5.0 TERRESTRIAL ENVIRONMENT

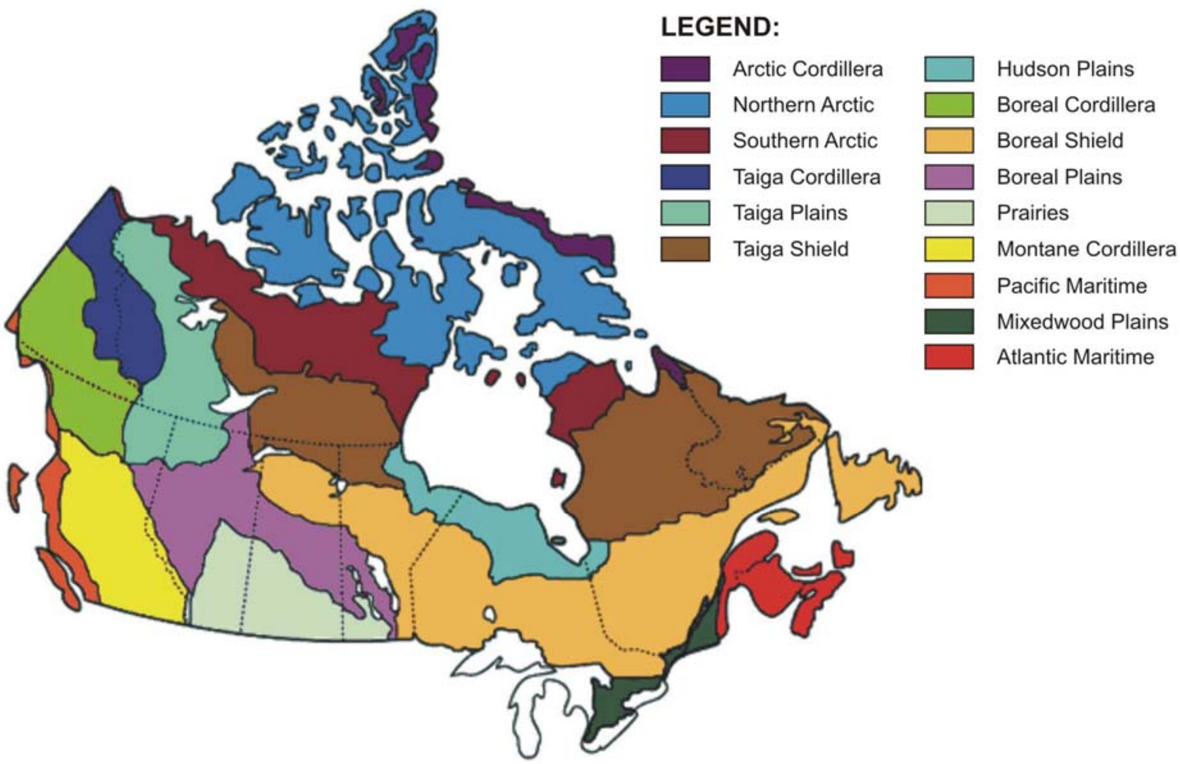
5.1 TERRESTRIAL ECOLOGY OF NWT

The Northwest Territories cover an area of 1.2 million square kilometres or approximately 13% of the land mass of Canada. Given the large size of the NWT, it is not surprising that it comprises a variety of habitats, each with its own distinct natural landforms, geology and biodiversity. The main features of these ecozones are described below. In addition, a brief overview of monitoring and research work that has been, or is being carried out, is provided. More detailed information on the findings of monitoring activities are presented in subsequent sections.

5.1.1 Ecozones of the NWT

Of the 15 separate terrestrial ecozones which have been defined for Canada using the national land classification framework (Wiken 1996), 6 ecozones cover parts of the NWT. The aerial extent of these ecozones is demonstrated on Figure 5.1-1.

FIGURE 5.1-1
ECOZONES OF CANADA



(Source: Parks Canada Website 2004)

Northern Arctic Ecozone

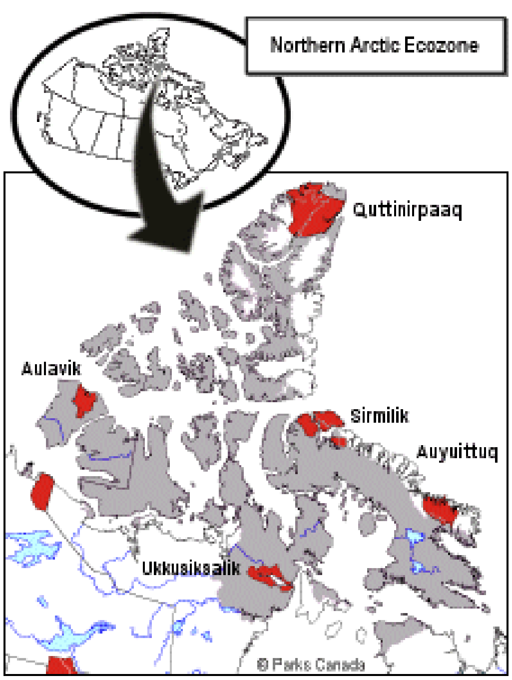
The Northern Arctic Ecozone encompasses most of Nunavut and a portion of both the Northwest Territories and northern Quebec (see Figure 5.1-2). Physically, it extends over most of the nonmountainous areas of the arctic islands and the western portion consists mostly of lowland plains covered with glacial moraine.

The climate is very dry and cold. Mean daily January temperatures ranges from -30ºC to -35ºC in the long winters and the daily July temperatures are between 5ºC and 10ºC in the short summers. The annual precipitation ranges from 100 mm to 200 mm. Snow may fall any month of the year and usually remains on the ground from September to June. Herb and lichen dominated communities constitute the main vegetation cover.

Mammals of the Northern Arctic Ecozone include Peary and barren-ground caribou, muskox, wolf, arctic fox, polar bear, arctic hare, and brown and collared lemmings.

Some representative birds include red-throated loon, brant, oldsquaw, gyrfalcon, willow and rock ptarmigan, and snowy owl.

FIGURE 5.1-2
NORTHERN ARCTIC ECOZONE
[Areas in red are Canadian National Parks]



Source: http://www.parkscanada.ca/

Southern Arctic Ecozone
The climate is typically arctic with long, cold winters and short, cool summers. Mean daily July temperatures tend to be cool (about 10ºC). Winter temperatures are highly variable, but the mean daily January temperature tends to be about -30ºC. Mean precipitation north-south ranges between 200 mm and 400 mm.

