Integrity Reporting

For the purpose of State of the Park reporting, five major ecosystem types have been identified within NNPR, and these are presented as ecological integrity *indicators* in this report. The indicators are: **Forest, Alpine Tundra, Freshwater, Wetlands and Glaciers.**

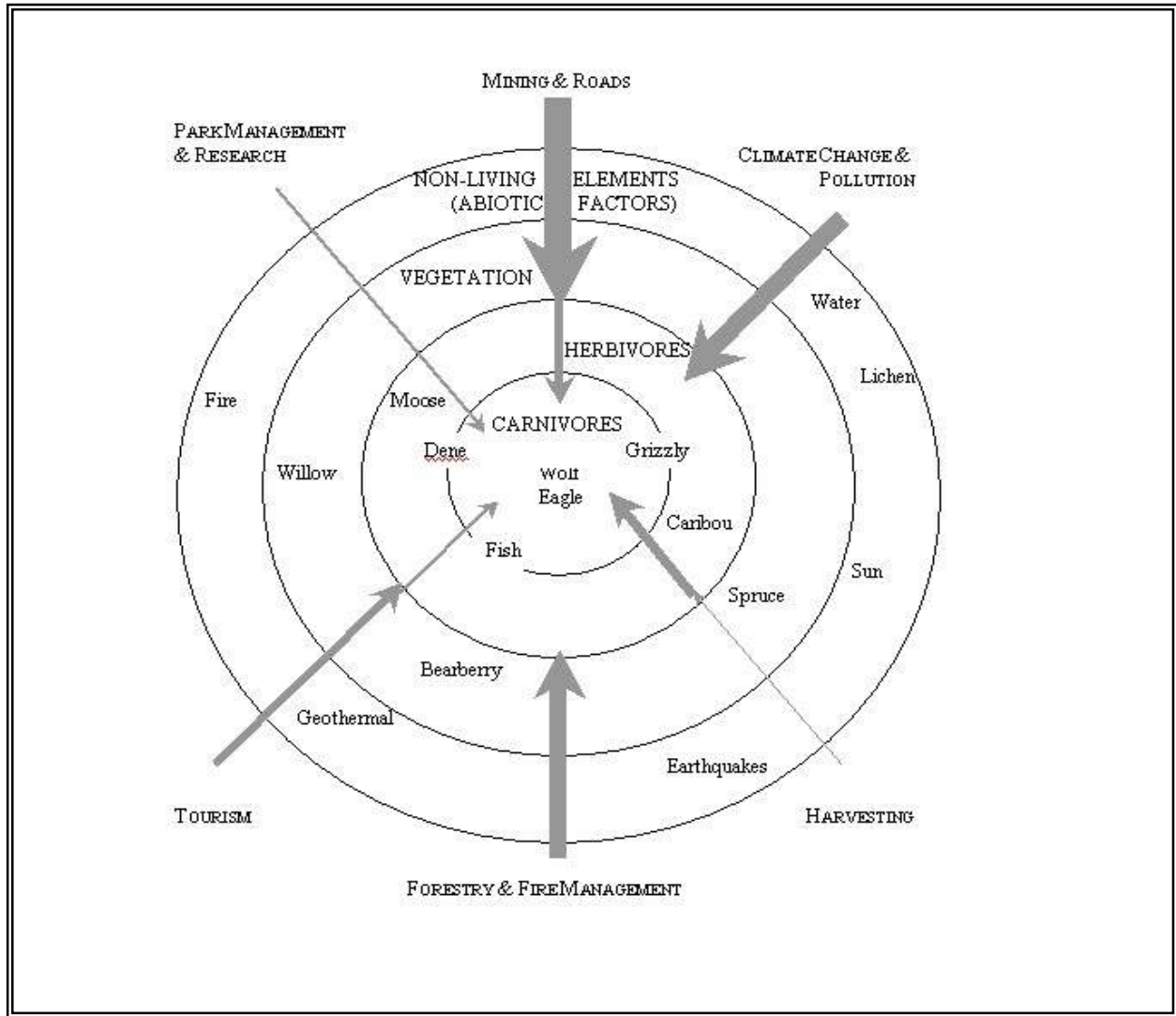


Figure 2. A simple ecological model of Nahʔa Dehé . The relative thickness of lines indicates potential impacts of stressor categories on ecosystem components. This model incorporates both hierarchical design of scientific models and traditional First Nation representation of the land (ndéh).

A suite of **monitoring measures** has been developed to help determine the state of each of these indicators. Different measures within each ecosystem (indicator) are ranked against thresholds for Good, Fair or Poor condition, and are then combined to give an assessment of ecological integrity. A measure may apply to one or more indicators, and the number of measures per indicator is not equal. Forest comprises the largest area within NNPR, and has the most measures. Several measures are still in development, and with the recent boundary

expansion, the ecological integrity monitoring program will require additional review.

Traditional Knowledge

Where available, traditional knowledge from local Dehcho elders and other community members has been included in the assessments of measures and indicators. Traditional knowledge contributions are highlighted in text boxes alongside the scientific assessments.

Some aspects of the park reserve, which may not be well-suited to quantitative assessment and management thresholds, but are important in understanding ecological function, are reported in narrative format below. This report includes an overview of results by measure; more detail on methods is available in the accompanying Technical Compendium.



Spruce-dominant woodland in Deadmen Valley, a common example of the Forest indicator in NNPR (© Parks Canada / D. Tate).

Climate

Climate has changed significantly in the park and the surrounding area since the baseline period of 1950 to 1979. This period serves as a baseline because it is generally the last period of climate normal¹ data (Environment Canada 2009) prior to the onset of rapid climate change in the north (IPCC 2007). This summary focuses on temperature, growing season, productivity, and precipitation.

Tracking climate change within the park boundaries is difficult because of the lack of a long continuous record at any of the three active stations within the park. To evaluate the long-term climate of the region, we focused on the records from Fort Simpson because they are longer and more complete. Fort Simpson tends

¹Weather patterns are often analyzed in 30 year blocks of time. These blocks define a "normal" or "norm". It is a way of summarizing the day to day even year to year differences in weather.

to be a few degrees warmer than the park stations due to its lower elevation.

Temperature and Growing Season:

Temperatures in Fort Simpson are warmer now than in the past but not in every month. Significantly warmer average temperatures occur now in December (+3.6 °C), January (+4.5 °C), February (+3.3 °C), March (+1.7 °C), and April (+2.3 °C) and slightly warmer but still significant increases in June (+0.9 °C), and July (+1.0 °C). May, and the fall months of September, October, and November, exhibited no significant change.

Despite the lack of average temperature change in fall, there have been significant changes at both ends of the growing season². Over the period from 1950 to 1979 the average dates for the start and finish were April 19 and October 7, respectively. This meant an average growing season of 173 days. In comparison, in the last 10 years the growing season has started an average of a week earlier (April 12) and ended two days later (October 9). This has lengthened the growing season by an average of 9 days per year. The growing season was also warmer. The last 10 years have seen an increase of about 100 degree days³, or an additional five days at 20 °C. Most of the additional degree days occurred in April, June and July.

Traditional Knowledge

Elders have indicated that winters are not as cold as they used to be in Nahanni Butte and the park area, and there was more snow years ago than what they see nowadays.

²We used a criteria of the first and last day of the year with an average temperature equal or more than 5 °C.

³“Degree days” measures the accumulation of heat over time. A day with an average temperature of at least 5 °C accumulates five degree days. If the average temperature is 10 °C, we accumulate 10 degree days.

Rain and Snow:

Even though the amount of rain and snow that fall can vary greatly from year to year, the amount of rain in August has increased significantly (Fig 3a). In the last 10 years, the August months have been the wettest since records began in 1895. Previously, July was wettest month of the year with rain tapering in August; when droughts (<1 cm rain) were not uncommon (e.g. 1957). Peak rainfall has shifted with August now being the wettest month.

Significant changes in snowfall have also been observed in the last 10 years for (Figure 3b), with significantly greater snowfall during most winter months: November (+21.7 cm), December (+11.2 cm), January (+10.5), and February (+10.6 cm). However, the increased snowfall is countered by increased temperatures that may decrease the additional snowpack. Snow depth records on the last day of the month showed no differences between the winter months of the norm and the last 10 years, except in March and April. The average snow depth on the last day of the March has dropped from 63 cm to 47 cm and from 16 cm to 5 cm at the end of April. The earlier onset of spring counters the lasting effects of the additional snowfall in winter.

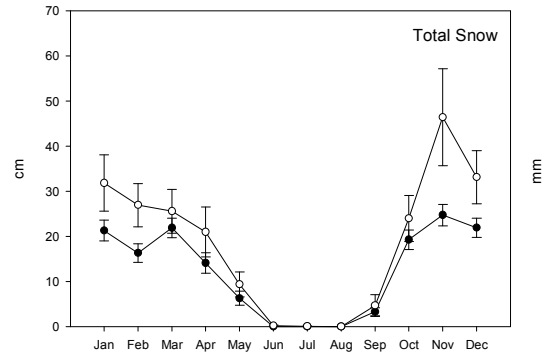


Figure 3 (b). Average monthly snowfall (based on pooling the total rainfall or snowfall for each month of year) for 1959 to 1979 climate norm and the last 10 years. Over the last 10 years, there has been significantly more rain in August and more snow in November, December, January, and February.

The weather patterns over the last ten years have been quite different than the last set of norms established in the pre-climate change era. Four major changes have occurred:

1. It is warmer, particularly in winter.
2. Spring is earlier.
3. The summers are wetter and the peak rains happen later.
4. More snow falls in the winter, especially in November.

Species at Risk in Nahanni

NNPR and the surrounding GNE provide seasonal and year round habitat for ten species which have been designated Special Concern, Threatened or Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Table 6). Five of these species have been listed under Schedules 1 & 3 of the federal *Species at Risk Act (SARA)*. Two additional species are listed as May be at Risk in the NWT General Status Ranks (GNWT 2006).

The GNWT is currently in the process of developing Species at Risk legislation. This process is taking into consideration cooperative management issues, traditional knowledge,

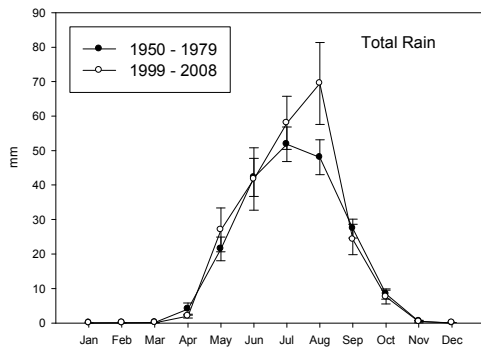


Figure 3 (a). Average monthly rainfall.

Table 6. Species at Risk found in Nahanni National Park Reserve. Shaded gray area indicates species presence in park is unconfirmed. Black arrows represent improved, declined, or stable COSEWIC status. References: ¹GNWT, 2006, ²Cannings et al. 2005; www.natureserve.org.

Species	COSEWIC Status	Species at Risk Act	NWT General Status Rank ¹ / Global Conservation Concern ²	National Status Trend in Last 5 Years
Wood Bison, <i>Bison bison athabasca</i>	Threatened	Schedule 1	At Risk	↔
Olive-Sided Flycatcher, <i>Contopus cooperi</i>	Threatened	–	Sensitive	↓
Common Nighthawk, <i>Chordeiles minor</i>	Threatened	–	Secure	↓
Grizzly Bear, <i>Ursus arctos</i> , Northwestern Population	Special Concern	–	Sensitive	↔
Woodland Caribou, <i>Rangifer tarandus caribou</i> , Northern Mountain Population	Special Concern	Schedule 1	Secure	↔
Wolverine, <i>Gulo gulo</i> , Western Population	Special Concern	–	Sensitive	↔
Rusty Blackbird, <i>Euphagus carolinus</i>	Special Concern	–	May be at Risk	↓
Peregrine Falcon, <i>Falco peregrinus anatum</i>	Special Concern (downlisted 2007 ³)	Schedule 1	Sensitive	↑
Short-eared Owl, <i>Asio flammeus</i>	Special Concern	Schedule 3	Sensitive	↔
Yellow Rail, <i>Coturnicops noveboracensis</i>	Special Concern	Schedule 1	May be at Risk	↔
Bull Trout, <i>Salvelinus confluentus</i>	No Status TBA 2009	–	May be at Risk / G3 (Vulnerable)	N/A
Nahanni Aster, <i>Symphyotrichum nahanniense</i>	No Status	–	May be at Risk / G1 (Critically Imperilled)	N/A
Canada Warbler, <i>Wilsonia canadensis</i>	Threatened	–	Undetermined	↓
Western Toad, <i>Anaxyrus (Bufo) boreas</i>	Special Concern	Schedule 1	May be at Risk	↔

³Still listed as Threatened under *SARA* legislation at time of report preparation.

current science, and the roles and responsibilities under land-claims agreements unique to the NWT (Miltenberger 2008).

Incidental sightings of Species at Risk in the park have been documented since 1977 through wildlife observation cards and a database system. Detailed assessments of all listed species in NNPR are currently being carried out,

which will help provide future direction on Species at Risk management.

Wood Bison are an intensively managed species in the Northwest Territories. The “Nahanni Herd” is a re-introduced population founded through three releases near Nahanni Butte in 1980, 1989, and 1998, and is estimated to number 399 adult animals (GNWT 2008a). This population tends to stay in the Liard River valley

from just north of Nahanni Butte south to Fort Liard and into British Columbia; bison are only rarely seen within the boundaries of NNPR. Wood Bison seldom occur in the park reserve, but are considered regionally stable or increasing.

Woodland Caribou are a species of cultural importance to the Aboriginal people of the Dehcho. Because of concerns raised by local communities, and their place as a critical part of the ecological integrity of NNPR, caribou herds in the park vicinity have been the subject of several research initiatives over the past 15 years; low recruitment, high harvest rates, and increasing industrial activity continue to be of concern. A recent cooperative study effort has begun with Yukon and Northwest Territories governments, and the Canadian Parks and Wilderness Society-NWT. Parks Canada is also represented on the technical advisory team and steering committee developing a national Management Plan for the Northern Mountain Woodland Caribou Population.



Caribou on the South Nahanni River in winter (© Parks Canada / D. Haggarty).

Grizzly Bears are often considered a symbol of wild places, and their continued existence in Nahanni is important to park management. A study of grizzlies in the GNE from 2002 – 2005 found the bears’ density and genetic diversity compared favourably to other mountain Grizzly Bear populations.

Other COSEWIC listed species have insufficient information to provide a preliminary park status at this time. Reports of ‘toads’ (possibly Western Toad) and Canada Warbler in the park remain unconfirmed. Two additional park species are ranked territorially as May be at Risk (GNWT 2006): Bull Trout are reasonably common and widespread in the park, and Nahanni Aster, a rare plant species endemic to a few thermal springs in the Nahanni area which was recently confirmed as a species distinct from closely related asters (Brouillet et al. 2006; Owen et al. 2006), is apparently stable.

Traditional Knowledge

Residents of Samba K'e (Trout Lake, ~150 km southeast of the park) have commented on decreasing numbers of Gozóo (Common Nighthawks) in recent years.

On a national scale, in the past five years, three species known to occur in Nahanni National Park Reserve have been added to the COSEWIC list and one has been downlisted (*i.e* improved status; Table 6). No species have been extirpated from the park.




















Introduced and invasive species have not been a significant concern in NNPR. There are only a few reports of non-native birds, no non-native mammals, and introduced plants are largely confined to a former homestead (*e.g.* Garden Parsnip at Kraus Hotsprings) and some heavily used sites. With park expansion, there are likely to be additional sites and/or species in newly included areas, particularly along access roads now within the park reserve.

Traditional Knowledge



Magpies and ‘grey herons’ (Great Blue Herons) are relatively new bird arrivals in the area. Deer numbers have increased, and Elk have recently been observed.

3.2 State of Ecological Integrity

Table 7. Ecological Integrity Measures, Conditions and Trends in NNPR.


Indicator	Measure	Type	Condition	Trend	Comment
Forest	Forest Fire Cycle	Process		↔	*
	Forest Insects	Process		↔	
	Productivity (NDVI)	Process		↓	
	Aspen Phenology	Process		↓	
	Forest Bird Community	Biodiversity		↔	
	Black Bear Occupancy	Biodiversity		↔	
	Grizzly Bear Occupancy	Biodiversity		↔	
	Moose Density	Biodiversity		N/R	
	Caribou Composition	Biodiversity		↓	
	Forest Vegetation	Biodiversity	N/R	N/R	Developing
Alpine Tundra	Productivity (NDVI)	Process		↓	
	Caribou Composition	Biodiversity		↓	
	Dall's Sheep Composition	Biodiversity		N/R	
Wetland	Trumpeter Swans	Biodiversity		↑	
	Wood Frog Presence/Absence	Biodiversity	N/R	N/R	Developing
Freshwater	River Flow	Process		↔	
	River Ice Phenology	Process		↔	
	Lake Ice-out Phenology	Process		↔	
	Water Quality Index	Process & Stressor		↔	*
	Sport Fish CPUE	Biodiversity		N/R	*
	Benthic Invertebrate Community	Biodiversity	N/R	N/R	Developing
	Benthic Stream Algae	Biodiversity	N/R	N/R	Developing
Glaciers	Mass Balance	Process		N/R	Developing
	Glacier Extent (length/area change)	Process		↓	*
	River Discharge	Process		↔	

Forests

Indicator – Forests	
CONDITION	TREND
	

Forest is the largest indicator in NNPR. Prior to the 2009 expansion announcement (including time of monitoring and analysis for this report), forests comprised over 80% of its area. Several measures to monitor ecological processes and aspects of biodiversity are associated with this indicator. Additional measures of forest structure (vegetation plots) are in development.

Caribou composition, a measure relevant to both Forest and Alpine Tundra indicators, is in poor condition with a declining trend. Most other forest measures are assessed as having a good condition with a stable trend, although the timing and amount of primary productivity in forests may be declining as a result of climate change. Overall forest condition is considered **Good** with a stable trend.

Measure – Area Burned Condition Class	
CONDITION	TREND
	N/R

Relevance: Forest fire is a natural agent of change in boreal forest ecosystems and the Fire Management Plan for Nahanni National Park Reserve recognizes the importance of fire on the landscape (Parks Canada 2004). The park’s policy is to allow naturally occurring forest fires to burn in the majority of the park area, thereby maintaining a natural fire regime throughout much of the park. Any fires occurring east of Yohin Ridge, which could potentially threaten the

community of Nahanni Butte, are suppressed. Forest fires are monitored on an ongoing basis, to keep abreast of the fire’s activity and safeguard park visitors and any values at risk. The mapping of these fires is being used to develop a fire history for the park area. Fires have been documented in the GNE over the past forty years, and the fire history for NNPR and the GNE has been recorded and mapped from 1960 to 2006 (Figure 4); however, we only have confidence in the comprehensiveness of the fire mapping within the former park boundaries.

We calculated the fire cycle (or mean return interval) (Dorner *et al.* 2003) and the Area Burned Condition Class (ABCC). This measure is designed to detect a departure of park ecosystems from a historical fire cycle. In order to calculate the ABCC (Rogeanu and Bothwell, 2006) we used an expected fire cycle of 104¹ years.

- Thresholds:** Area Burned Condition Class (ABCC) is between:
- Green:** -33% to 33%
 - Yellow:** -34% to -67% or 34% to 67%
 - Red:** -68% to -100 or >68%

Assessment: The Area Burned Condition Class (ABCC) measure is assessed as good with an undetermined trend. We calculated the fire cycle (or mean return interval) for forests within the original NNPR boundaries as being 136 years. The Area Burn Condition Class (ABCC) for NNPR was determined to be -24%. Changes to the fire regime (frequency & intensity) are thought to be among the most likely influences of climate change in the GNE. Within this context, additional metrics to develop include fire intensity and vegetation recovery.

¹ The expected fire cycle for the Taiga Cordillera Ecozone is 83 years and the Taiga Plains Ecozone is 125 years (Krezek et al 2008). The former park is mainly comprised of these two Ecozones, so we averaged these two figures.

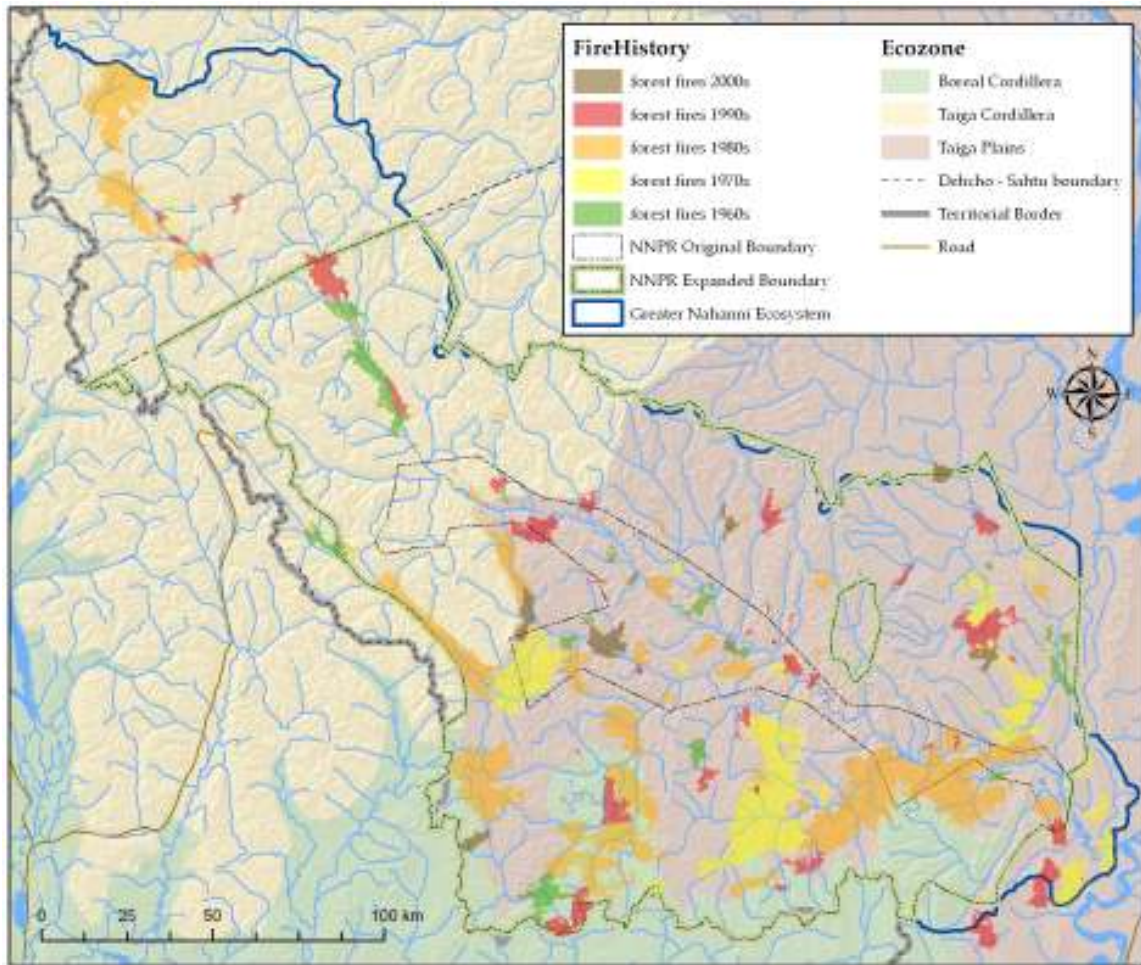


Figure 4. Map of fire history in NNPR and the GNE (1960-2005).

Measure – Forest Insects	
CONDITION	TREND
●	↔

Relevance: Forest insects play a significant role as a natural agent of change in boreal forest systems. Climate change also has the potential to increase the frequency & severity of infestations, as well as the number of defoliator species occurring in the park (Brett 2009). The two main insect defoliators identified in NNPR are Aspen Serpentine Leafminer and Spruce Budworm. The leafminer has not had significant impacts on forests, and no thresholds were set; however, previous large outbreaks of budworm have occurred in the region in 1955–1969 (not surveyed), 1982–1994, and 1998–2005.

Thresholds: Mortality of White Spruce can occur after 5-7 successive years of defoliation (Brett 2009). The widespread infestation of budworm in 1990 was reported at 146,000 ha (about one half of the spruce forest in NNPR), but this was coarse-level mapping; less actual spruce forest was affected (R. Brett, pers. com), and this event did not persist, or cause significant tree mortality. Sustained defoliation of 30% percent of the available spruce forest is considered a significant infestation, as widespread mortality would raise the risk of large, severe fires and associated impacts to river users, and caribou winter habitat. Thresholds were set according to these levels of impact.

- Green:** 1-year area extent <84,000 ha.
- Yellow:** 3 to 5 years at 84,000 ha or more.
- Red:** >5 years at 84,000 ha or more.

Assessment: The condition of forest insects is Good, with a stable trend. The insect species are present as a natural part of the forest ecosystem, are at low levels of occurrence with only small recent change, and low incidence of tree mortality was recorded.



Spruce Budworm defoliation (orange colour) near Nahanni Butte (© NRCan, Canadian Forest Service).

The amount of defoliation observed in the park over the last 5-year period is small relative to park area. Aspen Serpentine Leafminer was fairly widespread, with a slight increase from 2007 – 2008 (12,054 ha), but the majority of the affected area was considered moderate defoliation (Brett 2008). Small patches of Spruce Budworm defoliation were detected along the Flat River in 2004 and 2005. A fire in 2006 was thought to have eliminated the occurrence, but it reappeared in 2007 and increased slightly in 2008, when a total of 1564 ha were mapped (Brett 2008); this is less than 0.5% of the available spruce habitat. Mortality of White Spruce (may be due in part to flooding in some sites) was estimated at 2560 ha in 2008, and represented less than 30% mortality within the mapped area.

Measure – Primary Productivity (NDVI)	
CONDITION	TREND
●	↓

Relevance: Primary production or photosynthesis by plants is the building block of ecosystems, and the magnitude and the timing of the productivity of vegetation have important implications for wildlife. Across northern ecosystems, there has been an increase in the temperature during the

growing season, and the net rate of productivity of vegetation and the amount of green plant material, has shown a corresponding increase (He et al. 2008). One measure of vegetation productivity is an index of “greenness” derived from satellite imagery. The NDVI (Normalized Difference Vegetation Index;) is based on the spectral reflectance from green vegetation measured using satellite images from AVHRR (Advanced Very High Resolution Radiometer). NDVI values are determined for each of 21 photo-weeks, which are ten-day periods between April 1st and October 31st each year. Higher values of NDVI are associated with more green plant material.

Thresholds: Median NDVI values of each photo week from the last five (2003-2007) years in each ecodistrict in NNPR were compared to the average value from the preceding 17 years (1985-2002). In absence of biologically meaningful thresholds, 1.6 and 2.0 standard deviations of this mean were used as our upper and lower statistical thresholds.

Assessment: The condition of productivity in forests in Nahanni is good but shows a declining trend. The median NDVI values for most ecodistricts fall within the thresholds (Figure 5). The Sibbeston Lake Plain ecodistrict (235) has the highest median NDVI values, (*i.e.* the most green plant growth), which likely reflects the lower elevation of this ecodistrict. The average NDVI over the year (April to October) increased until the early 1990’s, and then decreased in the Nahanni Plateau ecodistricts, and remained stable in the Sibbeston Lake Ecodistrict from 1993-2007. The declining trend will need to be tracked to determine if the decline continues or if a cycle exists.

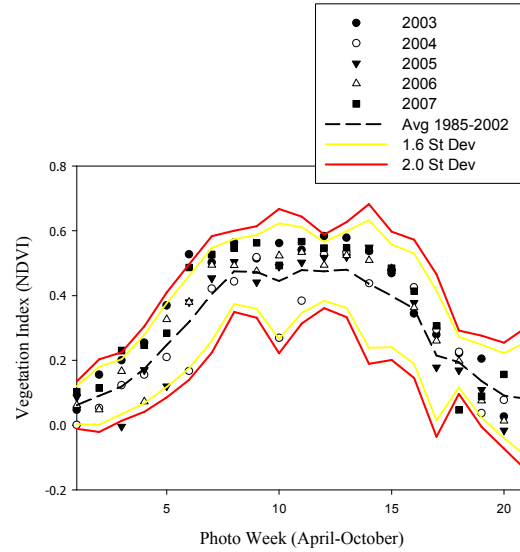


Figure 5. Sibbeston Lake Ecodistrict median Vegetation Index (NDVI) values (2003 to 2007) by Photo Week shown with the 1985-2002 mean and thresholds.

Measure – Aspen Phenology	
CONDITION	TREND
●	↓

Relevance: The date of leaf bud burst is an informative measure that may indicate a significant change in the ecological integrity of the park. Leaf bud burst is a proxy for a number of biological changes that occur with the onset of spring. It integrates a number of ecological processes including severity of winters, forest health, and length of growing season. Trembling Aspen is a common and widespread tree species in NNPR, and measurements have been done near Rabbitkettle Lake since 1996.

Thresholds: Thresholds were based on the data previous to the current State of the Park Report (pre-2004). The yellow and red thresholds are based on a 90% and 95% probability of a significant change, respectively. The minimum detectable trend for the earliest date of aspen leaf bud burst was ± 5 days in the next five years.

Late Red: May 26
Late Yellow: May 24
Early Yellow: May 7
Early Red: May 5

Assessment: The overall status for the date of aspen leaf bud burst is good. The range of leaf bud burst dates are still within the thresholds established by the pre-2004 benchmark (Figure 6). There is, however, a significant decreasing trend. The dates for leaf bud burst and hence the onset of spring are getting earlier. Based on a linear fit of the data, the onset of spring has increased on average by 5 days since 1996. However, spring is not consistently coming early every year, as there is much year-to-year variation. The timing of leaf bud burst was strongly correlated with ice out date, that is, in years when aspen leaf buds burst early, the ice went out early on Rabbitkettle Lake, and if leaf bud burst was late, ice out was late.

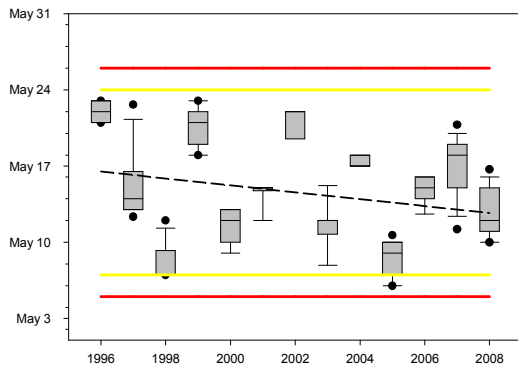


Figure 6. Changes in the dates of aspen leaf bud burst at Rabbitkettle Lake from 1996 to 2008. The median (inside bar), quartiles (box), and ranges (outlying bars) are shown for each year.

The current status is good with declining overall trend (earlier bud burst). Dates ranged from May 2 to 23. Bars denote warning thresholds.

Measure – Forest Bird Community	
CONDITION	TREND
●	↔

Relevance: Birds are often considered indicators of the condition of the larger ecosystem, many species have shown widespread population declines in recent years (NABCI 2009), and they are a relatively easy species group to monitor. Birds also hold a prominent place in popular culture, that is, they are meaningful to park visitors and the broader Canadian public. In Nahanni National Park Reserve, over 180 bird species have been recorded; nearly three times the number of all other vertebrate species (mammals, fishes, amphibians & reptiles) combined.

Thresholds: Reference condition for the species composition of forest birds was developed using existing datasets (Scotter *et al.* (1985); in particular, surveys in Deadmen Valley by J.D. Henry in 1976. Survey methods in 1970s and 2000s were too different for direct comparison of species abundance; common species were assessed based on recent trend data (2000s).

Green: All reference condition species present. All common species stable or increasing.

Yellow: One or two reference species missing; 3 or 4 (of 5) common species stable or increasing.

Red: Two or more reference species missing; less than 3 (of 5) common species stable or increasing.

Assessment: The species composition of forest birds in Deadmen Valley is considered good. All species listed as common or uncommon in 1970s (and most of the rare species) have been recorded in the past 5 years (not all on point counts). A subjective comparison suggests Swainson’s and Varied thrushes and Tennessee Warbler may be more common, whereas Red-eyed

Vireo and Hermit Thrush may be less common in the 2000s than in 1970s; however, the value of these comparisons is limited. Adequate power to detect trends in the recent data (2001 – 2008) was found for the five most common species: Tennessee Warbler, Swainson’s Thrush, Yellow-rumped Warbler, Varied Thrush, and White-throated Sparrow. Only Yellow-rumped Warbler decreased in abundance ($p=0.02$, $R^2=0.87$, % annual change= -20%). High numbers on the first count appears to cause this trend, with subsequent years’ numbers being relatively stable. The abundance of all other species was stable.



Dark-eyed Junco is a common forest bird in NNPR (© Parks Canada / D. Tate)

Measure – Grizzly Bear Occupancy	
CONDITION	TREND
●	↔

Relevance: Grizzly Bears are often cited as a good indicator or umbrella species for assessing ecological integrity, because they require large areas and usually do not tolerate habitat loss and disturbance well. Maintaining healthy Grizzly Bear populations is necessary to ensure EI of NNPR (Parks Canada 2004). Two methods were used to assess the population for this report. An intensive relative abundance and distribution survey method using scent-lure, hair-snagging and DNA analysis techniques was combined with landcover habitat

modeling to produce a density model and a population estimate over the entire GNE (Weaver 2006). This method produced an accurate "snapshot" of the bear population over the time period 2002 to 2005. The second method used observations by visitors travelling on the river, as recorded on mandatory trip reports, to assess the percent (%) occupancy of Grizzly Bears along the South Nahanni River; data were corrected for annual variation in visitation. The second assessment is limited to the river corridor and provides a signal of change, rather than a direct measure of density or population size, but is very cost-effective and provides annual values.

Thresholds: Based on a literature survey of similar areas, Weaver (2006) suggested an overall population of 500 animals would be needed to maintain a viable population Grizzly Bears within the Greater Park Ecosystem. Thresholds for % occupancy are based on detecting a significant change from the current levels with the yellow and red based on 90% and 95% probability of a significant change. The minimum detectable trend for % occupancy of Grizzly Bears using the current method was $\pm 3.6\%$ change in 5 years.

- Green:** > 40% Occupancy
- Yellow:** < 40% Occupancy
- Red:** < 39% Occupancy



Grizzly Bear in Fourth Canyon (© Parks Canada / S. Hayes).

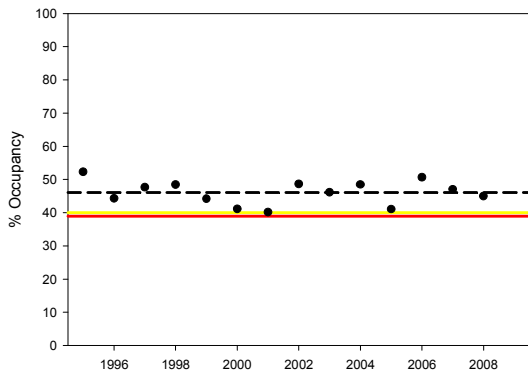


Figure 7. Percent (%) Occupancy of Grizzly Bears along the South Nahanni River corridor based on the trip reports of river travellers along with thresholds and the mean (dashed line).

Assessment: The status for the Grizzly Bear population is good. The current estimated population of 665 Grizzly Bears in the Greater Nahanni Ecosystem is well above the 500 animals suggested for a viable population by Weaver (2006). The estimated mean % occupancy of the Grizzly Bears along the river corridor is 46% but varies from 41% to 52% amongst years. There was no indication of an overall increase or decrease from 1995 to 2008 (Figure 7). The habitat suitability model suggests that at least 13 bears live within close proximity to the river corridor.

Traditional Knowledge

There used to be more grizzly bears, not now. (This is referring to east end of watershed and Nahanni Butte areas.)

Measure – Black Bear Occupancy	
CONDITION	TREND
●	↔

Relevance: Although less charismatic than Grizzlies, Black Bears are another important part of the mammalian fauna of NNPR. They are also of importance to park management because of the dual interests of park visitors in seeing a bear, but avoiding a negative encounter with one. There is some information on Black Bear habitat use and occurrence, but no direct measurement of populations, as there is for grizzlies. The percent (%) occupancy along the South Nahanni River was derived from visitor’s trip reports using the same methods as for Grizzly Bears. Changes in percent occupancy usually signal a change in population density.

Thresholds. As for Grizzly Bear % occupancy, thresholds are based on detecting a 90% of 95% significant change. No upper thresholds were set.

- Green:** ≥ 55% Occupancy
- Yellow:** 55-52% Occupancy
- Red:** < 52% Occupancy

Assessment: The status for the Black Bear population along the South Nahanni River is good and the trend is stable. The estimated mean % occupancy of the Black Bears along the river corridor is 64% but varies but the estimate varied from 57% to 77% amongst years. The minimum detectable trend for % occupancy using the current method was ± 5.6% change in 5 years. There was no indication of an overall increase or decrease from 1995 to 2008 but the data does have a cyclic pattern of which it appears to be on a downward part of the cycle (Figure 8). The % occupancy of Black Bears relative to Grizzly Bears is unchanged since 1995 with an average of about 40% more Black Bears than grizzlies along the river corridor.