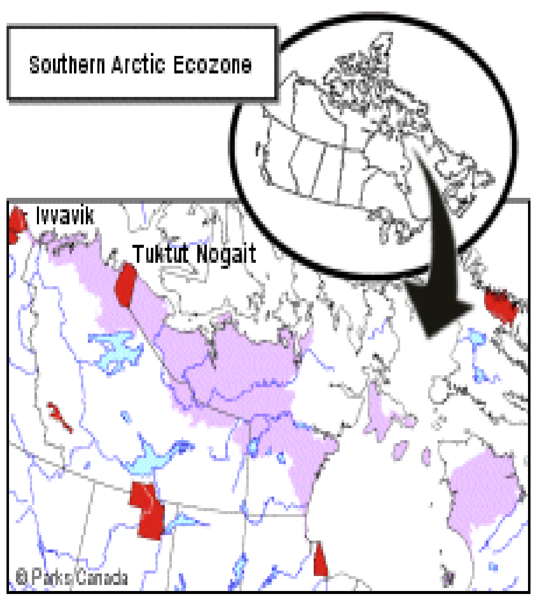
This ecozone represents a major area of vegetation transition and contains the major shrublands in the tundra.

Typical shrubs include dwarf birch, willows and heath species; these are commonly mixed with various herbs and lichens.

Characteristic mammals of the Southern Arctic Ecozone include moose, muskox, wolf, arctic fox, grizzly and polar bears, and arctic hare. The area also includes the major summer and calving grounds of two of the largest caribou herds.

The area is also a major breeding and nesting ground for a variety of birds. Representative species include yellow-billed, arctic and red-throated loon, whistling swan, snow goose, oldsquaw, gyrfalcon, willow and rock ptarmigan, northern phalarope, parasitic jaeger, snowy owl, hoary redpoll and snow bunting.

FIGURE 5.1-3
SOUTHERN ARCTIC ECOZONE
[Areas in red are Canadian National Parks]



Source: http://www.parkscanada.ca/

Taiga Shield Ecozone

The Taiga Shield ecozone lies on either side of Hudson Bay, as shown on Figure 5.1-4. The western segment includes portions of northern Manitoba and Saksatchewan, a portion of southern Nunavut, and the south-central area of the Northwest Territories.

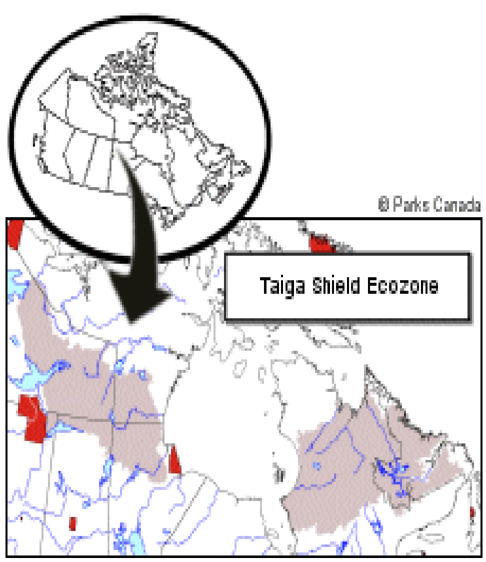
The climate is subarctic continental. Precipitation is low (from 175 mm to 200 mm). The mean daily January temperature ranges from -17.5ºC to -27.5ºC, with the mean daily July temperatures ranging from 7.5ºC to 17.5ºC.

The Russian term "taiga" refers to the northern edge of the boreal coniferous forest. In northern Canada, much of this forest rests on the Canadian Shield, the bedrock heart of the continent. Along the northern end of this ecozone, the poleward limits of tree growth are reached. The forest stands are open and form lichen woodlands which merge into areas of open arctic tundra. The central portion contains relatively unproductive and commonly stunted coniferous and deciduous stands, including open, stunted black spruce, accompanied by alders, willows and tamarack in the fens and bogs, and open, mixed wood associations of white spruce, balsam fir and trembling aspen.

Characteristic mammals of the Taiga Shield Ecozone include barren ground and some woodland caribou, moose, wolf, snowshoe hare, arctic fox, black and grizzly bears and lynx.

Representative birds include arctic and red-throated loons, northern phalarope, tree sparrow and grey-cheeked thrush.

FIGURE 5.1-4
TAIGA SHIELD ECOZONE
[Areas in red are Canadian National Parks]



Source: http://www.parkscanada.ca/

Taiga Plains Ecozone

The Taiga Plains Ecozone is an area of low-lying plains centred on Canada's largest river, the Mackenzie, and its many tributaries. As demonstrated on Figure 5.1-5, the plains are mainly located in the southwesterly corner of the Northwest Territories; however, they also extend into northeastern British Columbia and the upper margin of Alberta.

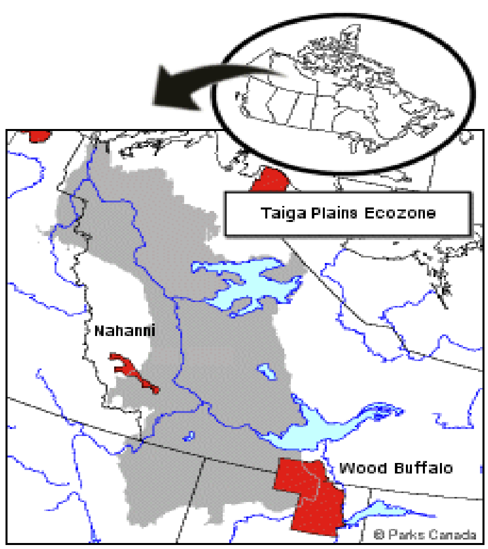
The climate is semi-arid and cold. Annual precipitation ranges from about 400 mm in the south to about 200 mm in the north. The mean daily January temperature ranges from -22.5ºC to -35ºC, while the mean daily July temperature ranges from 10ºC to 15ºC.

Dwarf birch, Labrador tea, willows, bearberry, mosses and sedges are associated with the arctic tundra environment. Upland and foothill areas and southerly locales tend to be better drained and warmer. The mixed wood forest is characterized by white and black spruce, tamarack, white birch, trembling aspen, balsam poplar and lodgepole pine.

Characteristic mammals of the Taiga Plains Ecozone include moose, woodland caribou, bison, wolf, black bear, marten and lynx. The southern portion is home to the world's largest Wood Bison herd.

Some representative bird species include red-throated loon, northern shrike, and common redpoll. The southern area contains the only known nesting site of the endangered Whooping Crane, and encompasses the sprawling Peace-Athabasca Delta, a wetland habitat of global significance.