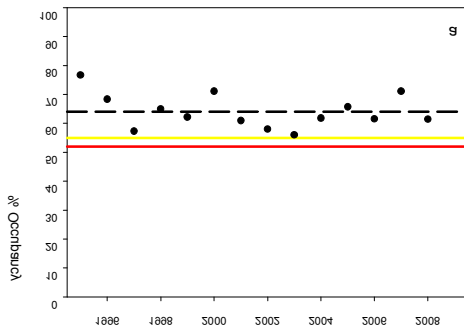


Figure 8. Percent (%) Occupancy of Black Bears along the South Nahanni River corridor based on the trip reports of river travellers along with thresholds and the mean (dashed line).

Measure – Moose Density	
CONDITION	TREND
●	N/R

Relevance: Moose are a common and widespread ungulate in NNPR, are culturally significant to the Dene people, and are the primary game species harvested by traditional users in the park. Moose are an important herbivore in the park ecosystem and may indirectly affect other species such as caribou by modulating predation rates by wolves (Hayes *et al.* 2003). Local communities, the Government of the NWT and Parks Canada have partnered on annual aerial surveys since 2004. This assessment is based on population and density estimates from survey blocks in the southeast end of NNPR and the area surrounding Nahanni Butte, using data from 2005-2008.

Thresholds: Survey data had high variability and low power to detect change; therefore, meaningful statistical thresholds could not be set. Therefore the expected Moose density in the NWT, which ranges from 0.03-0.17 Moose/km² (GNWT 2008a), was used as a threshold.

- Green:** > 0.03 Moose/km²
- Yellow:** 0.03-0.01 Moose/km²
- Red:** < 0.01 Moose/km²

Traditional Knowledge

There is still a lot of game in the Park, so we still hunt them (general comment on game species; Moose are main harvested animal).

Assessment: Moose density estimates for the total survey area (1152.5 km²) ranged from 0.02-0.07 Moose/ km² (Figure 9) and are within or near the expected range of Moose density for the NWT. These densities are towards the low end of the expected range, but they are likely underestimates because the area surveyed is close to communities, takes place following the fall hunt when animals may have been hunted or displaced from the vicinity, and there is no correction factor for sightability (N. Larter, pers. com). No significant difference among years was detected; however, the survey-based density estimates are highly variable and have very low power to detect changes. The status of Moose in NNPR is considered to be good but no trend can be assigned.



Calf and cow Moose at Rabbitkettle Lake (© Parks Canada / D. Tate).

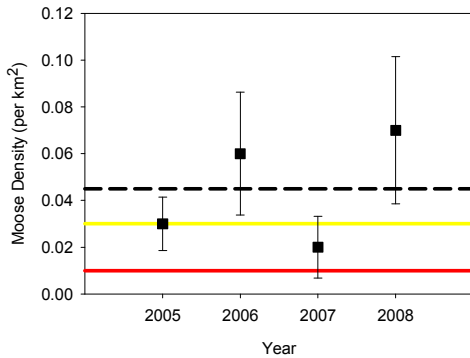


Figure 9. Moose density estimate standard error in the NNPR and Nahanni Butte area. There is no significant difference in the mean density values ($F=1.243$, $P=0.309$, $df=3$).

Measure – Caribou Composition	
CONDITION	TREND
■	↓

Northern Mountain Caribou travel widely in NNPR and the GNE. They overwinter in forested areas in the South Nahanni and Flat river valleys, and migrate to alpine areas in the spring for calving, post-calving and rutting seasons, so this measure applies to both indicators. See the **Alpine Tundra** indicator for details about this measure.

Alpine Tundra

Indicator – Alpine Tundra	
CONDITION	TREND
▼	↓

The overall condition and trend of the Alpine Tundra indicator is considered Fair and declining. There are a limited number of measures, but of the three ranked, two are good and one is poor. The monitoring program for this indicator is still in

development, with plans for a more robust measure of Dall’s Sheep density, on-the-ground measure(s) of plant productivity and biodiversity, NDVI measured spatially by indicator rather than by ecodistrict, and a landscape-scale measure of land-cover extent, change and tree line encroachment into the alpine.

Measure – Primary Productivity (NDVI)	
CONDITION	TREND
●	↓

Relevance: Primary production by plants is the building block of ecosystems, and the magnitude and the timing of the productivity of vegetation have important implications for wildlife, including Dall’s Sheep and Caribou. A study in Alaska related the calving success of Barrenland Caribou to the productivity of the calving grounds as measured by NDVI (Normalized Differential Vegetation Index) (Griffith *et al.* 2000). Calving and post-calving grounds for Northern Mountain Caribou are found in the alpine tundra indicator; however, similar research into the optimal NDVI values for caribou has not been done. The Selwyn Mountain Ecodistricts contain some of the Alpine Tundra ecosystems in NNPR.

Thresholds: See Forest Indicator.

Assessment: The EI status of productivity in the Alpine Tundra is good but shows a declining trend. The median NDVI values for most ecodistricts generally fall within the thresholds; however, some points fall below. These may represent snow events in the mountains since snow cover will dramatically decrease the NDVI value (Delbart *et al.* 2006) (Figure 10). The average NDVI over the growing season (April to October) increased until the early 1990’s, and then began to decrease in 1991 in 877 and 1994 in 880.

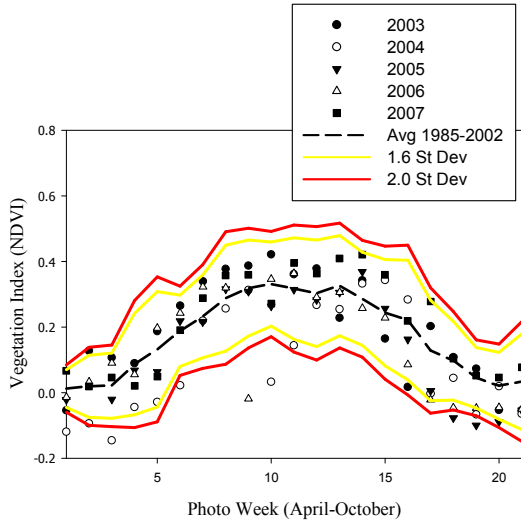


Figure 10. Selwyn Mountains Ecodistrict (#880) median NDVI values (2003 to 2007) by photo week shown with the 1985-2002 mean and thresholds.

Measure – Caribou Composition	
CONDITION	TREND
■	↓

Relevance: Caribou are an important part of the Dene culture, and the herds in the GNE belong to the Northern Mountain Population, which is listed as Special Concern under SARA. The caribou herds utilizing NNPR include the South Nahanni, Coal River, and LaBiche herds (Gunn *et al.*, 2002); all three use calving, post-calving and rutting grounds in alpine areas on both sides of the NWT-Yukon border, and winter ranges overlap along major river valleys within NNPR (Gullickson and Manseau 2000, Weaver 2006, Weaver 2008). Research has shown at least one herd is smaller than initially thought, recruitment is low, harvest may be excessively high, and threats appear to be increasing. Little information exists for the other two herds. Parks Canada, in partnership with Yukon & NWT governments and CPAWS-NWT, is continuing to monitor caribou. Recruitment

rates, as measured by the cow to calf ratio, are reported here. (See technical compendium for additional metrics & details).

Traditional Knowledge

First Nations concern over declining caribou numbers in the mountains was the catalyst that initiated caribou studies in the GNE during the mid-1990s. Scientific research has shown these concerns to be valid.

Thresholds: Research in the Yukon identified 26 calves per 100 cows as a minimum calf recruitment rate required to stabilize a caribou population (Hayes *et al.* 2003). However, management guidelines state that a successive number of years with recruitment rates below 30 calves per 100 cows results in population declines (Government of Yukon 1996).

- Green:** > 30 calves per 100 cows.
- Yellow:** 26-30 calves per 100 cows.
- Red:** < 26 calves per 100 cows.

Assessment: The status of caribou in NNPR is poor with a declining trend. The mean calf to cow ratio for the South Nahanni herd falls below the threshold for a sustainable herd in every survey year and is well below it in the four most recent surveys (Figure 11). The South Nahanni calf to cow ratio reached a low of 9.5 calves per 100 cows in 2008 and has averaged 12.8 (SE=1.0) calves per 100 cows over the past decade (four surveys dating back to 2000). The Coal River herd’s recruitment rate has also been below the threshold in both of the surveys conducted, with a low of 12 calves per 100 cows in the most recent 2008 survey (Figure 11). Only one composition count exists for the LaBiche herd: 22.5 calves per 100 cows (SE 3.8) in 1993. Fewer stressors have been identified for the LaBiche herd; its status and trend might be more favourable, but is currently unknown.

The observed low recruitment falls below the level required for population maintenance and suggests ongoing declines in the population. Moreover, if the *rate* of recruitment is declining, the caribou population decline may be accelerating. A population census on both the S. Nahanni and Coal River herds should be initiated and efforts made to understand population dynamics between South Nahanni, Coal River and LaBiche herds.

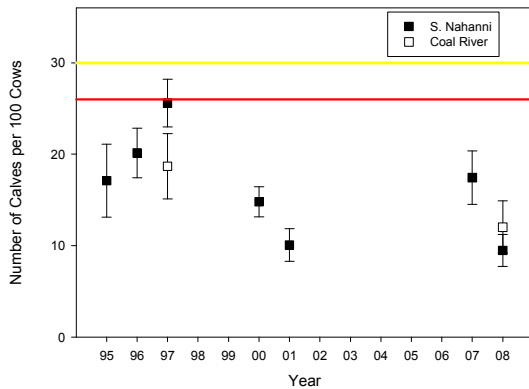


Figure 11. Mean ratio and standard error of calves per 100 cows during the fall rut of the South Nahanni and Coal River Caribou herds. The lower threshold of 26:100 calves to cows indicates inadequate recruitment to maintain the population.



Caribou in the alpine near Bologna Glacier, August 2007 (© Parks Canada / D. Haggarty).

Measure – Dall’s Sheep Composition	
CONDITION	TREND
●	N/R



Dall’s Sheep are characteristic of the alpine environment of NNPR (© Parks Canada / D. Tate).

Relevance: Dall’s Sheep are a significant component of Alpine Tundra fauna and are an important big game animal for sport hunters and Aboriginal harvesters. They are found in alpine areas across the GNE, concentrated primarily in the northern and eastern sections where winter snow pack is shallow or windblown (Weaver, 2006). The total population of Dall’s Sheep in the GNE is estimated at 800-1200 animals (Weaver 2006). Ground-based surveys were carried out on the Tlogotsho Plateau between 2001 and 2007. Mean lamb:ewe ratios and standard errors were calculated as described in Krebs (1999).

Thresholds: Dall’s Sheep monitoring is in development in NNPR and thresholds cannot be determined from these data; therefore, we have developed thresholds from the literature and expert opinion.

Green: ≥ 40 lambs per 100 ewes.

Yellow: 21 - 39 lambs per 100 ewes.

Red: < 20 lambs per 100 ewes.

Assessment: The status of Dall’s Sheep in NNPR is good, with an unknown trend. The lamb to ewe ratios observed on the Tlogotsho Plateau were highly variable (Figure 12), with a mean of 40 lambs per 100 ewes (SE =8.8). These ratios are within the range noted for healthy populations of Dall’s sheep in Alaska (21:100; Nichols and Bunnell, 1999) and are equivalent to the average ratio observed in northern Mackenzie Mountains (40:100; A. Veitch, pers.com). No significant difference was detected between years (F=1.29, p=0.3, df=4, 24), and the minimum effect size that can be detected is 70%. Therefore, the trend is unknown.

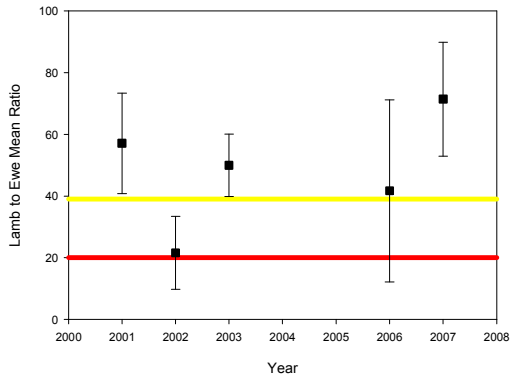


Figure 12. Dall’s Sheep lamb to ewe ratio by year of survey. The ratio for all years together is 39.5:100 (SE=8.8).

Wetlands generally appear to be in good condition in the park, and Trumpeter Swan populations are doing well. However, traditional knowledge suggests there are fewer waterfowl being seen.

Traditional Knowledge

Elders say there are fewer ducks and geese than there used to be.

The Nahanni Aster, a rare endemic plant associated with thermal springs in the park, was assessed as stable in 2003, but regular monitoring has not been formalized. Monitoring of the presence and relative abundance of Wood Frogs has been initiated, in collaboration with the binational Terrestrial Wetlands Global Change Research Network. Measures currently under investigation include the extent of wetlands in the park, and the dynamics of permafrost and its effects on wetland processes.



The Nahanni Aster is a rare plant associated with thermal springs in the Greater Nahanni Ecosystem (© J.C. Semple, University of Waterloo).

Wetlands

Indicator – Wetlands	
CONDITION	TREND
N/R	N/R

The *Wetlands* indicator is the least monitored of the five ecological indicators in NNPR; this SOPR reports on only one measure, the Trumpeter Swan population. With only one monitoring measure in place at this time, this indicator was not rated.

Measure – Trumpeter Swan Population	
CONDITION	TREND
●	↑

Relevance: The Canadian Wildlife Service coordinates national scale surveys of Trumpeter Swans on a 5-year interval, and these surveys have included the southwestern Northwest Territories since 1980. The species only occurs in the Dehcho and southern Sahtu regions, and these birds are considered part of the Rocky Mountain population (Beyersbergen 2007). NNPR contributes to this effort by surveying known swan habitats within the park reserve and GNE; opportunistic observations of swans are also recorded. Surveys are undertaken in late August or early September, recording group size and age classes for all observations. Yohin Lake, the largest wetland complex in NNPR, and adjacent wetlands in the Tetcela River valley support concentrations of breeding swans, and are considered a nationally important bird habitat area (Latour et al. 2008).

Thresholds: Trumpeter Swan was listed as a species at risk in the 1970s; populations have increased dramatically since that time, and the species was reassessed as Not at Risk based on 1995 survey data (COSEWIC 2009). Thresholds were based on population numbers at the time of species reassessment.

- Green:** > 178 adult swans;
- Yellow:** 90-178 adult swans
- Red:** < 90 adult swans



Trumpeter Swans on Yohin Lake (© Parks Canada).

Assessment: The current assessment of Trumpeter Swans is good, with an increasing trend. The amount of data and method of collection precluded park-specific analysis, and being a highly mobile species with more suitable habitat outside the park than within, assessment of Trumpeter Swans is considered at a regional scale. The number of adult swans observed in the NWT has increased exponentially from 1980 – 2005 ($R^2=0.99$, $p<0.0001$; counts adjusted to standardized survey area) (Figure 13). The number of cygnets observed has also increased over that time period. The Canadian Wildlife Service considers the Trumpeter Swan population in the NWT to be in very good condition, and increasing in numbers (P. Latour, pers. comm.).

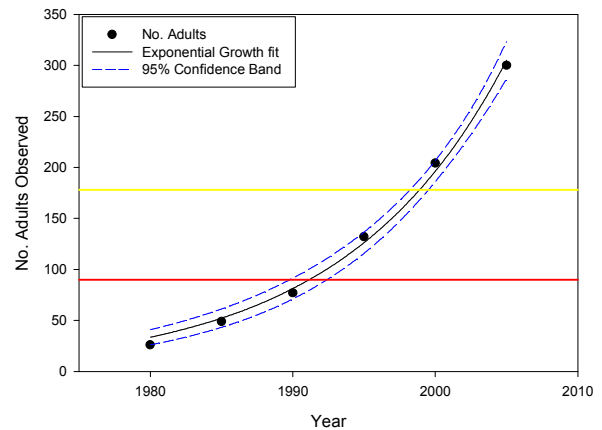






Figure 13. Trumpeter Swans observed on NWT surveys (adjusted to standard area), 1980 – 2005.

Freshwater

Indicator – Freshwater	
CONDITION	TREND
	

The Freshwater indicator is a high priority for NNPR; the park is known primarily for its river-based recreation opportunities, maintaining clean water is of great concern to DFN communities, and access to clean water is considered a basic human right. Existing and possible future industrial activity upstream of park boundaries, the transport of long-range pollutants and climate change all have the potential to decrease water quality and freshwater ecological integrity. The freshwater monitoring program in NNPR is relatively well developed with five measures presented in this report. Protocols for benthic invertebrate and algae population measures of ecological integrity are under development. The overall condition of Freshwater is assessed as **Good** with a stable trend.

Measure – River Flow	
CONDITION	TREND
	

Relevance: Stream flow regime is the driving force in river ecosystems and controls key habitat parameters such as river depth, velocity, and habitat volume (Richter et al 1998). River ecological integrity depends on this natural hydrological variability, or flow regime, that includes associated characteristics of timing, duration, frequency and rate of change (Ritcher et al. 1997). River flow is highly

variable throughout the year as well as from year-to-year, as is evident from the hydrograph of the South Nahanni River gauge above Virginia Falls (Figure 14), one of the two gauges in NNPR maintained by the Water Survey of Canada. The other gauge is on the Flat River near the mouth. NNPR’s management plan acknowledges that stream flow is a primary force shaping the ecosystem (NNPR 2004). However, climate change is altering the means and extremes of precipitation, evapo-transpiration, the rates of discharge of rivers. Although glacier melt water may temporarily enhance water availability; glacier and snow-pack losses diminish natural seasonal and inter-annual water storage (Milly et al. 2008)

Thresholds: River flow parameters from 2000-2007 were compared to a twenty-year baseline period (1973-1993). In order to assess condition, the Range of Variability Approach (RVA) (The Nature Conservancy, 2007) was used to identify trends in river flow parameters that describe flow regimes (Ritcher et al 1997, 1998). RVA determines if the observed flow parameters for the more recent time period (2000-2007) fall within the expected range defined using the 33rd and 67th percentiles of the baseline period. Regression analysis was used to determine the trend in flow parameters.

Assessment: River flow condition is assessed as green with a stable trend. Despite numerous changes apparent in the Virginia Falls and Flat River hydrographs, these changes appear to be cyclical in nature.

The most dramatic river flow changes occur in the winter. Statistically significant increasing trends in the median monthly flow during the base flow period (November-April) observed using the RVA method, linear regression and the Mann-

Kendall test. Winter baseflow originates from groundwater and increases may be due to permafrost thawing (St. Jacques and Sauchyn 2009), reductions in winter storage of water in the form of river ice (M. Demuth, pers com) or to large scale shifts in the atmospheric and climatic anomalies such as that expressed by the Pacific Decadal Oscillation (PDO) which shifted from a dry phase to a wet phase in the mid 1970's (Spence 2002).

Winter baseflow in the South Nahanni and Flat rivers is significantly correlated with the PDO, although flow lags behind the PDO by 9 years. Baseflow was below normal from 1965-1987 and it took up to 9 years to water replenish storage after the extended dry period (Spence 2002). Since there is not a long enough time series to determine if increased baseflow is a long-term change or simply a part of longer hydrological cycle, the trend in river flow is assessed as being stable; however, it will be monitored closely. Furthermore, increased baseflow

may provide better overwintering habitat for fishes such as Arctic Grayling, Bull Trout and Lake Trout.

Median flow in June, during the peak of the freshet, at both stations appears to be more variable in this decade than previously as the median value falls outside of the RVA range more frequently than expected, but no significant trends were found using the Mann-Kendall test or linear regression. Other flow parameters, such as the fall rate and the number of reversals (defined as a change from increasing to decreasing flow and vice-versa) also indicate that the South Nahanni and Flat rivers may be more variable on a day to day basis now than in the past; however, this may also be attributable to greater baseflow rates. September flow in the South Nahanni River also shows a departure from expected. Please see the Glacier Indicator, River Flow section for this discussion.

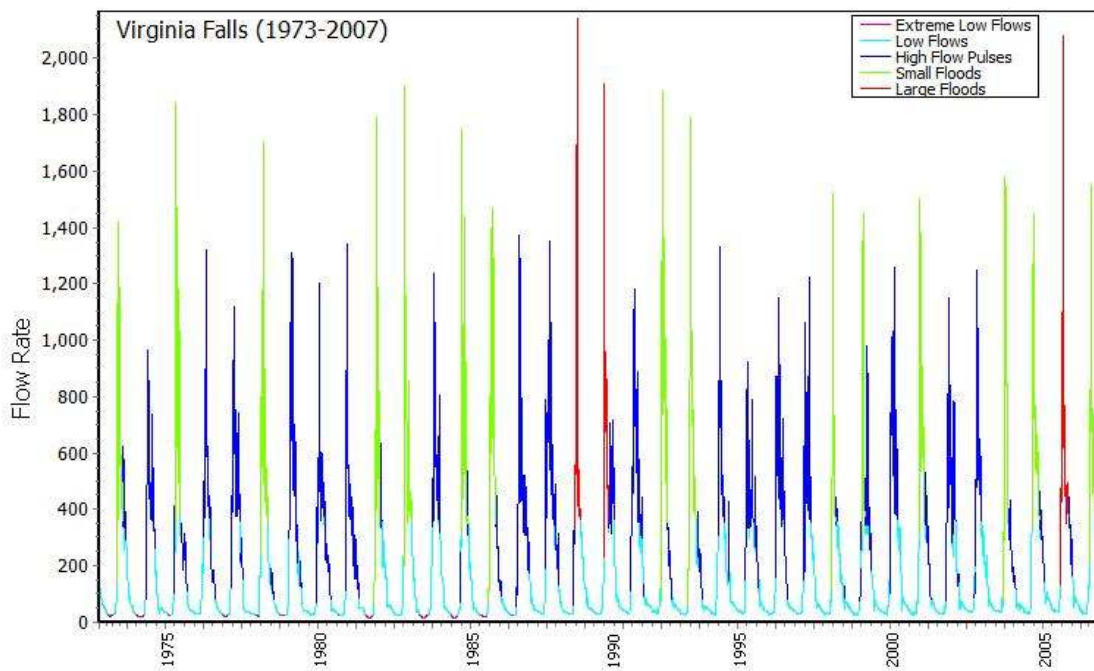




Figure 14. Hydrograph of South Nahanni River above Virginia Falls (1973-2007).

Measure – Water Quality	
CONDITION	TREND
	

Relevance: The water quality of the South Nahanni River (SNR) watershed is a key measure of NNPR’s ecological integrity and health (Parks Canada 2004). Parks Canada has commitment to comprehensive water quality monitoring to prevent degradation and to ensure the “highest possible standards of quality” of NNPR waters (Parks Canada 2004). Due to the NNPR’s location in the lower reaches of the SNR watershed, its near-pristine water quality is considered vulnerable to upstream development. Current and potential mining developments outside NNPR boundaries on tributaries to the SNR have raised concerns over possible effects on the NNPR’s aquatic ecosystems. An existing tungsten mine is found upstream of NNPR along the Flat River, and a lead-zinc mine is in development on the Prairie Creek, a mere 6 km upstream from the new park boundary.

Along with our partners at Environment Canada, we monitor 8 sites in the park 3 times per year. Comprehensive analyses of the water quality program are available in Halliwell and Catto (1998) and Parker *et al.* (2009). Here, we present the results of the Water Quality Index (WQI) analysis. WQI is a tool that combines complex water quality information, producing a simple, integrated water quality rating. The WQI rating is generated through the comparison of multiple water quality parameters against water quality guidelines, generating a single water quality rating which is dependent upon the number of parameters that have concentrations in excess of guidelines, as well as the frequency and magnitude of those exceedances. Index values range between 0-100 and are categorized as “Excellent” to “Poor” (CCME 2001).

Rather than comparing our data to CCME water quality guidelines, site specific guidelines (SSGs) were developed using a background concentration procedure, which has been applied in rivers, such as the South Nahanni, with high natural background concentrations of substances (CCME 2003; Khan 2005) using the mean + 2 SD. SSGs were calculated using data from the period of 1993-2006. Eleven parameters, including pH, nutrients, major ions and metals, were used in the WQI calculations. Where a suitable reference site (i.e. no known point sources upstream) was identified, the SSG developed for the reference site was applied to all sites downstream on a given river. WQI ratings were calculated for three-year rolling averages for the period of 1993-2006. A three-year rolling average was applied to limit the effects of intra- and interannual variability in water quality on the index rating.

Thresholds:

- Green:** WQI rating of **Excellent** (95.0-100) or **Good** (80.0-94.9)
- Yellow:** WQI rating of **Fair** (65.0-79.9)
- Red:** WQI rating of **Marginal** (45.0-64.9) or **Poor** (0-44.9)

Assessment: Water Quality is assessed as good and stable. WQI values for most monitoring sites within NNPR between 2000-2006 rated Excellent or Good with the exception of a few ratings of Fair (Flat River sites 2002-2004; Prairie Creek at Boundary 2003-2005, and Prairie Creek at Mouth 2001-2003) (Table 8). The stations at Nahanni Butte and Prairie Creek above and below the Prairie Creek Mine sites are outside of NNPR. No temporal trends in the WQI are apparent.

Water quality of the SNR rated between “fair” and “good”. Water quality was rated slightly better upstream than downstream. Water quality ratings at both the upstream and downstream sites increased from the 1990’s to the 2000’s due to a lesser scope

and frequency of exceedances in metals at SNR above Virginia Falls and nutrients at SNR above Nahanni Butte. Water quality on Flat River rated “fair” and “good”. Water quality rated better upstream than downstream. Water quality ratings increased at both sites from the 1990’s to the 2000’s due to fewer exceedances in metals at both sites and fewer exceedances in nutrients at the downstream site.

Water quality on Prairie Creek rated primarily “fair”, with water quality downstream of the park boundary rating “good” in the 2000’s. Index scores generally increased along the length of the river from upstream to downstream, and between the 1990’s and the 2000’s (Prairie Creek at the

Mouth) attributed to primarily to fewer exceedances in metals (particularly zinc) and nutrients. Exceedances in silver and tungsten were of greater magnitude and frequency at the two sites farthest downstream.

It is recommended that further consideration be given to the nature of the exceedances of high frequency and magnitude within the SNR basin. Of note would include silver and tungsten on Prairie Creek at the Mouth. Further consideration should also be given to the nature of the exceedances over the winter months (February, March) of 2000-2006, to determine if elevated concentrations are associated with natural or anthropogenic sources.

Table 8. WQI values for sampling stations on the South Nahanni River, Flat River and Prairie Creek (above and below the Prairie Creek Mine (PCM)).

Index Period*	South Nahanni River		Flat River		Prairie Creek			
	Virginia Falls	Nahanni Butte	Park Boundary	Mouth	Above PCM	Below PCM	Park Boundary	Mouth
1993-1995		94		84				75
1994-1996		79	79	74				78
1995-1997		68						68
1996-1998	79	73						
1997-1999	84	79						
1998-2000	79							
1999-2001	79							
2000-2002	84							
2001-2003	89	84						78
2002-2004	84	81	74	79				84
2003-2005	89	84	95	89	74	79	78	82
2004-2006	95	79	95	89	68	78	83	82

* The index could not be calculated in all years for all sites.

Measure – River Ice	
CONDITION	TREND
●	↔

Relevance: The date of river freeze-up, ice break-up and the duration of ice conditions are important characteristics of northern rivers. Burns and Hag Elnur (2002) and Zhang *et al.* (2001) found significant changes in the timing of river freeze-up, with the earlier onset of ice, as well as earlier break-up in the spring, resulting in no change in the duration of ice cover for rivers in BC and Yukon. The date of fall freeze-up and spring break-up are both indicated by a flag in the data archive for the river gauge stations maintained on the Flat River at the mouth of the South Nahanni and on the South Nahanni River above Virginia Falls. The duration of ice cover is the number of days when channel hydraulics are affected by ice conditions.



The top of Virginia Falls during spring break-up (© Parks Canada / D. Haggarty).

Thresholds: A change in the date of ice out may not trigger specific management actions, but it is an informative measure that may indicate a significant change in the ecological integrity of the park. The mean and standard deviation from 1960-1990/91 for the three measures for the Flat River and Virginia Falls were calculated as a base period. Statistical thresholds were then

calculated as 1.6 and 2.0 standard deviations around each mean. Data from 1998-2007 were plotted along with the thresholds to determine the status. In order to determine the trend, linear regressions were performed on the entire data set.

Assessment: The condition of the three parameters for both the Flat River and the South Nahanni River above Virginia Falls is good since most of the recent years fall within the expected range of the baseline periods (Figure 15). The mean date of the freeze up, break up and the duration of ice cover for the entire data set was October 18th, May 6th and 203 days for Virginia Falls and October 19th, May 3rd, and 200 days for the Flat River. The only significant regressions were the date of the Flat River freeze-up and Virginia Falls break-up, both with trends towards earlier occurrence. The linear model explains a low proportion of the variation in both cases ($R^2=0.11$, $p=0.03$ and $R^2=0.18$, $p=0.008$, respectively). There was no trend in the duration of ice cover for either river and the overall trend is assessed as stable. The date of river break-up of the Flat River is more strongly correlated with the date of ice-out at Rabbitkettle Lake ($R=0.81$, $p=0.01$) than the South Nahanni River’s break-up date is to the lake ice-out ($R=0.59$, $p=0.03$).

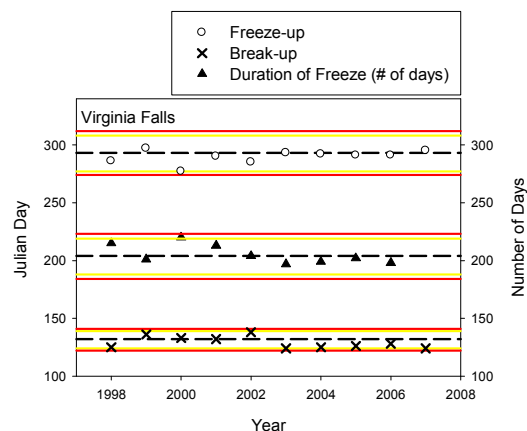


Figure 15. Dates of river freeze-up, break-up and the duration of ice cover in the South Nahanni River above Virginia Falls with thresholds and the mean (dashed line) of 1960-1990/91.

Measure – Lake Ice-out	
CONDITION	TREND
●	↔

Relevance: Along with the aspen leaf bud burst and river ice break-up, the date of ice out is a proxy for a number of biological changes that occur with the onset of spring. In particular, it signals change of seasons for aquatic systems. Measurements have been taken at Rabbitkettle Lake since 1995. These are used as an index of all freshwater lakes and ponds within Nahanni National Park Reserve.

Thresholds: The date of ice out is an informative measure that may indicate a significant change in the ecological integrity of the park. Since there were no trends within this dataset, thresholds were based on the entire dataset. The yellow and red thresholds are based on a 90% and 95% probability of a significant change. The minimum detectable trend for the date of ice out on Rabbitkettle Lake was ± 5 days in the next five years.

- Late Red:** May 26
- Late Yellow:** May 24
- Early Yellow:** May 8
- Early Red:** May 6

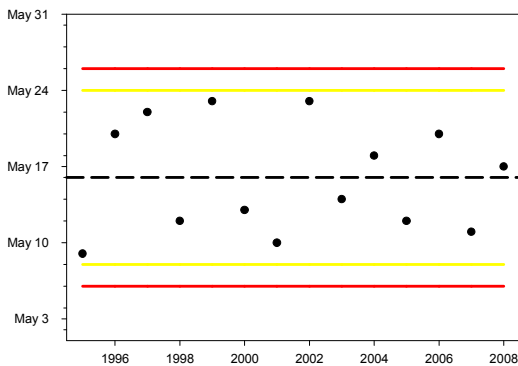


Figure 16. Dates of ice out on Rabbitkettle Lake from 1995 to 2008 with the long-term mean (May 16) denoted with the dashed line and warning thresholds.

Assessment: The overall status for the date of ice out is good with a stable trend. The mean date for ice out was May 16 with the earliest date on May 9 (1996) and the latest date on May 23 (1999, 2002) (Figure 16).

Measure – Sport Fish CPUE	
CONDITION	TREND
●	N/R

Relevance: Fish in northern waters grow more slowly and mature later than fish in southern waters, which can make northern populations more sensitive to habitat disturbance or harvest. The Committee on the Status of Endangered Wildlife In Canada (COSEWIC) is in the process of assessing the status of Bull Trout, Lake Trout, Inconnu, and Arctic Grayling populations. Bull Trout is listed as “May be at Risk” in the NWT. The current management plan of NNPR requires that recreational fishing within the park reserve be monitored to ensure that the natural dynamics of its fish populations are not jeopardized. The fish that anglers are most likely to encounter in the GNE include Arctic Grayling, Bull Trout and Lake Trout. In 2008, sport fishers were recruited to help monitor sport fish populations in the NNPR through a voluntary creel survey. They were asked to record and submit data on fishing effort and the number of each species caught. Similar creel surveys were conducted in NNPR in 1984, 1985, 1986 and 1990.

Thresholds: No ecological thresholds exist; therefore, we used statistical thresholds to assess the Total Fish Catch per Unit of Effort (CPUE). Lower thresholds were set as the 35th and 20th percentile of the historical catch rates (1984-1990). No upper thresholds are set.

- Green:** > 0.62 fish per hour
- Yellow:** 0.62-0.24 fish per hour
- Red:** < 0.24 fish per hour

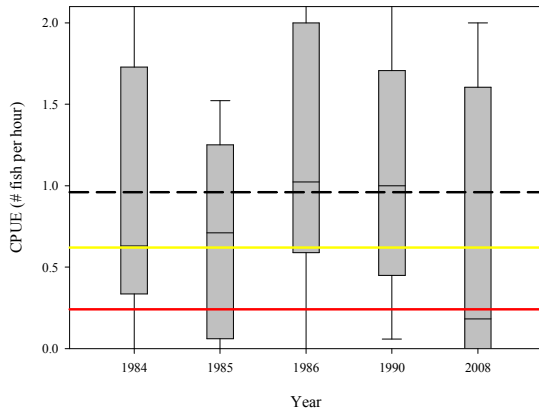


Figure 17. Catch per unit of effort (CPUE) of all sport fish species by year. The median (inside bar), quartiles (box), and 90th and 10th percentiles (whiskers) are shown for each year. The 1984-1990 median (dashed line) and the lower thresholds (35th (yellow) and 20th (red) percentiles) are also shown.

looked at the species composition of the total catch. Arctic Grayling was the most commonly caught species in all years (between 66-87% of the catch). Two species of char, Lake Trout and Bull Trout, are also caught; and their numbers were added together due to uncertainty of species identification. A significantly greater proportion of char (between 20-34%) were caught in 1984-1990 as compared to only 7% in 2008 ($\chi^2=21.9$, $df=4$, $p<0.001$).

NNPR has recently changed its fishing regulations to include the non-retention of Bull Trout in the park reserve by sport fishers. Sport fish populations should continue to be monitored and sport fishers should be strongly encouraged to take part in the survey to improve the sample size.

Traditional Knowledge

The fish are scarce. People haven't been keeping an eye on the fish that much. If you want to protect the fish and water, you have to protect the whole watershed.

Assessment:

The catch rates of all fish species were too low and variable to merit individual calculation of CPUE. Therefore, we combined all species caught into a Total Fish CPUE. The median Total Fish CPUE in 2008 falls below the thresholds, however no statistically significant difference among years was found (Kruskal-Wallis test, $H = 5$, $p = 0.28$, 4 df ; Figure 17). Therefore, we assessed the condition as good. No trend is available since only one year of contemporary data is available. We also



Fishing on the South Nahanni River (©Parks Canada / D. Haggarty).

Glaciers

Indicator – Glaciers	
CONDITION	TREND
▼	↓

Glaciers are an important source of freshwater. They maintain stream flow when other sources such as snowmelt or precipitation are in decline or absent. Glaciers influence water temperature and hydraulic conditions and provide ecosystem services for highly adapted aquatic life. The majority of the Earth’s glaciers have been contracting over the last 150 years, and recent evidence indicates an accelerating trend (e.g., IPCC 2007) therefore, glaciers are the subjects of intense cultural, ecological and technical interest.

Three related measures are monitored: 1) Glacier Extent at a landscape scale, 2) Mass Balance at one glacier in NNPR, and 3) River Flow in September at Virginia Falls. The overall rating for the Glacier Indicator is fair with a declining trend.

Measure – Glacier Extent	
CONDITION	TREND
▼	↓

Relevance: The glaciers of the GNE carry intrinsic landscape values and have public safety, visitor experience and ecological significance. Their presence generates strong katabatic wind flows - one of the benefits being a reduction in ungulate insect harassment. Glaciers that flow over significant topographic barriers may also provide convenient (though potentially hazardous) passage for wildlife and humans from one region of the GNE to another. Digital glacier extent data in the GNE are

available for three time periods: circa 1982 (from the National Topographic Database (NTDB) permanent snow and ice layer), and 1999 and 2008 (Landsat 5, 7 TM imagery; Wilson 2009).