FIGURE 5.1-5
TAIGA PLAINS ECOZONE
[Areas in red are Canadian National Parks]



Source: http://www.parkscanada.ca/

Taiga Cordillera Ecozone

The Taiga Cordillera is located along the northern extent of the Rocky Mountain system (see Figure 5.1-6). It covers segments of the Yukon Territory and the southwestern portion of the Northwest Territories. "Cordillera" refers to the series of mountain ranges and valleys that form this ecozone's rugged interior. This ecozone hosts some of Canada's largest waterfalls, deepest canyons, and wildest rivers.

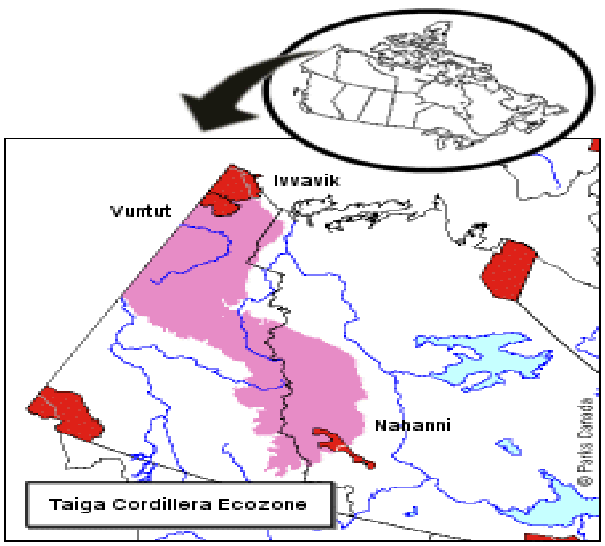
The climate is generally dry and cold. Total precipitation averages about 300 mm per year. The mean daily January temperature ranges from about -25ºC to -30ºC, with the mean daily July temperature ranging from 12ºC to 15ºC.

Steep, mountainous topography, consisting of repetitive, sharply etched ridges and narrow valleys, predominates. The Arctic tundra formations are more common in the north, the alpine tundra in areas of higher elevations and the taiga in the south.

Characteristic mammals of the Taiga Cordillera Ecozone include Dall's Sheep, woodland and barren-ground caribou, moose, mountain goat, black and grizzly bears, lynx, arctic ground squirrel, American pika and wolverine.

Gyrfalcon and willow ptarmigan are representative bird species.

FIGURE 5.1-6
TAIGA CORDILLERA ECOZONE
[Areas in red are Canadian National Parks]



Source: http://www.parkscanada.ca/

Boreal Plains Ecozone

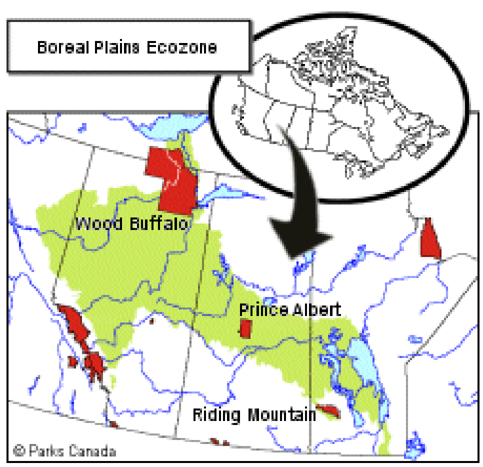
The Boreal Plains Ecozone extends as a wide band from the Peace River country of British Columbia in the northwest to the southeastern corner of Manitoba (see Figure 5.1-7). The ecozone extends along the Slave River to the southern perimeter of Great Slave Lake.

The moist climate is typified by cold winters and moderately warm summers. Precipitation is about 400 mm over much of the ecozone, nearing 500 mm along the southern boundary. The mean daily January temperature ranges from -17.5ºC to -22.5ºC, with the mean daily July temperature ranging from 12.5ºC to 17.5ºC.

White and black spruce, jack pine and tamarack are the main conifer species. Nevertheless, there is a wide distribution of broadleaf trees, particularly white birch, trembling aspen and balsam poplar. Characteristic mammals of the Boreal Plains Ecozone include woodland caribou, mule deer, bison, coyote, fisher and least chipmunk.

Representative birds include boreal owl, great horned owl, blue jay, evening grosbeak and brown-headed cowbird.

FIGURE 5.1-7
BOREAL PLAINS ECOZONE
[Areas in red are Canadian National Parks]



Source: http://www.parkscanada.ca/

5.1.2 Monitoring and Research Activities

Several monitoring and research programs are ongoing in the NWT, and elsewhere in the world, for species found in the NWT. Federal and territorial agencies have the ongoing mandate to conduct research and monitor individual species. Co-management boards, Hunters and Trappers

Associations and Renewable Resource Councils also provide continuing assessments on resources of concern to them.

A key theme in evaluating the status of the terrestrial ecosystem is the maintenance of the biodiversity, which generally refers to the maintenance of the individual species of plants and animals, and their genetics, within the current system. The NWT has extensive research, monitoring and assessment programs to monitor biodiversity, both independently and in conjunction with federal agencies and non-governmental organizations. Most of the programs are conducted under goals and objectives defined under the Northwest Territories Biodiversity Action Plan[1] (NWT Biodiversity Team 2005). The results of many of these programs can also be used in order to help determine the current status of the terrestrial system. For example, the list of programs identified under the Biodiversity Action Plan (Appendix A) provides useful information on a broad range of agencies, co-management boards and wildlife monitoring research activities.

This assessment for the terrestrial ecosystem was conducted by reviewing the scientific literature, reports, scientific and government on-line resources and through discussions with key researchers. The objective of the review of background material was to develop a consensus from several perspectives of the status of the indicators and to determine the methods and state of knowledge used in other jurisdictions for the same indicators.

The quality of the data in the reports was screened before using the information in the assessment. The highest credibility was given to scientific papers because the manuscripts are reviewed by other scientists before publishing, which removes many of the errors and poorly-designed studies. Some jurisdictions are maintaining bibliographies of research of immediate relevance to their area (WMACNWT 2003) or general bibliographies of wildlife and habitat that include the NWT (e.g., Yukon Renewable Resources)[1] and provide good source material.

This assessment also made a concerted effort to include traditional knowledge in the determination of the status of indicator species and to determine how prevalent the use of traditional knowledge is in monitoring programs. Although the incorporation of traditional knowledge into environmental assessments and environmental management programs has been recognized as a formal requirement for some time, the organization of the knowledge into a useable form by project proponents and regulators has made its use difficult (Usher 2000). Recently there has been a trend towards publishing traditional knowledge studies in the scientific literature (e.g., Lyver and Lutsel K'e First Nation (2005), Parlee *et al.* (2005)), making it easier to access during assessments. This type of widespread distribution of traditional knowledge is

[1] http://www.nwtwildlife.rwed.gov.nt.ca/Biodiversity/news.htm

encouraging because it helps First Nations, Inuit and Métis contribute important information to the review process in an accessible way. This has changed considerably over the last ten years and is an encouraging trend.