Thresholds: This measure is assessed using the Fractional Area Change (FAC) and the rate of change (km²/yr).

- Green:** FAC is increasing or close to zero.
- Yellow:** FAC is negative and the rate of change is ≤ to the previous time period.
- Red:** FAC is negative and rate of change is accelerating relative to previous time period.

Assessment: The condition of this measure is assessed as fair with a declining trend. Between 1982 and 2008 (26 years) the glacier-cover area in the GNE contracted by approximately 30% (from a total area covered of 262 km² to 184 km²) but the FAC and the rate of change varies with the size of the glacier. Most of the decline occurred within glaciers that were 1.0 to 10 sq. km and 0.1 to 10 sq. km (Table 9, Figure 18). This included the loss of 57 glaciers in these size classes. The smaller and larger size classes including the 2 large outlet glaciers were less prone to losses. Some glaciers do show little to modest growth. These glaciers were confined to the smaller size classes at higher elevations and were found in areas where topography provides reliable nourishment from drift snow, and protection from solar radiation.

The rate of change of glacier area varies significantly between the two time periods (1982-1999 and 1999-2008) for the two middle size classes (Table 1). The rate of change appears to decrease for the 1999-2008 period. This may reflect that some glaciers have already retreated to higher elevations. Given the resolution of the remote sensing imagery, there is also greater uncertainty in measuring change over this relatively short period (9-years).

Table 9. Fractional Area Change (km²) of glaciers in the GNE by Size Class, proportion of glaciers in each size class in 2008, and Rate of Change of glacier area by year.

Area Class (km ²)	1982 Baseline		1999		2008		Mean Rate of Change 82 to 08	% of Total Glacial Area	
	Area	N	Area	N	Area	N			
0.01 – 0.1	1.9	23	1.6	22	-1.5	1.5	20	-1.0	0.8
0.1 – 1.0	63.8	173	44.0	157	-1.6	33.5	127	-0.7	18.1
1.0 – 10.0	166.7	65	142.0	64	-1.2	121.1	54	-0.4	65.6
10.0 – 100	29.9	2	29.0	2	-0.2	28.5	2	-0.2	15.4
Total	262	263	217	245	-1.5	184	203	-0.7	100

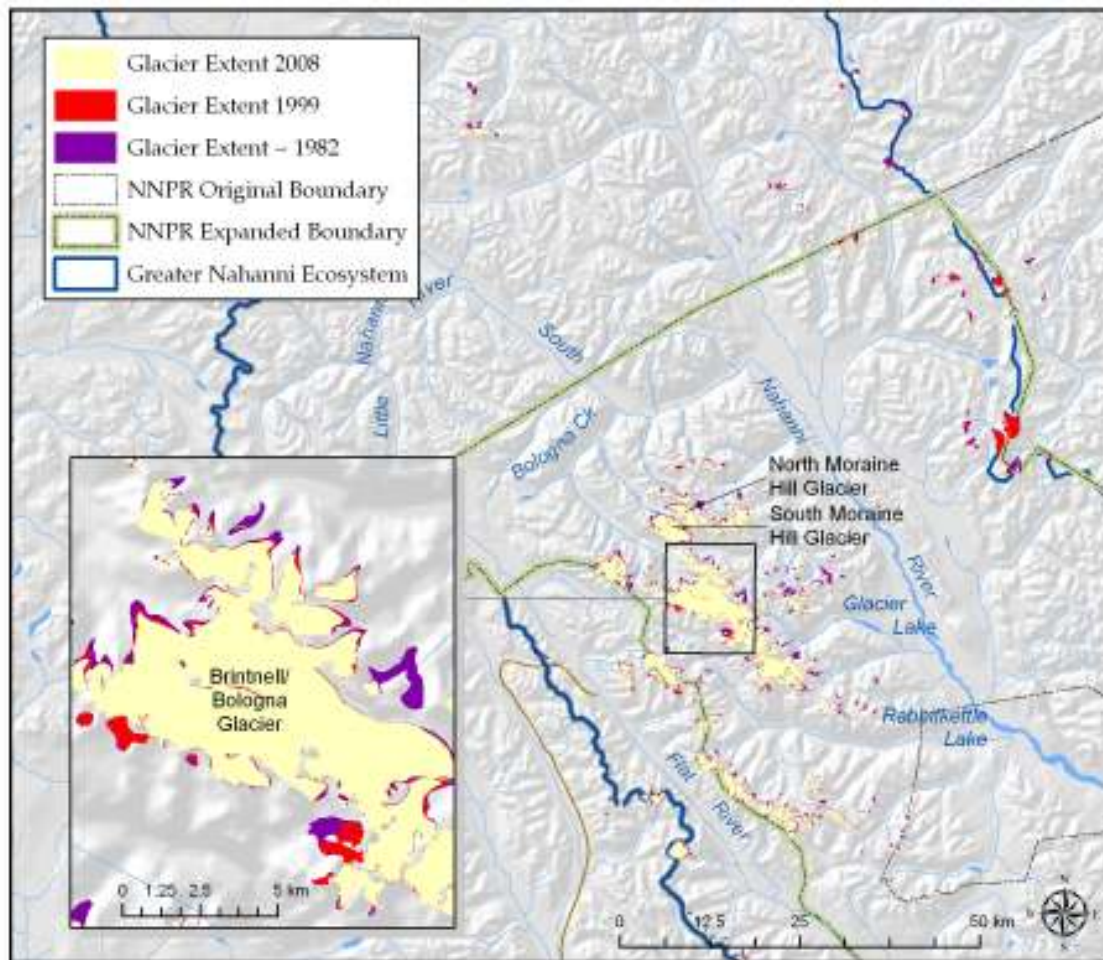


Figure 18. Map of glacier extent in NNPR in c. 1982, 1999 and 2008.

Measure – Mass Balance	
CONDITION	TREND
▼	Undetermined

Relevance: To understand the underlying processes that lead to changes in glacial extent over the landscape, we measure and report on the mass balance of a glacier over the seasons. Glaciers accumulate mass through snowfall in the winter, and lose mass through melting in the summer. The balance of the accumulation to melt can be measured *in-situ* using a mass balance monitoring. Year-to-year persistence in a negative/positive mass balance will lead to glacier thinning/thickening and contraction/advance. Therefore, both measures are needed to provide annual and decadal perspectives on the moisture and energy fluxes in the alpine regions of the GNE. The mass balance of one large glacier in NNPR, the Bologna Glacier, has been monitored semi-annually since 2007.

Thresholds: Glaciers exhibiting persistent equilibrium mass balances (i.e. 0 ± 200 mm water equivalent) will tend towards a stable geometry and therefore stable EI values. However, no thresholds will be set until additional years of data are collected.

Assessment: Only two years of mass balance data are currently available (2007, 2008). In the absence of a long-term data set, these two data points can be evaluated with respect to other mass balance observation sites in Western Canada and Alaska (Figure 3). The mass balance of the Bologna Glacier was estimated to be -765 mm W.E. (Water Equivalent) in 2007 and -775 mm W.E. in 2008. The value for 2007 falls within the 95% confidence interval for the aggregate time series on the negative side of the balance, and 2008 is also likely to be within this range (data from other sites are not yet available) (Figure 19). Therefore, it is likely to that the Bologna Glacier is behaving similar to other glaciers.

Extrapolating from this time series would suggest that the previous years would have also fallen within the confidence bounds of other glaciers measured and the Bologna Glacier would also have exhibited a negative trend. However, due to the uncertainty extrapolations, this measure is rated as having a fair condition. Trend will not be assessed until more data points for the Bologna Glacier are collected.

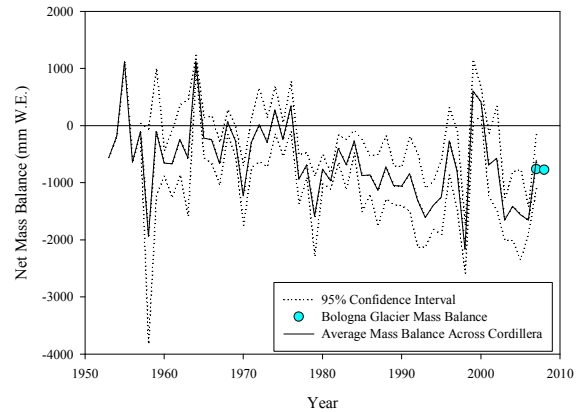


Figure 19. 2007 and 2008 Bologna Glacier net mass balance (mm W.E.) with mean and 95% Confidence Intervals from mass balance sites in the Cordillera (data from the NRCan-ESS *State and Evolution of Canada’s Glaciers* initiative, http://pathways.geosemantica.net/WSHome.aspx?ws=NGP_SECG%26locale=en-CA).

Measure – River Flow	
CONDITION	TREND
▼	↔

Relevance: As discussed in the River Flow measure in the Freshwater Indicator, stream flow regime is the driving force in river ecosystems and controls key habitat parameters such as river depth, velocity, and habitat volume (Richter *et al.* 1998). Glacier run off can contribute significantly to stream flow in watersheds such as the South Nahanni. Catchments with glaciers have been shown to have freshets that are longer, larger and peak later than catchments without glaciers and also have higher winter

baseflows (Fleming 2005). Glacier melt water also influences river temperature, sediments, nutrients and hydraulic variability (Petts *et al.* 2006). Petts *et al.* (2006) shows that substantial changes in discharge and sediment load during the melt season (July-August) can lead to channel instability in glacier-fed streams as well as fluxes in temperature including cold pulses. These all have consequences for stream invertebrate communities and fish populations (Fleming 2005, Petts *et al.* 2006). Climate change is altering the rate that glaciers are melting at (IPCC 2007). Although glacier melt water may temporarily enhance water availability, glacier and snow-pack losses diminish natural seasonal and inter-annual water storage (Milly *et al.* 2008).

Thresholds: Using the Range of Variability (RVA) analysis (Ritcher *et al.* 2007, 2008) and the Mann-Kendall test (Burn and Hag Elnur 2002), the recent (2000-2007) September river flow data are analyzed to see if they fall within or depart from the expected range (1973-1993). Regression analysis was used to determine the trend in September flows. See Freshwater Indicator for more information.

Assessment: The River Flow measure is fair with a stable trend. September flow in the South Nahanni shows a departure from expected using the RVA and the Mann-

Kendall test however no significant regression trend exists. The South Nahanni River above Virginia Falls is fed by a number of glaciers. Therefore, the increased flow during September may be reflective of increased amounts of glacier melt contributing to the South Nahanni in September. Increased rates of run-off from the glaciers may also be contributing to the increased winter base-flow in the South Nahanni River (M. Demuth, pers. com).



Glaciers in the Ragged Range, NNPR. (© Parks Canada / D. Haggarty).

4. State of Cultural Resources

4.1 Cultural Resources Context

Dene peoples have used the lands in and around Nahanni National Park Reserve since time immemorial, harvesting plants, fish and the abundant ungulate populations of the region. Evidence of precontact human use has been found at Yohin Lake and other sites within NNPR, and the first human occupation of the area is estimated to have occurred 9,000 - 10,000 years ago.



A stone tool from a precontact site near Nájłicho, Virginia Falls (© Parks Canada / D. Arthurs).

Prospecting and trapping in the late 19th and early 20th centuries began with the influx of gold seekers en route to the Klondike Gold Rush across the Mackenzie Mountains both on the Flat and South Nahanni Rivers (1896-1898). Albert Faille traveled extensively in the area over a span of six decades, and is one of the best-known historical figures; Faille was featured in a National Film Board production. Mary and Gus Kraus homesteaded at Kraus Hotsprings from 1940 to 1971 and were the only known permanent residents of the park reserve in recent history.

Earlier archaeological surveys were conducted along the South Nahanni River corridor in 1977-1978, and at Yohin Lake in the late 1980s. An

archaeological reconnaissance survey of the park, to revisit previously recorded sites and update cultural resource information, was initiated in 2000 and completed in 2005. Most of the sites documented during these surveys relate to the more recent historic use of the river corridor.

Currently, there are no national historic sites in NNPR and, therefore, no Level I¹ cultural resources. The Deadmen Valley Forestry Cabin was submitted for consideration under the Federal Heritage Buildings Review Office policy but was not considered a heritage building. The park still considers this building and site to be a Level II resource worth protecting and presenting for its interpretive values.

Cultural resources within NNPR, including those identified in this report, are managed according to Parks Canada's *Cultural Resource Management (CRM) Policy*. Only sites within the former NNPR boundary are assessed in this section.

4.2 State of Cultural Resources

Resource Condition

Indicator – Resource Condition	
CONDITION	▼

Numerous cultural resources have been recorded in NNPR; these fall into the five basic categories of *Archaeological Sites, Buildings and structures, Landscapes and Landscape Features, Objects, and Intangible Heritage*. The overall Resource Condition is considered **Fair**.

¹ Level I resources have national historic significance. Level II resources are not of national historic significance, but may have historic value, and are managed under the CRM policy.

Measure – Archaeological Sites	
CONDITION	▼

Ninety-two (92) archaeological sites are located in NNPR. Eight of these sites did not meet the rating criteria¹; the total number of evaluated archaeological sites is 84 (Table 10), and their overall condition is **Fair**.

Table 10. Summary of archaeological sites rated as Good, Fair and Poor.

CONDITION OF ARCHAEOLOGICAL SITES	
<i>Total of 84 archaeological sites:</i>	
Good (green) = 60	72 %
Fair (yellow) = 21	25 %
Poor (red) = 3	3 %
Overall Rating: Fair	

Archaeological sites are described as camps, trails, caches, and isolated finds of cultural material. Selected buildings remain in the archaeological site evaluation because they are considered archaeological resources. Other buildings and structures are identified as assets and are discussed in the next section, *Buildings and Structures*.

Site vulnerability was recorded for the archaeological sites at the time of inventory. The majority of sites are considered to be stable. The condition of sites were rated as highly threatened (2%), threatened (7%), possibly threatened (19%), stable (64%) and highly stable (7%).

¹See Technical Compendium for the Rating Guide and methods used in this report.

Over half of the impacts are caused by natural processes such as decay, vegetation growth, and riverbank erosion (56%). Visitor activity is the second most prevalent impact to the sites (23%). Fire is a minor natural impact (8%). Other impacts include development (3%) and wind erosion (3%).

The location of the majority of archaeological sites in NNPR are in the lower valleys along the South Nahanni and Flat river corridors; this accounts for the high percentage of natural impacts on the sites. This environment is heavily forested, rich in ground cover and foliage and the sites consist primarily of log and pole features that are susceptible to the natural process of decay and vegetation growth.

Measure – Buildings & Structures	
CONDITION	■

Five buildings in the park reserve have been identified as having cultural or historic value. The overall condition is **Poor**.



Deadmen Valley Forestry Cabin (© Parks Canada).

Four buildings were rated for their current condition and one was not rated because of lack of information (Kraus Outhouse #2). The four buildings are rated as follows: Deadmen Valley Forestry Cabin is in Good condition; the Albert

Faille and Fred Sibbeston cabins are in Poor condition; and the Kraus Generator Shed is in Poor condition.

There are many other building remains and foundations¹ located in NNPR. Some of these include the Kraus scow and the semi-subterranean cabin near Wildmint Hotsprings. These sites were rated in the archaeological section, as they no longer have a roof and/or the physical integrity of the building or structure is no longer intact.



Semi-subterranean cabin at Wildmint Hotsprings (© Parks Canada / L. Dueck).

Measure – Landscapes & Landscape Features	
CONDITION	N/R

NNPR has not yet formally identified landscape features within a Cultural Resource Values Statement (CRVS) framework. Landscape features include trails, portages, trail systems and river corridors.

Possible landscape features might be the South Nahanni River as a transportation corridor with associated portages, historical trails, scow, and moose hide boats, etc. This section is **Not Rated**.

¹See technical compendium for a full list of Buildings and Structures.

Measure – Objects	
CONDITION	●

The artifact collection is stable (99%) and rated in **Good** condition overall.

NNPR has a collection of 441 artifacts and samples recovered within the park boundaries from investigations over the past 31 years, primarily from the 1970s. The collection was reviewed, inventoried, and upgraded to collections management packaging standards in 2000. Fourteen items, recently received, have not been inventoried and are pending inclusion into the collection.



A hide scraper fashioned from moose bone (© Parks Canada).

The artifacts have been assessed for conservation requirements. One bone artifact has been conserved and four metal artifacts require conservation treatment. Most of the artifacts are lithics, considered to be a stable material.

A reference collection representing different categories of artifacts was developed for the park in 2001. The reference artifacts include lithic tools and debitage such as one chopper, two bifaces, one end scraper, two retouched flakes, one core fragment and five flakes, and two bone tools, a rifle and gun spring.

Measure – Intangible Heritage	
CONDITION	N/R


Intangible heritage includes oral histories, languages, traditional place names, and

traditional uses and knowledge. Some challenges in this area include the loss of knowledgeable elders in the communities, lack of language and cultural transmission to the younger generations, and less traditional use of the land than in the past.


Nahanni Butte is currently undertaking a traditional place names and land use study of its traditional territory, including a review of previous oral history, archaeological, and ethnographic studies.

Some oral history work was done by Addison & Associates, focusing on post-contact figures such as Patterson, McLeod, Kraus, Faille and Clark in 1975-76 (MRS 196). Wendell White has published two documents on the history of Nahanni Butte, based partially on oral history materials, but this work has not been peer reviewed or verified. Some oral history work was undertaken recently as part of the park expansion feasibility studies. Also, many books have been published on the stories and lives of explorers and gold seekers in the Nahanni.

Selected Management Practices

Indicator – Selected Management Practices	
CONDITION	

To date, the Park does not have a Cultural Resource Values Statement (CRVS) in place. In the absence of a CRVS selected management practices are considered under the following headings: *Inventory, Evaluation, Cultural Resource Management Strategy, and Monitoring Program*. The overall Selected Management Practices rating is considered **Fair**.


Measure – Inventory	
CONDITION	

The river corridors of the South Nahanni and Flat Rivers, have been the areas of focus for the archaeological inventory. The majority of the sites are identified as camps and trails. There are associated sites showing land use evidenced by cut stumps, caches, and the few objects left behind (isolated finds). Table 11 identifies the types of archaeological sites related to different cultural time periods. The majority of the sites found are within the Post-contact period.

Table 11. Archaeological sites summarized by Time Period.

Time Period	Site Type	Total
Post-contact	Camp	50
	Isolated find	1
	Cache	1
	Stump	2
	Trail	6
	Undetermined	12
	Total	72
Precontact / Post-contact*	Camp	1
	Isolated find	1
	Total	2
Precontact	Camp	6
	Isolated find	2
	Lithic scatter	2
	Total	10
Undetermined Time Period	Camp	1
	Cache	1
	Isolated find	2
	Trail	1
	Undetermined	1
Total	6	
Total sites *		90

* Sites may have more than one occupation (e.g. camp used in the Precontact and Postcontact Periods) and/or had more than one type description (e.g. camp and a trail site).

Measure – Evaluation	
CONDITION	

The CRVS is the main instrument in cultural resource management used to evaluate CRM levels and the nature of a resource’s historic value (physical values and human themes).

While the park does not have a CRVS, it is taking steps to document important areas in the Park. Activities such as archaeological surveys, heritage recording and oral history research provide opportunities to engage local knowledge and expertise in the documentation of the resource and help to capture important stories associated with the site, providing a better understanding of the importance and history of these places.

As mentioned above, the park submitted the Deadmen Valley Forestry Cabin to Federal Heritage Buildings Review Office for evaluation and it was not considered to have heritage value, however the park considers this building as a Level II resource for local and historical significance.


Measure – Cultural Resource Management Strategy	
CONDITION	

A draft CRM Strategy is in place that identifies a field unit approach to Cultural Resource Management. NNPR and Wood Buffalo National Park are included in the Southwest NWT Field Unit, and this broader strategy that outlines specific CRM priorities for both parks. This document was drafted in 1999 and is updated periodically to reflect the on-going activities in both the national parks and national historic sites in the field unit.

The strategy ensures a multi-disciplinary approach to cultural resource management. It considers all cultural places and sites to be cultural resources until they have been evaluated

and determined otherwise. CRM priorities identified in the strategy include updating the inventory and evaluation of cultural resources. This will enhance our understanding of the cultural history of the park; identify gaps and aid in the development of a thematic framework that can assist in the evaluation of the resources.

The Nahʔa Dehé Consensus Team provides recommendations regarding the on-going inventory, evaluation and monitoring of cultural sites including “the identification and management of sites of spiritual and/or cultural significance to the Deh Cho First Nation, including historic habitation and burial sites.” (NNPR Interim Park Management Arrangement, 2000) In this way, the Consensus Team promotes and ensures that the management of cultural resources in the national park reflects and respects the views and wishes of those who traditionally use and have interests in the area.

Measure – Monitoring Program	
CONDITION	

A formal monitoring program has not yet been developed for NNPR. Park staff, during the course of their regular operations make a point of scanning the CRM database for sites that may be in the vicinity, and some effort has been made to visit unverified and threatened sites in order to update site information. Park visitors are also provided with information regarding what to do if they come across a cultural artefact or site.

The park is currently developing a “Values at Risk” (VAR) map and database that will include the cultural resources in the park. The VAR database will include information concerning each resource including GPS location, description, basic condition assessment, an assigned value and current photographs of the resource.

5. External Relations – Public Outreach Education

5.1 Public Outreach Education Context

Overview

The number of people who experience NNPR in person is limited by the remote and rugged landscape, difficult travel conditions, the specialized skill level required for many activities and the cost of travel to the Northwest Territories as well as into the park. Public outreach education is therefore a particularly important program area for NNPR, in order to facilitate learning about the park reserve and understanding of its significance by all Canadians. People who are unable to visit the park reserve must have opportunities to connect with its ecological and cultural values through outreach education programs.



Access to NNPR is almost exclusively by float plane (© Parks Canada / D. Tate).

Audiences

Outreach education has been identified as especially important for local region residents and students from the Dehcho communities of Nahanni Butte, Fort Simpson, Fort Liard, Wrigley, Jean Marie River, Trout Lake, Fort Providence, Hay River and Kakisa. Local outreach has potential to provide for more involvement in and support for cooperative management of NNPR between Parks Canada and Dehcho First Nations, relationship-building

with potential future local employees, and enhanced awareness of opportunities for local business development. Possible increases in local visitation may also result. The broad Canadian public and urban youth in particular have also been identified as target audiences in which to develop awareness, appreciation, and understanding, and ideally a sense of value and personal relevance of NNPR.

Approaches

Public outreach education has never had dedicated staff in NNPR. Capacity for outreach has therefore been limited, but a number of successful initiatives have gone ahead, particularly in the last 10 years. Park staff have worked in collaboration with Parks Canada Education Specialists as well as the ‘Pan Northern Group’ (Parks Canada outreach education staff from Northwest Territories, Nunavut and Yukon) on various formal and non-formal outreach education materials and initiatives.

The NNPR curriculum-linked, web-based, case study “*How Much Space Does Nature Need? The Expansion of NNPR*” and other materials accessed by students and teachers on the Parks Canada website are examples of active formal learning resources which have been developed. NNPR provides content and is profiled in new experiential science, secondary school textbooks developed through the GNWT Department of Education, Culture and Employment.

Conferences, career fairs and special events each year are examples of non-personal and informal learning venues where NNPR displays, print materials and park staff are present for outreach purposes. The park website is another primary public outreach tool, in addition to serving pre-trip planning purposes for visitor experience. NNPR also responds to outreach education requests through regular emails, phone calls, and distribution of various print materials. Various

governmental, educational, environmental, community and tourism organizations have links to NNPR web pages or content further serving as outreach multipliers to audiences who may never visit NNPR.

On-going local, regional and national print, radio as well as television media interest provide opportunities for outreach messages, as do the multitude of yearly requests for photography and filming projects within NNPR. The park reserve has been a magnet for projects profiling this iconic northern Canadian wilderness and NNPR has been able to work with such projects to incorporate significant outreach messages.

Outreach momentum has developed through the recent NNPR expansion process, and indicates overwhelming public support for the park reserve. Informal 'word of mouth' outreach is also known to extend from NNPR visitors who take seriously their sense of stewardship responsibility long after their visit in the park reserve.

Over the last ten years, the NNPR program in External Relations and Visitor Experience (ERVE) has developed significantly. A new organizational chart (2009) has placed greater emphasis on ERVE, with additional positions and conversion of student positions to seasonal terms. The recent park expansion announcement also carries the promise of additional employment and public outreach education opportunities.

Partners

NNPR collaborates on various public outreach education opportunities with partners such as: Dehcho First Nations; Nahanni River Outfitters Association; Fort Simpson based air charter companies; Canadian Parks and Wilderness Association; GNWT Industry, Tourism and Investment; GNWT Environment and Natural Resources; GNWT Education, Culture and Employment; Fort Simpson Historical Society; Village of Fort Simpson; Northwest Territories Tourism; Fort Simpson Chamber of Commerce; and the Dehcho Divisional School Board.



Film crew from TBS Tokyo shooting Emerald Lake and Rabbitkettle Mountain in background (© Parks Canada / D. Tate).

Information Sources and Gaps

A number of NNPR studies conducted since 2006 touch briefly on description, assessment, opportunities and challenges of past, present and future outreach education including:

- 2006-2007 and 2007-2008 NNPR Visitor Survey Final Reports;
- 2007 Assessment of Effectiveness and Identification of Product-Market Match for Developing Enhanced Aboriginal Heritage Presentation Program for Nahanni National Park Reserve;
- 2008 Non-Personal Media Action Plan for Nahanni National Park Reserve Final Report;
- 2009 Interpretation Plan Framework for Nahanni National Park Reserve;
- 2009 Nahanni National Park Reserve Off-site Exhibit and office Interpretive Plan and Preliminary Media Concepts;

Other informal records and anecdotal accounts of the NNPR outreach education program do exist, e.g. regarding number of contacts and general successes or outcomes. A more formal and sophisticated identification of audiences and approaches, and development of a comprehensive plan for a Public Outreach Education program would be beneficial. There is excellent potential for further developing and enhancing local community outreach education

opportunities as well as building on existing formal, non-formal and informal initiatives to increase the constituency of public awareness, learning, appreciation, and understanding of the significance of NNPR.

5.2 State of Public Outreach Education

Indicators used to assess the state of outreach education are currently being developed nationally. Two primary areas of interest to assess are the extent to which Canadians:

1. learn about the heritage of Parks Canada's administered places, and
2. understand that nationally significant places administered by Parks Canada are protected and presented on their behalf.

Until national standards for these indicators and targets are developed, their condition at NNPR will not be rated.

The new staff and financial resources associated with the ERVE realignment and park expansion will assist in developing a comprehensive NNPR outreach education plan. Establishing baseline data and measuring performance for each indicator will be a focus of this plan, to enable an objective performance assessment by 2014.



Career Fair in Yellowknife (© Parks Canada).

6. External Relations - Stakeholder & Partner Engagement

6.1 Stakeholder & Partner Engagement Context

Overview

As noted above, NNPR lies within the traditional territory of Dehcho First Nations (DFN). The DFN represents 10 communities, including both Dene and Metis in the Dehcho region, with a population of approximately 7500 people. The park works most closely with the communities, from south to north, of Fort Liard, Nahanni Butte, Fort Simpson and Wrigley.

As part of the Dehcho Process negotiations between DFN and Canada, the *Deh Cho Interim Measures Agreement* included a provision for cooperative management of the park. In 2000, the Nah?a Dehé Consensus Team (NDCT) was established for this purpose; the NDCT consists of four members appointed by Dehcho First Nations – two of whom are from the closest community of Nahanni Butte – and three

appointees from Parks Canada. One of the latter members is often affiliated with a non-government organization such as the Canadian Parks and Wilderness Society. Under this arrangement, DFN are full partners in cooperative management.



Nahʔa Dehé Consensus Team meeting in Nahanni Butte (© Parks Canada / D. Tate).

In terms of business relationships, NNPR works closely with river outfitting companies and local air charter companies. The Nahanni River Outfitters Association (NROA) is a group comprised of the three businesses currently licensed to guide and outfit river travelers on the South Nahanni and Flat rivers within the park, namely BlackFeather (Wilderness Adventure Company), Nahanni River Adventures and Nahanni Wilderness Adventures. Over 50% of NNPR visitors travel with guide outfitters, therefore the relationship between NNPR and NROA is extremely important for all parties.

Because almost all access to the park is by air, NNPR relies on local air charter companies to provide this service to park visitors as well as to facilitate park operations. Currently three fixed-wing charter companies based in Fort Simpson and another six from other locations in the NWT, Yukon and northern British Columbia are licensed to operate within the park boundaries.

Partnerships with numerous academic and research organizations, and government agencies

have developed over the years, particularly in the field of ecological monitoring. NNPR has relatively high profile among several non-governmental conservation organizations; in particular, the Canadian Parks and Wilderness Association has long been a strong and vocal advocate of protection and presentation of NNPR ecological and cultural values.

Other significant stakeholders in the region include industry associations and individual companies, particularly in the mining and petroleum industries, and sport hunting outfitters who operate in the regions adjacent to the park. Some outfitted hunting will continue in parts of the expansion area for up to 10 years. The relationship with both of these stakeholder groups will be high priority for park management in the next several years.

Approaches

The primary venue for engaging DFN members and communities is the NDCT. As the cooperative management body for the park, the team's mandate is broad in scope, ranging from finances to staffing to resource management and research permitting. One area of particular importance is traditional renewable resource harvesting within the park. Harvesting by Aboriginal people continues in both the original area and the expansion areas of NNPR, and any management of this harvest is under DFN responsibility.

At the request of Nahanni Butte, the NDCT assisted in developing a Traditional Harvesting Protocol document, to record and disseminate the proper way to harvest in Nahʔa Dehé – the traditional area of Nahanni Butte – as well as safety and courtesy recommendations such as checking in with the community before hunting in the area.

The Dehcho region of the NWT experiences many of the same opportunities and challenges as other spectacular yet remote areas; its grandeur is well known nationally and internationally, yet the numbers of people who actually visit are limited, in part by its

remoteness and the expense of travel. NNPR makes a significant contribution to existing and potential tourism markets in the NWT overall, the Dehcho region, as well as to adjacent areas such as northern British Columbia and Yukon. This provides a strong link to stakeholders and partners with shared interests, such as Northwest Territories Tourism, GNWT Industry, Tourism and Investment as well as locally through the Fort Simpson Chamber of Commerce, the Village of Fort Simpson and the Fort Simpson Historical Society. NNPR works with these groups to coordinate tourism promotion, visitor experience, staff training and business development. Annual meetings with the NROA and air charter companies have helped to encourage business opportunities while ensuring park management objectives are met.

The NNPR area is unique in many ways, and park management works to encourage research into the area's environment and culture. Online posting of research priorities, a standardized permitting system and application reviews through the NDCT are intended to facilitate research projects compatible with park management. Areas of common interest with other agencies have been pursued, and numerous collaborative research and monitoring initiatives have been undertaken. Among these partners are governments of Yukon and Northwest Territories, Environment Canada, Canadian Wildlife Service, Canadian Forest Service, Geological Survey of Canada, and many others. Related partnerships with respect to fire and law enforcement have been developed with the GNWT and Royal Canadian Mounted Police, respectively.

Non-government organizations, including the Wildlife Conservation Society Canada and CPAWS have been research partners as well. The park's working relationship with the CPAWS NWT Chapter based in Yellowknife has been very close; in fact, a CPAWS employee has sat as a member for much of the history of the NDCT. CPAWS has also been a partner in several educational initiatives over the years.

The feasibility studies undertaken to develop a new park boundary initiated and further

developed numerous working relationships. DFN and PCA were equally represented on the Nahanni Expansion Working Group, which coordinated research and an extensive consultation process, including industry and other stakeholders associated with 'non-conforming uses'.



Nahanni Expansion Working Group at NNPR expansion announcement, Ottawa, June 2009 (© Parks Canada).

The final boundary left certain areas open to future resource exploration. Agreements have been established with the mining industry in terms of access and environmental management approaches, including Parks Canada representation on a technical working group for the Prairie Creek proposed mine operation. The expansion legislation has provided for a continuation of big-game hunting in the expansion area for up to 10 years, while mutually acceptable agreements are worked out in terms of outfitter compensation.

Information Sources & Gaps

The current understanding of NNPR stakeholder and partner engagement comes largely from on-going active communication through working groups, consultation feedback and involvement in other processes such as social science assessments. NNPR stakeholder and partner relationships tend to be very strong, however, a more formal and comprehensive strategy to measure these strengths and to identify any potential gaps would be beneficial.

6.2 State of Stakeholder & Partner Engagement

Indicators used to assess the state of stakeholder and partner engagement are currently being developed nationally. Two primary areas of interest to assess are the extent to which stakeholders and partners:

1. support the protection and presentation of Parks Canada's administered places, and
2. feel that they have opportunities to influence and contribute to Parks Canada's activities.

Until national standards for these indicators and targets are developed, their condition at NNPR will not be rated.

The current state of stakeholder and partner engagement is thought to be good, but is not objectively measured as such. One indication of success is that the information collected through interviews for this State of the Park Report indicated good support for the Nah 7a Dehé Consensus Team. Also, the park expansion briefing presented at the Dehcho Assembly in June 2009 was well received.



*Community meeting and barbeque at Nahanni Butte
(© Parks Canada / D. Tate).*

Similar to the assessment for outreach, a plan will be developed for establishing baseline data and performance measurement methods for each indicator of stakeholder and partner engagement. The Park Management Planning process will provide an excellent opportunity for engagement.

7. Visitor Experience

7.1 Visitor Experience Context

For many visitors, their Nahanni experience is a trip of a lifetime. Flying into the park, range after range of rocky peaks, vast plateaux and canyons hundreds of metres deep unfold below the wings. On the ground, watchful eyes may catch a glimpse of wildlife: a bear passing in the bush, a moose browsing at the side of a pond, or Dall's sheep nimbly leaping on a rocky mountainside. The calm river turns thunderous at Náìlìcho (Virginia Falls), where the plunging waters create a spectacular waterfall. The immense walls of the four canyons lining the river inspire awe and a humbling sense of size for any who choose to venture down the river.

Nahanni National Park Reserve offers adventure, solitude and magnificent scenery for those Canadian and international visitors who want to experience wilderness. NNPR is acclaimed as Canada's premier wilderness river national park; despite high travel costs, far distances and big time commitments, new groups come year after year. Visitors can be segmented into two main groups: overnight river travellers and day users flying in to Náìlìcho. Some fly-in visitors to Náìlìcho opt to camp for one or two nights, though this is a small segment of overall visitors.

NNPR Visitor Surveys have found that the majority (over 86%) of visitors are visiting for the first time. Visitor statistics since 1984 indicate that an average of 62% are overnight visitors. Of overnight visitors, an average of over 59% are on guided river trips, while the remaining are on non-guided trips. The average age of visitors surveyed in 2006 was 47 years, while 20 years prior it was 38.

To ensure a wilderness experience and to respect visitor expectations at Náìlìcho (where all users intersect), a reservation system is in place. This system manages visitation by regulating the daily total number of overnight users and staggering departure dates for river trips. Registration is required for overnight use, and



The Ragged Range, in the western part of NNPR, contains the highest mountains in the NWT (© Parks Canada).

can be done in Fort Simpson or by phone. An in-park orientation, including safety and leave-no-trace camping messages, is usually conducted at Rabbitkettle Lake or Náìlìcho. De-registration can be completed in person at Fort Simpson, at Blackstone Territorial Park, or via phone. A park staff member is on call 24 hours a day between June 15 and September 15 to provide emergency assistance to visitors.

Park staff are located at Rabbitkettle Lake and Náìlìcho for the months of July and August. NNPR is an integrated backcountry operation, where staff are trained and skilled cross-functionally; visitors may encounter resource conservation staff delivering interpretive programs and visitor experience staff conducting resource management activities.

NNPR features a high rate of contact between visitors and staff. This may extend from initial trip planning a year or more in advance, to arrival in Fort Simpson, to in-park visitation such as at Rabbitkettle Lake and Náìlìcho, to de-registration. NNPR prides itself on professional and quality contacts with park visitors as well as partners in visitor experience.

Five staff cabins are located in the park, and there are four visitor sign-in stations. The latter are located at Rabbitkettle Portage Landing,

Náìlìcho above the falls, Deadmen Valley across from Prairie Creek (Forestry Cabin), and Kraus Hotsprings. At Náìlìcho and Rabbitkettle Portage Landing the stations are incorporated into interpretive display kiosks. Other operational infrastructure includes float plane docks and helicopter pads at Rabbitkettle Lake and Náìlìcho. The park headquarters and operations base is located in Fort Simpson.

Unique to NNPR are the two “paddle cabins”, in Deadmen Valley opposite Prairie Creek, and at Kraus Hotsprings (see Cultural Resource Management section for more details on these buildings). These historical cabins have become part of the classic Nahanni experience where visitors carve and leave small paddles and other mementos from their trip. Rather than taking something away, visitors have the opportunity to leave the story of their trip for others, and become part of the active lore of the river.