5.2 TERRESTRIAL ENVIRONMENT STRESSORS

Terrestrial ecosystems in the Northwest Territories are vulnerable to a wide range of anthropogenic and natural stressors, each with the potential to affect the ecology in different ways. Chief among these stressors, but listed in no particular order, are:

- climate change;
- contaminants;
- development (habitat disruption); and,
- harvesting.

5.2.1 Climate Change

Several comprehensive assessments have been written on the present and future effects of a warming climate on northern terrestrial systems. Groups such as the Intergovernmental Panel on Climate Change (IPCC)[2] and the Arctic Climate Impact Assessment (ACIA 2004) of the Arctic Monitoring and Assessment Program (AMAP)[3] have considered the evidence of climate change on a global scale and explicitly consider the effects to the northern landscape. International teams of scientists made up of several disciplines, including meteorologists, geologists and biologists, conducted these assessments. The teams used data collected over the last several decades to document ongoing changes and used computer models to predict the extent of changes over the next few decades. Summaries of the assessments are available at their websites. A major Canadian document on climate change by Natural Resources Canada primarily addresses changes to southern Canada and places little emphasis on the northern terrestrial system (CCIAP 2004)[1].

The most likely driving force behind the increasing temperatures is the accumulation of the greenhouse gases carbon dioxide, methane and nitrous oxide that cause heat to be retained in the atmosphere. Although effects from changing climate have been observed around the globe, the greatest effects are found in the higher latitudes, where melting ice and large tracts of drying tundra cause significant changes to the natural hydrologic cycle and carbon exchange. Overall, it has been estimated that the air temperature over the arctic landmass has increased at a rate of 0.40°C per decade since the 1960s. ACIA (ACIA 2004) reports that average winter temperatures

[1] http://www.yukia.ca/libraries20/renres.cfm
[2] http://www.ipcc.ch/
[3] http://www.amap.no/acia/index.html

in the western Canadian Arctic have increased by 3 to 4°C in the last 50 years, and that precipitation appears to have increased by 8% across the Arctic. ACIA predicts that total annual precipitation will increase by 20% in the Arctic by the end of the century. These prolonged changes to the climate are expected to have major effects on the northern terrestrial biological community.

Although the largest effects to birds and mammals are expected in the marine system with the loss of sea ice and elevated sea levels, major changes are also predicted for terrestrial plants and wildlife, primarily due to changes in the hydrologic cycle. A warming climate would result in eroding permafrost, erosion of soils and thermokarst and the possibility that wetlands and lake levels will be reduced (IPCC 2001a). The IPCC concludes that significant erosion of permafrost has already occurred in some areas of the north. This erosion of permafrost will lead to changes in surface water drainage and an increase in the active growth layer (i.e., the layer between permafrost and ground surface). Increases in the melting of snow and ice could cause the ponding of surface waters in some areas, but drying out of wetlands in other areas because of increased evaporation and transpiration. IPCC (2001b) cite studies in which the area of tundra is predicted to decrease by as much as two-thirds of its present size. The new environment will result in new assemblages of plant species.

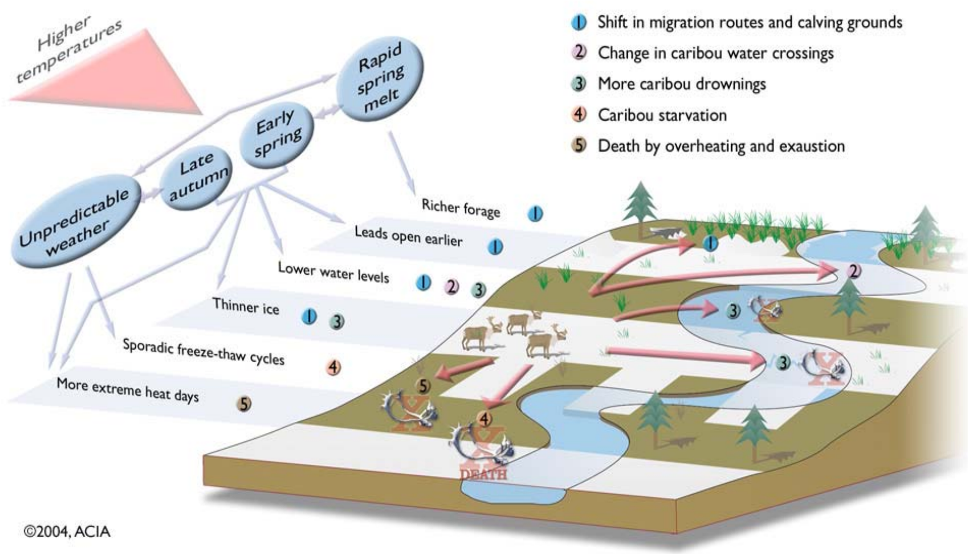
The exact nature of the changes to terrestrial wildlife in light of changes in climate, hydrology and plant communities is difficult to predict. Current predictions suggest that the overall effects to the terrestrial wildlife are a balance between plant and animal species that benefit from the warming temperatures and changes in surface water drainage and those species that will be negatively affected. Greater snow depth in winter, one of the consequences of higher air temperatures and higher moisture levels in the atmosphere, would make access to food difficult for resident birds and mammals, and make large-scale movements more difficult for species like caribou. Several times over the past decades, deep snow in spring has slowed migration of the Porcupine herd to the extent that calves were born in suboptimal habitat during the migration. This caused very low calf survival rates for those years (Russell and McNeil 2002). Similarly, freezing rain events on Banks Island appear to have been a major factor in the decline of the Peary caribou herd during the 1990s by forming an impenetrable barrier over lichen during much of the winter (Miller and Gunn 2003). Significant changes to the landscape could also influence millions of nesting waterfowl that rely on open water for nesting, and landbirds that require insect food sources at specific times during their breeding cycle.

Several studies predict impacts of climate change on caribou in northern Canada. The Kitikmeot Inuit used traditional knowledge to predict the impacts on the breeding cycle of a caribou herd

[1] http://adaptation.nrcan.gc.ca/perspective_e.asp

(Figure 5.2-1). Changes were predicted for the migration route and on the calving grounds, major river crossings, and possible death of caribou from starvation, overheating and exhaustion (ACIA 2004). An increase in freeze-thaw cycles and freezing rain would have a major impact on the herd condition, particularly during late winter and spring when the pregnant females require sustained nutrition. ACIA (2004) also reported a summary of changes expected to occur in the Porcupine herd with climate change (Table 5.2-1). The changes are a combination of positive (e.g., faster plant growth, higher pregnancy rates) and negative effects (e.g., extreme weather events, higher predation rates), but ultimately it is predicted that the herd will decline. Note that none of the predictions can be made with much certainty and that research and monitoring of the physical and biological components of the environment must continue.

FIGURE 5.2-1
SUMMARY OF ENVIRONMENTAL CHANGES THAT COULD IMPACT A CARIBOU HERD, AS PREDICTED BY THE KITIKMEOT INUIT



Source: ACIA (2004).

Scientists are also trying to assess how the northern species will react to the changing conditions by predicting how they will adapt to the new climate regimen (IPCC 2001b). In general, the IPCC authors note that natural systems in polar regions are highly vulnerable to climate change and have low adaptive capacity. Adaptation is expected to occur by the migration of species within the ecosystem and changing species assemblages (IPCC 2001a). IPCC has predicted with a high level of confidence that physical changes in the environment will affect the distributions, the population size, densities and behaviour of bird and mammal species as vegetation changes.

TABLE 5.2-1
POTENTIAL CHANGES IN THE PORCUPINE CARIBOU HERD AND ITS HABITAT FROM A WARMING CLIMATE

Climate Change Condition	Impact on Habitat	Impact on Movement	Impact on Body Condition	Impact on Productivity	Management Implications
Earlier snow melt on Coastal Plain	Higher plant growth rate	Core calving ground move further north	Cows replenish protein reserves faster	Higher probability of pregnancy	Concern over development on northern portion of present core calving area
		Less use of foothills for calving	Higher calf growth rate		
			Lower predation risk	Higher June calf survival	
Warmer, drier summer	Earlier peak biomass	Movement out of Alaska earlier in season	Increased harassment resulting in lower body condition	Lower probability of pregnancy	Protection of insect relief areas important
	Plants harden earlier	More use of coastal zone when in Alaska			
	Reduction in mosquito breeding sites	More dependence on insect relief areas, especially from mid- to late July			
	Significant increase in oestrid activity				
	Greater frequency of fire on winter range				
	Few “mushroom” years				
Warmer, wetter autumn	Deeper denser snow	Increased use of low snow regions	Greater over-winter weight loss	Maternal bond broken earlier	
		Later to leave winter range			
Warmer spring	More freeze/thaw days, snow forms ice layers	Move to windswept slopes	Accelerated weight loss in spring	Higher wolf predation due to use of windswept slopes	Concern over timing and location of spring migration in relation to harvest
	Faster spring melt	Faster spring migration			Lower productivity due to high spring mortality
Overall effect	Calving range improves, summer, autumn and winter ranges probably lower quality	Seasonal distribution less predictable, timing less predictable	Improves June condition but later summer condition reduced, more rapid weight loss in winter and early spring	High pregnancy rates but overall survival and recruitment; Shift mortality later in year (late winter, early spring); Herd more likely to decline	Need to assess habitat protection in relation to climate trends
	Extremes (such as very deep snow or very late melt) hard to adapt to)				Need to factor climate change on harvest levels
					Need to communicate impacts of climate on harvest patterns and timing
					Need to set up monitoring programs

Source (ACIA 2004)

Arctic mammal species have special adaptations for survival in the extreme northern climate but they cannot compete with temperate species that move north with the moderating climate. The arctic species would tend to move to new areas that are being formed further north.

Another issue that is similar to climate change, but occurs through a different mechanism, is the increase in ultraviolet radiation exposure in the terrestrial system caused by the thinning of the stratospheric ozone layer. The thinning of the ozone layer, which absorbs UV-B radiation, is caused by the emission of chlorofluorohydrocarbons (CFCs) that have eroded the ozone layer over the last 50 years. In general, the thinning of the ozone layer is at its maximum in the spring. The effects of this increased UV radiation to the terrestrial system could be extensive. Some plant species can create more pigmentation to reduce the effects of the radiation, while other plant species may die-off. Most effects to date have been described in the lower trophic systems and the impact to wildlife and bird species is largely unknown.

5.2.2 Contaminants

The presence of contaminants in Arctic wildlife has been the focus of extensive research since organochlorines were first reported in ringed seals in the ISR in the early 1970s (Bowes and Jonkel 1975). These observations ultimately led to two 5-year phases of DIAND's Northern Contaminants Program (NCP) beginning in 1992 that was dedicated to understanding the sources, transport and spatial and temporal trends of synthetic contaminants in traditional foods in the NWT and Nunavut. The goal of Phase II was to take action that would lead to the reduction of the chemicals in the environment of the north. The results of the program have been published in the Canadian Arctic Contaminants Assessment Reports (Jensen *et al.* 1997, DIAND 2003) and have been summarized in several scientific papers. The summary papers for the terrestrial system are presented in Thomas *et al.* (1992) and Braune *et al.*(1999).