Day Use

Due to the lack of road access, day visitors need an air charter to experience the park. While an over-flight without landing is possible, most day use visitors choose to stop at Náìlìcho, the only authorized day use area in the park. Once at Náìlìcho, visitors can enjoy a picnic as well as a short walk (2.5 km return) to a viewpoint above the falls. Guided interpretive hikes with park staff are available daily during the peak visitor season July to August. A longer non-guided walk (4 km return) is possible, along the portage trail which descends to the base of the falls.

Floatplanes may be chartered in many of the regional communities, including Fort Simpson, Fort Liard and Yellowknife in the Northwest Territories; Fort Nelson and Muncho Lake in British Columbia; and Watson Lake, Yukon. These trips may include other stops such as Glacier Lake and Little Doctor Lake; flights and itineraries are weather dependent.

River Trips

Multi-day river trips are the park's most popular recreational offer, providing the best means to

explore Nahanni. Trips usually range from one to three weeks. Visitors can choose to descend the river on their own or with experienced guide outfitters, in rafts, canoes or kayaks.

Paddling the length of the South Nahanni River, visitors have en-route hiking opportunities to many scenic features. While there are no developed trails other than at Náìlìcho and Rabbitkettle, route descriptions are available for some of the more popular hikes. Sport fishing is permitted in park waters with a valid national park fishing permit; these permits, and a summary of regulations, are available at the park office, or at the staffed park cabins.



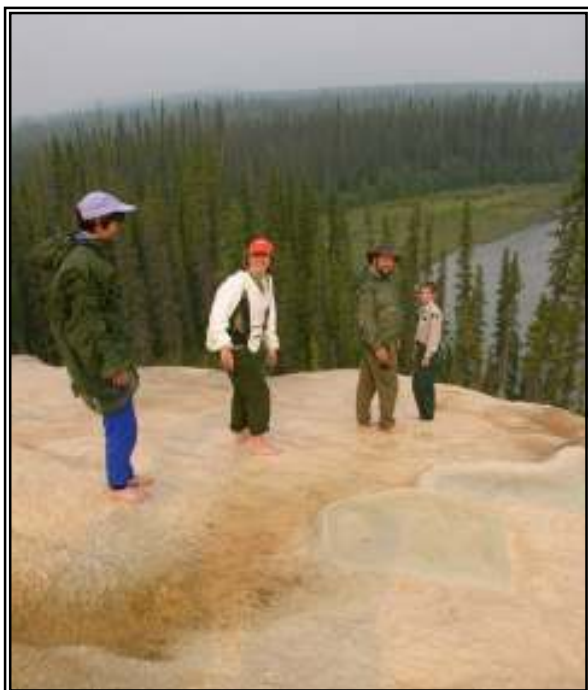
Inflatable canoes are an option for travelling on the South Nahanni River (© Susan Henry).

River users have various options for accessing the park. Most fly in to start at Náìlìcho near the geographic centre of NNPR; the second most common access point is Rabbitkettle Lake, farther upriver to the northwest. There are two designated campsites in the Rabbitkettle Lake area with food caches and outhouses. From Rabbitkettle Lake there is a short portage trail to the South Nahanni River.

Other upriver fly-in access points include Island Lakes, and for the greatest extent of whitewater travel some river trips begin at the Moose Ponds, near the South Nahanni River headwaters. A less common access point is Seaplane Lake, which provides access to the Flat River. Road access is possible at the Flat Lakes, which feed

the Little Nahanni River – a major tributary of the South Nahanni River.

Nájl̄icho is about three days travel downriver from Rabbitkettle Lake, and offers visitors a campground (with tent platforms, firepits and picnic tables), canoe racks, food caches, composting / pit toilets and a campfire circle for interpretive programs. The campground and much of the trail system is on raised boardwalk to protect the fragile environment below.



Guided interpretive hike at Rabbitkettle Hot Springs tufa mounds (© Parks Canada).

As the intersection of river users and day visitors, Nájl̄icho is a very popular location. Overnight use is limited to two nights and dates of use are reserved in advance.

Downstream of Nájl̄icho, visitors are free to choose random camping sites. Certain areas, including The Gate (Pulpit Rock), Prairie Creek, and Lafferty Creek are popular overnight campsites offering great views and hiking opportunities. Kraus Hot Springs, near the eastern park boundary is a popular site for rest and relaxation. In August and September, Kraus Hot Springs is closed to overnight camping due to

the emergence of abundant berry crops and subsequent increase in use by bears.

Learning Experiences

Visitors to the park can experience a remarkably varied geological landscape, and a biologically diverse area for its northern latitude. Interpretation of these natural features, and the cultural history and Aboriginal traditions of the region, is provided through non-personal media such as the website, print materials and displays, as well as through personal contacts with visitors in Fort Simpson and in the park.

Extensive information is provided on the NNPR web pages of the Parks Canada website. These pages provide an overview of cultural and natural resources, recreational opportunities and detailed information about the river experience, visitor safety and the registration system. Due to the level of wilderness skills required to travel in the park, the presence of bears and the potential for wildlife encounters along the narrow river travel corridor, public safety messages are key components of pre-trip information.

Upon arrival at the Fort Simpson park office, visitors meet knowledgeable park staff who help to orient them to the park, make their stay more enjoyable, and provide information on campsites, wildlife and river safety. The Village of Fort Simpson's Visitor Information Centre (VIC) has information pertaining to NNPR, including a selection of videos about the park. Additional interpretive opportunities for the VIC and NNPR office are planned.

At Nájl̄icho, visitors can participate in guided hikes to the lookout over the waterfall. Park staff interpret the geological and human history of the area. Evening campfire programs focus on Aboriginal cultural connections to the park and surrounding area. Local Aboriginal student interpreters and respected members of Dehcho First Nations lead these programs, which offer visitors the opportunity to meet and learn from local people.

A guided hike is also offered twice daily from Rabbitkettle Lake to Rabbitkettle Hot Springs,

taking visitors to two tufa (travertine) mounds. The mounds are one of seven designated Zone I (Special Preservation) areas in the park, and the only Zone I area where public access is permitted. Access is facilitated by the guided interpretation program, which allows visitors to walk on the north mound. The south mound has great cultural and spiritual significance to the Dene and no visitor access is permitted. The interpretation program provides information about geology, culture and bear safety.



Interpretive program at Náìlìcho (© Parks Canada / S. Cameron).

Partners in Delivering Visitor Experiences

Dehcho First Nations and Parks Canada cooperatively manage the park. Dene are inseparable from the land, and traditional subsistence harvesting continues to be an integral and sustainable part of the ecosystem, occurring in accordance with Dene laws and principles. The importance of NNPR to Dene is an important message in both personal and non-personal interpretation. Parks Canada and Dehcho First Nations work closely together to develop interpretation messages and methods to communicate them. An example is the Community Cultural Demonstrators program at Náìlìcho, which offers visitors the opportunity to meet and learn from local people.

The Nahanni Butte Dene Band has worked with NNPR over the years to provide de-registration

services at Blackstone Territorial Park; a critical component to the safe completion of all river trips. Cooperative efforts to develop potential visitor experience opportunities in the village of Nahanni Butte are ongoing.

The air charter companies provide the primary means for visitors to access NNPR, and facilitate park operations through transporting staff and equipment. As such, the companies, in particular, those in Fort Simpson (the primary gateway to NNPR) work closely with park staff.

The three licenced outfitting companies, which provide guided river trips also work closely with NNPR. All the river guides are required to be certified in first aid and obtain a guide license from the park. The guides are key figures in ensuring leave-no-trace camping principles are followed, and develop an intimate understanding of the area's natural and cultural history. They bring a wealth of knowledge and skills which enhances their clients' visitor experience.

7.2 State of Visitor Experience

When visitors were asked to provide suggestions for improvements, many of them said their visit was wonderful and required no improvement. In their words:

“Trip of a lifetime.”

“It was darn near perfect.”

“It doesn't get much better, thank you.”

“The best wilderness trip I've ever been on.”

“All the park staff we met were very friendly and helpful.”

Marketing and Promotion

The national target for the *Marketing and Promotion* indicator is to maintain the number of visits at Parks Canada administered places. Over the past 25 years, visitation at NNPR has been relatively consistent, despite noticeable annual fluctuation (avg. 980 visits). This is reflected in

the numbers for the last five years (avg. 935 visits; Figure 20), however, recent data (2008 & 2009) suggest a decline in the number of river trippers could be occurring (see Technical Compendium for more details on visitation).

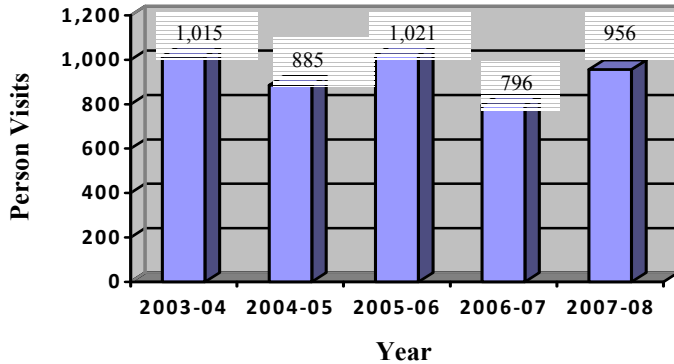


Figure 20. Visitation to NNPR 2003-2008.

Visitors to NNPR represent a major share of the NWT tourism market. Based on data from 2006-7 (GNWT 2007), visitors to NNPR (n=796) represented 37% of all summer pleasure travelers to the NWT visiting for purposes of outdoor adventure (n=2,160). The average length of stay for overnight use is 12 nights. Factors such as the cost of coming to the north, remoteness, and required travel skills all affect the number of park visitors.



NNPR enjoys a very high level of visitor satisfaction (© Parks Canada / S. Cameron).

The 2006-2007 Visitor Survey found that a high percentage of visitors were satisfied with the three factors allocated to the marketing and promotion indicator (Table 12). These figures are exceptionally high, as most parks and sites rate well below the 50% and 85% thresholds for very satisfied and satisfied respectively for ‘value for entry fee’ and for ‘availability of park information prior to visit’.

Table 12. Visitor satisfaction scores for NNPR.

	Very Satisfied	Satisfied	Total
Visit meets expectations	80%	14%	94%
Value for entry fee	62%	27%	89%
Availability of park info prior to visit	55%	34%	89%

The park is promoted in regional tourism and commercial publications and featured in Parks Canada promotional material, such as the 2009 national television advertisement. NNPR also greatly benefits from significant media interest, getting coverage in newspapers, magazines and film. A significant amount of promotion for Nahanni is undertaken in partnership with or by others, such as NROA member companies, air charter companies, the Canadian Parks and Wilderness Society, NWT Tourism and the Government of the Northwest Territories.

Visitation trends are difficult to predict; there are suggestions of a decrease for economic and aging population reasons, but this may be balanced by active promotion of NNPR and an increased service offer associated with park expansion.

Expected Result	Target	Actual Results
Canadians visit Parks Canada administered places.	Maintain number of visits.	Visitation fluctuates; relatively stable over last 5 years (2003-2007 avg. = 935) but recent data suggest decrease may occur.

Interpretation

The target for the *Interpretation* indicator is that 60% of visitors consider that they learned about the heritage of the park. The recent NNPR visitor surveys did not include the exact question above; therefore, an overview of related findings is presented.

First, participation in interpretive programming, taken from the 2006-2007 survey, was over 55% for four program / product types - exceptionally high rates. Satisfaction with interpretive activities overall, and with three of four program / product types, was over 90%. Satisfaction scores fell below the thresholds of 50% very satisfied only for displays (45% very satisfied). Village of Fort Simpson VIC and NNPR office displays are dated, and recapitalization projects are in progress.



Interpretation at Nailicho highlights local Aboriginal culture (© Parks Canada).

In the 2007-2008 survey, more than half of the visitors indicated that interpretive programs (56%) and interpretation of Aboriginal culture (72%) were an important contribution to their overall park experience. In the same survey, an average of 72% of visitors gave an overall positive rating for the impact of NNPR programs on their awareness or knowledge of the park.

Three studies were recently conducted about interpretive programs and products at Nahanni. The first study, *Assessment of Effectiveness and*

Identification of Product – Market Match for Developing Enhanced Aboriginal Heritage Presentation Program, concluded that current Aboriginal interpretation is beneficial, and that strengthening and enhancing the program is possible.

The second study, *Non-personal Media Action Plan (2008)*, was a review of non-personal media. Recent products are high quality and receive favourable reviews from visitors, such as the interpretive kiosks at Rabbitkettle Lake and Virginia Falls. For river users, the South Nahanni River Touring Guide and the Natural and Cultural Guide to Nahʔa Dehé are both rated as quite useful, with the website providing much pre-trip information.

The review found that NNPR does not have a solid non-personal interpretation offer for potential visitors who are already in Fort Simpson, or for local community members. The only interpretation in place is the dated exhibit in the Fort Simpson VIC and the park office, which has limited space for exhibits and offers little draw to visitors not traveling into the park. The study findings reflect staff concerns expressed at the 2008 Visitor Experience Assessment (VEA).

The review also determined that there is great potential for improvement to existing non-personal media. Developing new media for all of NNPR's audiences would expand the stories being told about NNPR, which currently focus on the few areas where signage is present, and on the river itself. The key recommendation of the study was to begin the development of an interpretive plan.

The third study is a three-part document: *Interpretation Plan Framework; Nahanni National Park Reserve Office Interpretive Plan and Media Concept 2009; and Nahanni National Park Reserve Off-site Exhibit Interpretive Plan and Preliminary Media Concept 2009*. This document addresses some recommendations in the *Non-personal Media Action Plan*. A thematic interpretive framework was developed for the park and conceptual designs for two Fort Simpson venues: the park office and the park's exhibit space in the Fort Simpson VIC.



Visitors give high ratings to NNPR's in-park interpretation offer (© Parks Canada / S. Cameron).

Visitors are learning about the heritage of the park; however, some improvements are recommended to improve the interpretive programs and products.

Expected Result	Target	Actual Results
Visitors learn from experience and active participation.	60% of visitors learn about natural or historical heritage.	In 2008, an 72% of visitors gave a positive rating for the impact of programs on their awareness or knowledge of the park.

Visitor Service Offer

At the corporate level, the target for the visitor service offer indicator is that 85% of visitors enjoyed their visit. This target was only recently added to visitor surveys and was not included in the recent NNPR visitor surveys.

Many factors are thought to contribute to visitor enjoyment. A review of the wide range of activities and services offered to visitors was conducted, and satisfaction levels for 12 elements were surveyed in 2006. All elements except one, the condition of the toilets (74%),

met the 85% targets. During the 2008 VEA, staff did note “stinky washrooms,” “need to deal with outhouses” and “need privacy screens at composting toilets.” In the 2007 survey, the most frequently noted visitor suggestion for improvement was the toilets (11%). However, in terms of serious detractors from visitor experience, ‘too many people on the river’ (12%) and ‘number of aircraft overhead’ (11%) were the highest ranked factors.

Of the many factors that contribute to enjoyment, notably the range of services and facilities offered, the 2008 VEA identified shortfalls related to the toilet facilities and the limited memorabilia available at departure time. The lack of signage or clear routes for hiking was mentioned by a number of visitors and staff.

Expected Result	Target	Actual Results
Visitors enjoy their visit.	85% of visitors enjoy their visit.	Visitor comments show they enjoy their trips to Nahanni. A few shortfalls, such as the toilets, need to be addressed.

Personal Connection

National visitor satisfaction targets are 85% of visitors are satisfied, and 50% are very satisfied, with their visit. NNPR has exceeded these targets with 96% of visitors reporting they were satisfied and 80% very satisfied with their visit.

Visitors have been surveyed with regard to their recommendations, and support or opposition to possible management initiatives in the park. Of note are questions asked in an NNPR visitor survey in 1986, and repeated in 2006-2007. Park staff are responsive to visitor concerns and have acted on a number of the detractors identified.

No data is available yet for the second target, *Increase the % of visitors by 2014 who consider*

the place is meaningful to them. Repeat visitation (14%) is not an accurate reflection of this indicator, as the park is considered by many to be a once in a lifetime experience due to the remote nature of the park, the cost and difficulty of travel. Although there is low repeat visitation, half of visitors say they plan to return – indicating a personal connection with the park. Those who offered comments on their visit indicate very memorable and rewarding experiences.

Selected quotes from visitors:

“The most spectacular two weeks in my life.”

“This was a trip my son and I will always remember; it far exceeded our expectations.”

“This trip changed my life so positively.”

“It was truly the trip of a lifetime, rain or shine, magnificent!”

« Simplement la plus belle place au monde. »

“Trip was fabulous and we plan to return.”

“We felt very special.”

“A highlight of my life.”

Expected Result	Measures	Actual Results
Visitors feel a sense of personal connection to the places visited.	Satisfaction with visit.	Average of 97% of visitors satisfied, and 83% very satisfied, with their visit.
	Meaning of place.	Comments are very positive; some described their visit as <i>“the trip of a lifetime”</i> .



Many visitors start their trip at Rabbitkettle Lake, seen here with Rabbitkettle Mountain reflected in its placid waters (© Parks Canada / D. Tate).