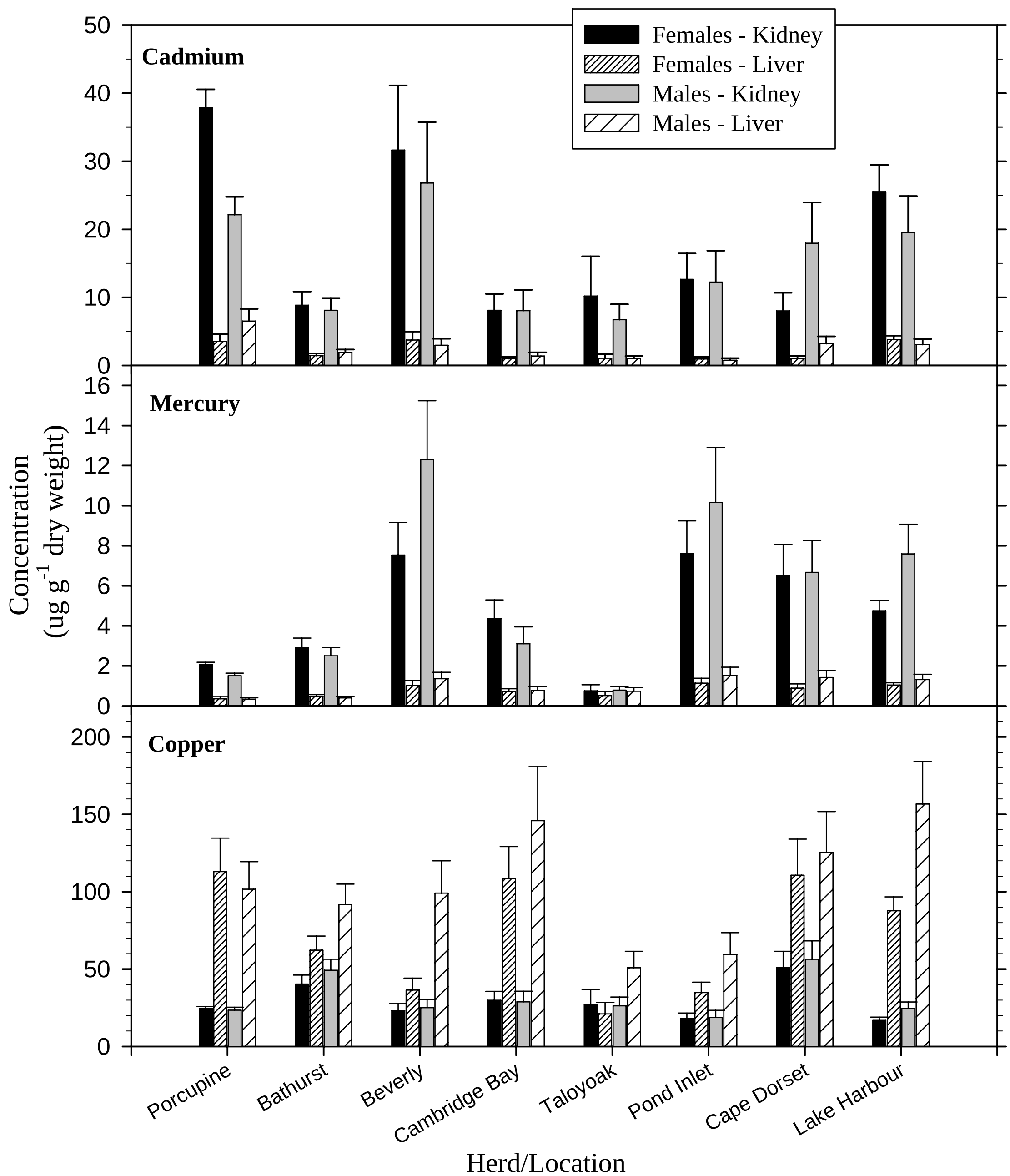
The consensus from two or more decades of research indicates that organochlorine contaminants, which reach levels of concern in marine wildlife and some freshwater fish species, remain at very low concentrations in terrestrial biota. This is largely due to the short food chains in the northern terrestrial food web. The concentrations of major contaminants such as PCBs, DDT, toxaphene and chlordane are at or below detection limits in caribou in the NWT and Nunavut (Elkin and Bethke 1995).

Metals and radionuclides occur naturally in the environment and many are present in all biological material. Some metals, such as copper, molybdenum and zinc, are important micronutrients for humans and wildlife and are required for the maintenance of health. In general, the highest concentrations of metals are in liver and kidney, with very low levels found in wildlife meat. The higher concentrations observed in liver and kidneys are typical of all organisms because of the mechanism of accumulation in these tissues.

A review of metal concentrations in caribou (Macdonald et al. unpublished MS) summarized the extensive data set of metals in caribou from the NWT and Nunavut generated by Environment and Natural Resources in a multi-year project partially funded by the NCP (Elkin and Bethke 1995). The program consisted of sampling from 10 to twenty caribou collected in community hunts and analyzing muscle, liver and kidney for a broad range of metals using high resolution chemical analysis. The age-corrected concentrations of some metals varied between herds, but the variation was attributed to normal biological variation (Figure 5.2-2). Cadmium, total mercury and copper accumulated with the age of the animals. There was no indication of consistent large-scale contamination for any of the metals tested and the concentrations of the metals tested were consistent with other caribou and reindeer studies from Europe and Alaska.

Radionuclide levels in the caribou were at natural levels, and the concentration of cesium-137, which was produced during the nuclear weapons tests in the 1950s and 1960s, was declining with an environmental half-life of about 10 years (Macdonald *et al.* 1996). The study concluded that there was no evidence of man-made contamination in the caribou and that they remain an important nutritious food source.

FIGURE 5.2-2
LEAST-SQUARE MEAN CONCENTRATIONS OF THREE METALS IN CARIBOU LIVER AND KIDNEY FROM THE NWT AND NUNAVUT



Source: [Data are from MacDonald et al. (unpublished ms).]

5.2.3 Development

Another significant threat to the habitat of wildlife in the north is the cumulative impact of large development projects that make a number of small changes to the terrestrial system. These small changes combine to produce stress on the biological community. Several issues are considered in this category, including the loss of habitat and the effects of development activities such as noise, dust, and the construction of buildings. Development has been an integral part of the northern environment for several decades; however, individual projects have been relatively small and widely dispersed. Mines may have affected local environments by building roads and other infrastructure and releasing contaminants to air, soil and water but the footprint of the mines were small in nature compared to currently proposed projects. Proposals for extensive oil and gas development, pipelines, permanent roads, hydro projects and several mines will make considerable changes to the landscape. A summary of the number of developments occurring within the range of the Bathurst and Porcupine caribou herds (Table 5.2-2) has been prepared by Kofinas and Gunn (2000)[1]. Some of the projects have been developed and expanded since the list was written in 2000.

The extent and significance of changes to northern wildlife caused by large development projects are still unclear and difficult to predict. One of the most heavily researched areas in this regard is the development of oil and gas fields on the Alaskan North Slope where oil exploration has been conducted in some form since the 1950s. It is possible to make a direct comparison of the Alaskan experience with the NWT because of the similarity in terrain and wildlife. Since the 1950s, the TransAlaska Pipeline has been built from the Alaskan northern coast to Valdez on the south coast, and the Prudhoe Bay oil field has been heavily developed. Extensive seismic activity has also been conducted since the 1950s. Originally, the seismic testing was conducted using very destructive land-based methods (Forbes 1992, 1995, 1997); however newer techniques and equipment have reduced the amount of damage caused in this phase of exploration. Other development includes roads, airstrips, gravel pads, drill rigs and other infrastructure needed for oil extraction. The development of oil reserves in this environment provides a very good comparison to the type of development that is beginning to occur in the NWT.

[1] http://www.taiga.net/sustain/lib/sustain2/cum_effects.html

TABLE 5.2-2
LIST OF ONGOING OR PROPOSED PROJECTS WITHIN THE RANGE OF THE PORCUPINE AND BATHURST CARIBOU HERDS

Activity Class	Activity
Bathurst herd	
Non-renewable resource explorations and development	• Izok Lake projects (base metals). Proposed; winter range. • Jericho Project (diamonds) Proposed winter range. • Ekati Mine (diamonds), Active on preferred migratory route. • Diavik Project (diamonds), Active; winter range. • Boston Windy Project (gold), Proposed; northern of calving grounds • Snap Lake Mine. Proposed (wintering grounds) • Kennedy Lake Mine. Proposed. (Winter range).
Non-renewable resource exploration and development	• No pipelines in area. • Extraction activities currently by road or air. • South Bathurst Inlet Sea Port Facility. Proposed. Suggested that various levels of shipping activities may affect migration across the inlet. (Animals swim or cross ice)
Year-round, service, and winter roads	• Yellowknife Road (year round). Active; winter range. • Three winter roads to support resource extraction and other development activities. All active. • Other service roads likely to be constructed if additional mine proposals are approved. • The proposed Bathurst Inlet Port and Road project would see an all-weather road constructed from Bathurst Inlet southwest to Contwoyto Lake.
Other activities	• Air traffic. Likely to increase with hydrocarbon and tourism development. • Increased access by hunters as a result of changes in hunting technology (i.e. faster snow machines). • Future changes in number of local and non-hunters; increased take. • Bush camps. Increase in number may follow if there is an improved economy and larger human population in villages.
Porcupine herd	
Non-renewable resource exploration and development	• On-shore gas pipeline routes -- from Mackenzie Delta and Prudhoe Bay south. Several alternatively currently proposals; winter range. • Coastal sea port(s) to support off-shore gas pipeline. Proposed; calving and post calving habitat.

TABLE 5.2-2 (Cont'd)
LIST OF ONGOING OR PROPOSED PROJECTS WITHIN THE RANGE OF THE PORCUPINE AND BATHURST CARIBOU

Activity Class	Activity
Year-round, service, and winter roads	• Dempster Highway - a year-round road completed in 1979. Active; transects winter range and across migratory routes. Increase in traffic is likely with oil and gas development and tourism in the region. Recent gas exploration activity in the Mackenzie Delta Region is projected to bring dramatic increase in large truck traffic on the Dempster. • Winter road to Old Crow, an ice road constructed in 1999. May be reconstructed in the future, depending on need and economy. • Year-round roads to and between communities. Possible roads in the areas of Aklavik, Arctic Village and Venetie, and Old Crow are today part of the local and regional development discussions. • Additional service roads (winter and year-round) are likely to accompany oil and gas development
Other activities	• Air traffic. Likely to increase with hydrocarbon and tourism development. • Increased access by hunters as a result of changes in hunting technology (i.e. faster snow machines). • Future changes in number of local and non-hunters; increased take. • Bush camps. Increase in number may follow if there is an improved economy and larger human population in villages.

Source: (Kofinas and Gunn 2000)[1]

[1] http://www.taiga.net/sustain/lib/sustain2/cum_effects.html[1]

Debate on the effects of oil development to wildlife on the Alaskan North Slope, including caribou, continues (Maki 1992, Cronin *et al.* 1998b, Ballard *et al.* 2000, Murphy and Lawhead 2000, Cameron *et al.* 2005). Three of the four barren-ground caribou herds that calve in areas adjacent to the oil development on the Alaskan North Slope have increased in size since the 1970s when oil production began to increase (Cronin *et al.* 1998b, Ballard *et al.* 2000). The Porcupine herd, which has not been exposed to oil development in a significant way, has declined during the same time, and there are plans by the U.S. to begin development in the Porcupine herd calving ground. Caribou use the open areas, such as roads and gravel pads, in the oil fields to avoid insects during the summer (Cronin *et al.* 1998a, Noel *et al.* 1998), but there is increasing evidence that females and calves avoid these structures during calving. Parturient females may move to suboptimal habitats to avoid oil activity during times of the year that are critical to calf health and nutrition (Nellemann and Cameron 1996, 1998, Cameron *et al.* 2005).

New developments in Alaska may also have other significant effects on the distribution of wildlife species. Buildings associated with oil development on the Alaskan North Slope has provided new habitat to the raven and the Arctic fox that have become "subsidized" predators because the developments provide food at the landfill and new structures for nesting or denning. For the raven, which doesn't naturally nest on the North Slope, the oil field structures provides unique nesting habitat. The influence of these predatory species on local bird and mammal populations is unknown.

Other structures have an impact on the local landscape far exceeding their physical footprint. Roads affect the local landscape by modifying permafrost, the drainage of surface water and by the transport of dust (Walker and Everett 1987, Walker *et al*. 1987). Recolonisation of abandoned gravel pads occurs very slowly. Walker and Walker (1991) suggest that although the local impacts from the oil industry are small in scale (less than 1 m^2 to 1 km^2), the cumulative impact from all the development affects the region on a mesoscale of 1 km^2 to 10,000 km^2. By comparison, climate change is predicted to affect the tundra regions at a larger scale of 10,000 to 1,000,000 km^2.

Based on the Alaskan experience, it is not unreasonable to expect that a similar level of development in the NWT will result in significant changes to the terrestrial environment, but the impact to major wildlife species that are valued ecosystem components is still unclear. Considering the potential changes in mammal and bird populations, and traditional hunting patterns, that may be caused by the cumulative effects of development, it is important that research and monitoring continue on all major species to ensure the long-term viability of the resource.

5.2.4 Harvesting

The terrestrial ecosystem is highly valued by the people of the North as the primary source of food (e.g., caribou, moose, small mammals, landbirds and waterfowl) as well as for the making of clothing items (from animal hides) and medicinal products (from various plants). Fur bearing animals are also trapped for sale of hides as a source on income. These harvesting activities can affect the populations of certain species.

Harvest statistics provide a record of the numbers and types of wildlife species collected annually in each community. Statistics have been compiled in the Sahtu Settlement Area (SSA), Gwich'in Settlements Areas (GSA) and the Inuvialuit Settlement Region (ISR), as required under the respective land claims agreements. The objectives of the harvest statistics are to establish the minimum wildlife harvest required to support the beneficiaries of the lands claims. The intent is to provide co-management boards with data to allow harvest levels sufficient to support traditional uses if a wildlife population declines to the point that restrictions must be placed on hunting and harvest levels. Currently, summary harvest survey reports cover eight years (1995-2002) for the GSA (GRRB, pers. comm.), ten years (1988-1997) for the ISR (Joint Secretariat 2003) and four years (1998-2001) for the SSA (SRRB 2002, 2003). A 5-year summary is in the process of being finalized for the SSA. These survey reports provide an excellent basis for the selection of Valued Ecosystem Components that are highly relevant to people in the communities. Unfortunately, similar surveys are not currently being undertaken for the unsettled land claim areas in the southern portion of the Northwest Territories.