8. Results of Management Actions

OBJECTIVES	INDICATORS	TARGETS	ACTIONS	RESULTS
Over the last 5 years, what were the main objectives for which management actions were identified to maintain or improve the state of the park?	What indicator(s) will be maintained or improved by achieving the objective?	What target(s) were set to achieve this maintenance or improvement?	What actions were implemented to meet the target?	Was the target met? Why not? How was the state of the park affected by the actions (e.g., did they improve the condition of an indicator)?
Establish an ecologically-based park area, and/or alternative adjacent protected areas (<i>PMP S. 5.1</i>).	All Ecological Integrity Indicators VE Indicators	Include complete sub-watersheds, critical wildlife habitats, and movement corridors. Include Tlogotsho Plateau, Ragged Range, Nahanni Karst areas. Include areas of the five ecoregions in watershed.	Nahanni Expansion Working Group established. Feasibility studies, ecological assessments and consultation used to make boundary recommendation. Discussed headwater protection (Naats'ihch'oh proposal) with Sahtu reps	Park expanded to 30,055 km ² . All targets within Dehcho portion of watershed met. Expansion represents improvements to all EI indicators, and opportunities to improve VE indicators.
Mitigate impacts to the tufa mounds from visitor access (<i>PMP S. 5.3, 8.2, 11.2; Protect sensitive and endangered habitats and terrain characteristics</i>).	Wetlands Personal Connection Interpretation Visitor Service Offer	No measurable human-caused net damage to the tufa mounds.	Group size on the tufa mound restricted to 7 per trip. Visitors accompanied by park staff. Physical structure of tufa monitored for impacts.	No significant difference in tufa mound structure between trail and control sites, or between years (if there are impacts between pre- and post-season, they are self-repaired by next season).
Document and protect cultural resources (<i>PMP S. 6.1</i>).	Resource Condition	Develop CRM Plan; continue inventory, monitoring & evaluation.	Inventory of SNR & Flat rivers, and Kraus sites. SOPR evaluation undertaken. Moved DMV forestry cabin.	CRM Plan not yet complete. Inventory & evaluation improved. Cabin condition improved

OBJECTIVES	INDICATORS	TARGETS	ACTIONS	RESULTS
<p>Maintain opportunities for wilderness and spiritual experience <i>(PMP S. 8.2 – 8.5; To protect & manage wilderness qualities of the park).</i></p>	<p>Personal Connection</p>	<p>Less than 3 planes at VF and RKL at a time. Less than 25 overnight arrivals at VF per day. 85% of visitors satisfied with their wilderness and / or spiritual experience.</p>	<p>Require air charters to notify staff in advance. Reservation system in place for overnight use at VF. QVE training provided to all staff. Visitor & stakeholder opinions solicited and considered.</p>	<p>Approx 1 incident annually Typically 1-2 incidents per year; may be weather-related Visitor surveys indicated 97% satisfied or very satisfied.</p>
<p>Mitigate ecological impacts to campsites from visitor use <i>(PMP S. 8.2; To sustain park ecosystems within the concept of Limits of Acceptable Change).</i></p>	<p>Forest Personal Connection Visitor Service Offer</p>	<p>Formal ‘Limits of Acceptable Change’ not yet developed. No decline in condition of monitored sites. Sites with two successive Poor ratings will be closed to visitor use.</p>	<p>Leave-no-trace camping encouraged in registration and pre-trip planning. Annual Campground Impact Monitoring conducted. Two sites closed in 2003.</p>	<p>Low level of recreational impacts observed. Since 2004, all sites have maintained or improved in condition. Closed sites improved; 7 other sites have shown improvements.</p>
<p>Prevent PAH (hydrocarbon) contamination from fuel caches <i>(PMP S. 9.2; NNPR serves as a regional model for environmental management and stewardship).</i></p>	<p>Freshwater Forests</p>	<p>All fuel barrels in good condition; store all fuel in secure containment facilities by 2009. No leakage from fuel caches. No spills. In event of spill, cleanup occurs as quickly as possible.</p>	<p>Fuel cache storage facilities placed at RKL, VF, DMV, and Flat River cabins. Fuel cache monitoring.</p>	<p>Most fuel in storage facilities (not Sunblood) No recorded spills No PAH contamination recorded.</p>
<p>Develop a partnership with the Dehcho First Nations in the management of the park <i>(PMP S. 10.2).</i></p>	<p>Stakeholder and Partner Engagement</p>	<p>Formalize DFN role in cooperative park management. Involve DFN in park management plan development. Ensure DFN employment, training, and career opportunities.</p>	<p>Nahʔa Dehé Consensus Team (NDCT) created Park management plan co-written with DFN. Local students hired. Project involvement opportunities provided for community members.</p>	<p>Park management plan completed (2004) NDCT meets monthly on park management issues. Over 60% of staff are DFN members. Avg. of: 3 work crews, 4 cultural demonstrators, 2 research assts annually</p>

9. Key Issues

Maintaining Water Quality

Clean water is of great concern to DFN member communities; access to clean water is a human right. Present and future upstream industrial activity, long-range transported pollutants and climate change all have the potential to decrease water quality. Water quality monitoring is in place; new stations and sampling techniques may need to be added as the result of boundary expansion. Working with local communities, capacity may be increased through training to achieve enhanced monitoring.

Incorporating Traditional Dene Names

To capture the essence of the culture and the land, linking local legends with places and history, traditional Dene names need to be used. This issue has often been raised at community and consensus team meetings. An initial list of names has been developed, Dene names for key features have been incorporated into NNPR print, exhibit and personal programming materials, but more can be done. The Dene names are descriptive and tell the story of the land; connecting the visitor with local culture and history.



Elders from Nahanni Butte and Fort Simpson enjoy the view along the trail to the tufa mounds near Rabbitkettle Lake (© Parks Canada).

Maintaining and Increasing Visitation

The remoteness of the landscape, the skill level required for most activities and the costs to get to NNPR, mean that only a small number of people will ever experience the park in person. The people who visit are very satisfied with their experience. The issue facing the park is how to achieve Parks Canada's corporate direction to maintain and/or increase visitation while maintaining visitor satisfaction levels.

Increasing visitation may be difficult during the current economic downturn, as people are travelling much closer to home to save money. In addition to the expense of travel, the river has a finite carrying capacity, as too many visitors will detract from the highly valued wilderness experience. Moreover, the demographics of river users are aging, along with the Canadian population.

Currently, river rafting and canoeing are the primary activities, with fly-in day use at Náìlìcho (Virginia Falls) also being popular. Park expansion has brought with it the opportunities and challenges of a diversified visitor experience offer, including hiking, rock climbing and other uses in areas such as Ram Plateau, Cirque of the Unclimbables and Glacier Lake. The new uses will likely introduce different demographics to visitation, and assist in maintaining and increasing visitation.

Infrastructure Supporting the Visitor Experience

Three issues exist in regards to infrastructure: addressing Náìlìcho (Virginia Falls) boardwalk repairs, improving human waste infrastructure and management, and an infrastructure needs assessment for the expansion area. The installation of a new boardwalk and tent pads (2004) was intended to protect the sensitive environment around Náìlìcho (Virginia Falls). Significant damage occurred to the boardwalk

due to frost heave over the 2007-08 and 2008-2009 winters; much work needs to be done to provide a safe visitor experience and protect the fragile landscape.

Human waste management and associated infrastructure at Nájl̓cho (Virginia Falls), The Gate and Kraus Hotsprings, three areas where visitors concentrate, is an on-going issue requiring a focussed project to assess and develop solutions. In addition, analysis of visitor infrastructure requirements, considering visitor needs, ecological integrity, public safety and the overall visitor experience, needs to be assessed for the expanded park area.



The Gate / Pulpit Rock is a popular overnight camping site on the South Nahanni River (© Parks Canada).

Expanding Outreach Education

Outreach education is very important to ensure Canadians feel a strong sense of connection with Nah ʔa Dehé. It is especially important for local communities, local students and the wider “virtual” audience – including youth, urban and new Canadians. The recent expansion of NNPR indicates overwhelming support for the park; this support needs to be maintained as the campaign for expansion fades into memory. There is excellent potential for further developing and enhancing local community outreach and education opportunities as well as building on existing distance outreach education initiatives to build the constituency of support for NNPR.

Establishing Monitoring Programs

Establishing and expanding monitoring programs will continue to be important in the coming years. The last management plan cited, as an action, the development and maintenance of ecological integrity monitoring programs. Many of these programs are now in place, with some needing to be expanded or initiated. Ecological monitoring programs in NNPR have been focused on forests and freshwater indicators; with the expansion, monitoring programs for alpine, wetlands and glaciers need to be enhanced or developed.

Cultural resource monitoring has been identified in this report as an area of park management in need of improvement. In addition, new monitoring and reporting protocols need to be developed for visitor experience, outreach education and stakeholder relations. As national standards are developed, these new indicators and targets need to be incorporated in the NNPR’s overall monitoring program.

Declining Northern Mountain Caribou Populations

Decreasing populations of Northern Mountain Caribou is an issue highlighted in this report. The decline in numbers is the result of several factors. The expansion of NNPR may address this issue in part, as more caribou habitat is now protected within the park. Activities outside park boundaries have an impact on declining caribou populations. Positive change can be affected through collaboration with others, including the Government of the Northwest Territories, the Yukon Territorial Government, Aboriginal partners, sport hunting outfitters and industry, through the development of regional management regimes and measures to ensure accountability. Parks Canada and Dehcho First Nations will continue to monitor caribou populations within the park boundaries.

References

- Beyersbergen, G.W., Ed. 2007. The 2005 International Trumpeter Swan Survey in Alberta, Saskatchewan, Manitoba and the Northwest Territories. Canadian Wildlife Service Technical Report Series No. 485. Prairie and Northern Region. Edmonton, Alberta. 45pp.
- Brett, R. 2009. The summary of historic spruce budworm outbreaks in Nahanni National Park Reserve and vicinity. Unpublished Report. Canadian Forestry Service. Edmonton, AB.
- Burn, D.H. and M.A. Hag Elnur. 2002. Detection of hydrologic trends and variability. *Journal of Hydrology*. **255**: 107-122.
- Cannings, S.M. Anions, R. Rainer, and B. Stein. 2005. Our Home and Native Land: Canadian Species of Global Conservation Concern. NatureServe Canada: Ottawa, ON.
- CCME. 2001. Canadian water quality guidelines for the protection of aquatic life: CCME Water Quality Index 1.0, Technical Report. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.
- CCME. 2003. Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2009. Trumpeter Swan. <http://www.cosewic.gc.ca> Accessed 05 February 2009.
- Delbart, N., T. Le Toan, L. Kergoat, and V. Fedotova. 2006. Remote sensing of spring phenology in boreal regions: A free of snow-effect method using NOAA-AVHRR and SPOT-VGT data (1982–2004). *Remote Sensing of Environment*, Vol. 101, p. 52-62.
- Dorner, B., H. Sandmann, and C. Wong. 2003. A catalogue of quantitative methods for estimating historical variability and other attributes of natural disturbances. pp 67-78. *Environment and Natural Resources (ENR)*. 2008. Moose in the NWT. GNWT Wildlife Division. <http://www.nwtwildlife.com/NWTwildlife/moose/moosetop.htm>
- Environment Canada. 2009. National Climate Data and Information Archive. http://www.climate.weatheroffice.ec.gc.ca/prods_servs/documentation_index_e.html
- Fleming, S.W. 2005. Comparative analysis of glacial and nival streamflow regimes with implications for lotic habitat quantity and fish species richness. *River Research Applications*. **21**: 363-379.
- Gullickson, D. and M. Manseau. 2000. The South Nahanni Woodland Caribou Herd Seasonal Range Use and Demography. Parks Canada. Ottawa, Ontario.
- Gunn, A., R. Farnell, J. Adamczewski, J. Dragon, and L. Laberge. 2002. Census for the South Nahanni Mountain Caribou Herd. Report No. 147. Department of Resources, Wildlife and Economic Development, Government of the Northwest Territories, Yellowknife.
- GNWT. 2006. NWT Species: General Status Ranks of Wild Species in the Northwest Territories. Environment and Natural Resources Wildlife Division.
- GNWT 2008a. Moose in the NWT. Environment and Natural Resources Wildlife Division. <http://www.nwtwildlife.com/NWTwildlife/moose/moosetop.htm>

- GNWT 2008b. NWT Wood Bison Management Strategy, 2008 - 2018. Draft 5. Oct 17, 2008. Environment and Natural Resources Wildlife Division.
- Government of Yukon, Department of Environment. 1996. Woodland Caribou Management Decision Guidelines - July 1996. <http://www.yfwcm.ca/species/caribou/guidelines.php>.
- Government of the Northwest Territories. 2007. Northwest Territories 2006 Visitor Survey. Industry, Tourism and Investment. <http://www.iti.gov.nt.ca/publications/2007/tourismparks/2006%20Exit%20Survey%20-%20Summary.pdf>
- Griffith, B.D., C. David C., D.E. Russell, R.G. White, T.R. McCabe, K.R. Whitten. 2000. Rangifer; 2000 Issue Spl. 12, p65-65.
- Halliwell, D, 1998. Protecting the Aquatic Quality of Nahanni National Park Reserve, N.W.T. With contributions from S. Catto. Environment Canada, Yellowknife, NT.
- Hayes, R.D. et al. 2003. Experimental reduction of wolves in the Yukon: ungulate responses and management implications. *Wildlife Monographs*. 67(3):1-35, supplement No. 152.
- He, Y., X. Guo, P. Dixon, and J. F. Wilmshurst. 2008. Satellite monitoring of northern ecosystems using multi-sensors. Report to Parks Canada.
- Intervale Conservation and Heritage Associates, Inc. with the New Zealand Tourism Research Institute. 2007. Assessment of Effectiveness and Identification of Product-Market Match for Developing Enhanced Aboriginal Heritage Presentation Program for Nahanni National Park Reserve. Doyles, NL. December 2007. 126 pp.
- IPCC, 2007. [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. *Climate Change 2007: The Physical Scientific Basis*. Contribution of the Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, United Kingdom and New York, N.Y. USA. 996 pp. <http://www.grid.unep.ch/glaciers/>
- Ipsos Reid. 2007. Report for: Parks Canada 2006-2007 Nahanni NPR Visitor Survey Final Report. Ottawa, ON. April 2007. 130 pp.
- Ipsos Reid. 2008. Report for: Parks Canada 2007-2008 Nahanni NPR Visitor Survey Final Report. Ottawa, ON. April 2008. 84 pp.
- Khan, A., A. Tobin, R. Paterson, H. Khan and R. Warren. 2005. Application of CCME Procedures for Deriving Site-Specific Water Quality Guidelines for the CCME Water Quality Index. *Water Quality Research Journal of Canada* 40: 448-456.
- Krebs, C.J. 1999. *Ecological Methodology*. 2nd Ed. Menlo Park, Calif.: Benjamin / Cummings. 620 pp.
- Krezek, C.C., F. Ahern, A. Cantin, and M.D. Flannigan. 2008. Taiga Cordillera and Taiga Plains Ecozones, Natural Disturbances (draft).
- Latour, P.B., J. Leger, J.E. Hines, M.L. Mallory, D.L. Mulders, H.G. Gilchrist, P.A. Smith and D.L. Dickson. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut. Third Edition. Canadian Wildlife Service. Occasional Paper No. 114. 120pp.
- Milly, P.C.D., J. Betancourt, M. Falkenmark, R.M. Hirsch, Z.W. Kundzewicz, D.P. Lettenmaier, and R.J. Stouffer. 2008. Stationarity is dead: whither water management? *Science*. **319**: 573-574.
- Nature Conservancy, The. 2007. Indicators of Hydrological Variability, Version 7.0.4. <http://www.nature.org/initiatives/freshwater/conservationtools/art17004.html>
- Nichols, L. and F. Bunnell. 1999. Natural history of thinhorn sheep. pp. 23-77 in Valdez, R and P. Krausman (editors) *Mountain*

- sheep of North America. The University of Arizona Press. 353 pp.
- Norwegian, H., and P. Cizek [ed]. 2009. *Aboriginal Perspectives Nahanni National Park Reserve State of Park Report*. Report to Parks Canada. Contract No. 5P415-040021.
- Parker, B. R., L.M. Levesque, A. Gue, L. Perry, D. Halliwell and D.R. Haggarty. 2009. *Water Quality Analysis for Nahanni National Park Reserve, N.W.T.* Environment Canada.
- Parks Canada. 2004. *Nahanni National Park Reserve of Canada Nah'a Dehé Management Plan*. Parks Canada, Ottawa. 56 pp. Cat. No. R63-281/2002E.
- Parks Canada. 2009. *Nahanni National Park Reserve of Canada Visitor Experience Assessment*. Ottawa, Ontario. April 2009. 18 pp.
- Petts, G.E., A.M. Gurnell and A.M. Milner. 2006. Eco-hydrology: new opportunities for research on glacier-fed rivers. *In: Demuth, M.N., D.S. Munro and G.J. Young (Editors), Peyto Glacier: One Century of Science*. National Hydrology Research Institute Science Report #8, 278pp.
- Robertson Weir Ltd. 2008. *Non-Personal Media Action Plan for Nahanni National Park Reserve Final Report*. Lacombe, Alberta. March 2008. 81 pp.
- Robertson Weir Ltd. 2009. *Interpretation Plan Framework for Nahanni National Park Reserve*. Lacombe, Alberta. March 2009. 53 pp.
- Robertson Weir Ltd. 2009. *Nahanni National Park Reserve Off-site Exhibit Interpretive Plan and Preliminary Media Concept*. Lacombe, Alberta. March 2009. 20 pp.
- Robertson Weir Ltd. 2009. *Nahanni National Park Reserve Office Interpretive Plan and Preliminary Media Concept*. Lacombe, Alberta. March 2009. 19 pp.
- Rogean, M-P. and P. Bothwell. 2006. *Preliminary fire regime study of Greater Nahanni Ecosystem*. Prepared for Parks Canada Agency, Gatineau, PQ. 23 p.
- Rettie, Kathy. 2009. *Draft Nahanni National Park Reserve Report on Visitor Experience*. Banff, Alberta. March 2009. 19 pp.
- Ritcher, B. D., J.V. Baumgartnew, R. Wigington, and D.P. Braun. 1997. How much water does a river need? *Freshwater Biology*. 37: 231-249.
- Ritcher, B. D., J.V. Baumgartnew, D.P. Braun, and J. Powell. 1998. A spatial assessment of hydrologic alteration within a river network. *Regulated Rivers: Research and Management*. 14: 329-340.
- Spence, C. 2002. Streamflow variability (1965-1998) in five Northwest Territories Rivers. *Canadian Water Resources Journal*. 27:135-154.
- St. Jacques, J.M. and D.J. Sauchyn. In press. Increasing winter baseflow and mean annual streamflow from possible permafrost thawing in the Northwest Territories, Canada. *Geophysical Research Letters*, 36: L01401.
- Tucker, C. J., D. A. Slayback, J. E. Pinzon, S. O. Los, R. B. Myneni, and M. G. Taylor. 2001. Higher northern latitude normalized difference vegetation index and growing season trends from 1982 to 1999. *International Journal of Biometeorology*, 45:184-190.
- Weaver, J.L. 2006. *Big Animals and Small Parks: Implications of Wildlife Distribution and Movements for Expansion of Nahanni National Park Reserve*. Wildlife Conservation Society Canada Conservation Report No. 1. Toronto, Ontario, Canada.
- Wilson, P. 2009. *2008 Ragged Range Glacier Inventory Greater Park Ecosystem Nahanni National Park Reserve*. Report to Parks Canada. Contract Number: 5P415-090020

Zhang, X., K. D. Harvey, W. D. Hogg, and T. R. Yuzyk. 2001. Trends in Canadian streamflow. *Water Resources Research*. **37**:987-998.

Personal Communications

Brett, R. Forest Health Technician. Canadian Forest Service, Edmonton, AB. July 2009.

Demuth, M. Glaciology Research Scientist, Natural Resources Canada. Ottawa, ON. May 2009.

Larter, N. Dehcho Regional Biologist, Environment & Natural Resources, GNWT. Fort Simpson, NT. January, 2009.

Latour, P. Habitat Biologist, Canadian Wildlife Service, Environment Canada. Yellowknife, NT. February 2009.

Veitch, A. Sahtu Regional Biologist, Environment & Natural Resources, GNWT. November, 2008.