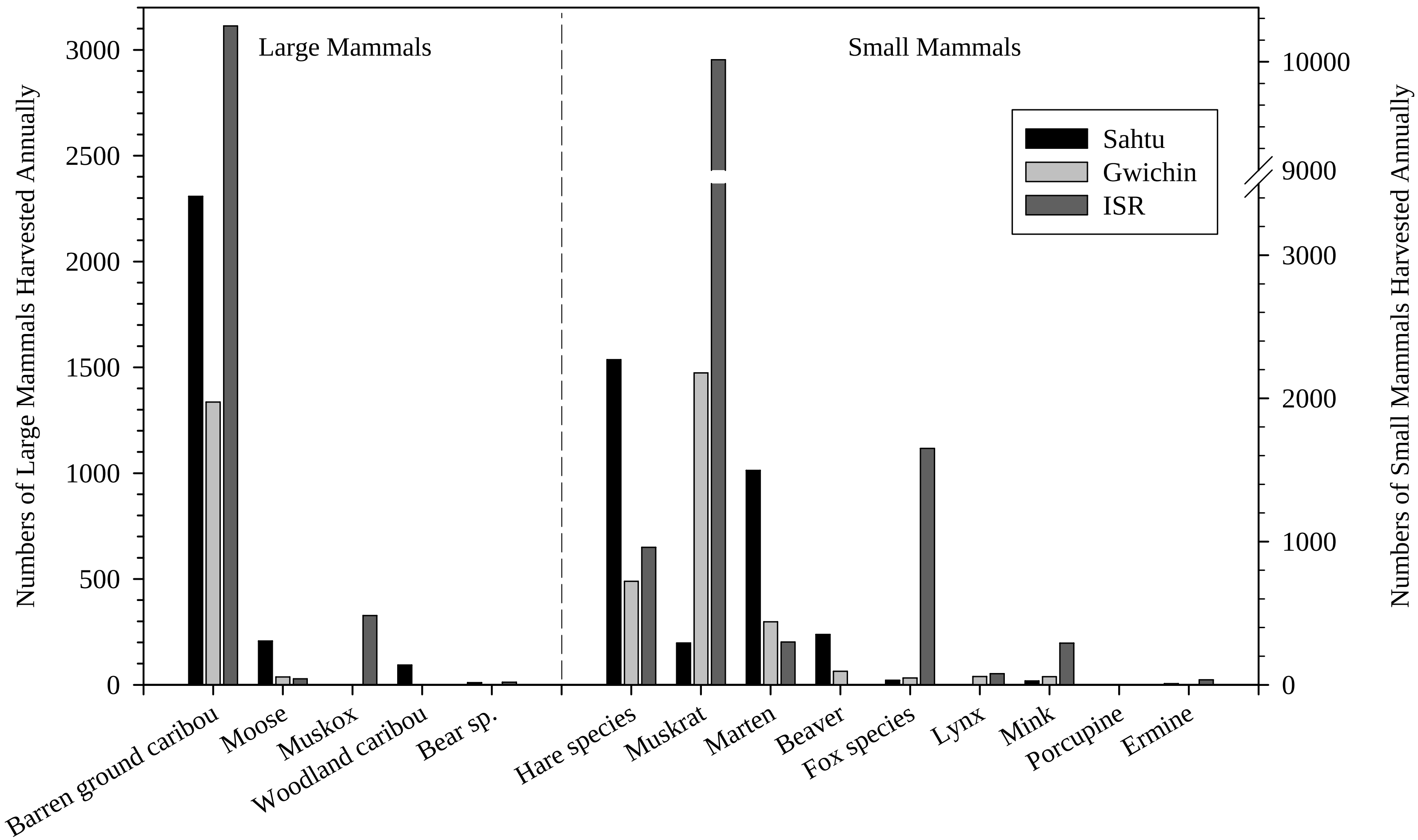
A summary of the major species harvested in the three regions noted above are shown in Figures 5.2-3 and 5.2-4 and Table 5.2-3. Similar wildlife species have been grouped under general categories for presentation purposes but also because the surveys include general categories when it is not known which species was collected (i.e. designated as hare species, fox species, duck species, etc.). Data for these miscellaneous categories and the individual species were pooled for this analysis. In addition, species for which relatively few individuals are taken, or may be harvested in only one region and not the others, are not included. Large changes in the number or condition of any of these species would be significant to harvesters, although the low numbers harvested for some species probably indicates opportunistic collections that may not occur in some years.

The data show major similarities between regions in the types and amounts of wildlife species harvested and the importance of barren-ground caribou, waterfowl and ptarmigan throughout the NWT. The same wildlife groups, although not necessarily the same species, are probably collected in the southern NWT as well (Kuhnlein *et al.* 1995, Morrison *et al.* 1995, Berti *et al.* 1998). There are clear regional differences in the individual species harvested, however the comparison shows the importance of these general wildlife groups to the communities in the settlement areas. For example, the Arctic hare is the dominant species harvested in the ISR while the snowshoe hare is the major hare species collected elsewhere. Comparison of the summarized data for the three regions show a broad diversity of wildlife mammal and bird species harvested.

TABLE 5.2-3
SUMMARY OF MAJOR WILDLIFE SPECIES HARVESTED IN THE GSA, SSA AND ISR THAT COULD BE USED AS ENVIRONMENTAL INDICATORS

Common Name	Scientific Name	Common Name	Scientific Name
Mammals		***Landbirds***	
Barren-ground caribou	*Rangifer tarandus groenlandicus*	Ruffed grouse	*Bonasa umbellus*
Woodland caribou	*Rangifer tarandus*	Spruce grouse	*Dendragapus canadensis*
Moose	*Alces alces*	Sharp-tailed grouse	*Tympanuchus phasianellus*
Grizzly bear	*Ursus arctos*	Ptarmigan	*Lagopus sp.*
Black bear	*Ursus americanus*	***Waterfowl***	
Dall sheep	*Ovis dalli*	Canada goose	*Branta canadensis*
Small Mammals		Greater white-fronted goose	*Anser albifrons*
Arctic fox		Snow goose	*Anser caerulescens*
Red fox	*Vulpes vulpes*	Brant	*Branta bernicla*
Snowshoe hare	*Lepus americanus*	Mallard	*Anas platyrhynchos*
Arctic hare	*Lepus arcticus*	Northern pintail	*Anas acuta*
Lynx	*Lynx lynx*	Long-tailed duck	*Clangula hyemalis*
Marten	*Martes americana*	Merganser	*Mergus merganser*
Mink	*Mustela vison*	Scoter	*Melanitta sp.*
Muskrat	*Ondatra zibethicus*	Widgeon	*Anas americana*
Wolf	*Canis lupus*	Scaup	*Athya sp.*
Wolverine	*Gulo gulo*	Tundra swan	*Cygnus columbianus*
Ermine	*Mustela erminea*	Northern shoveler	*Anas clypeata*

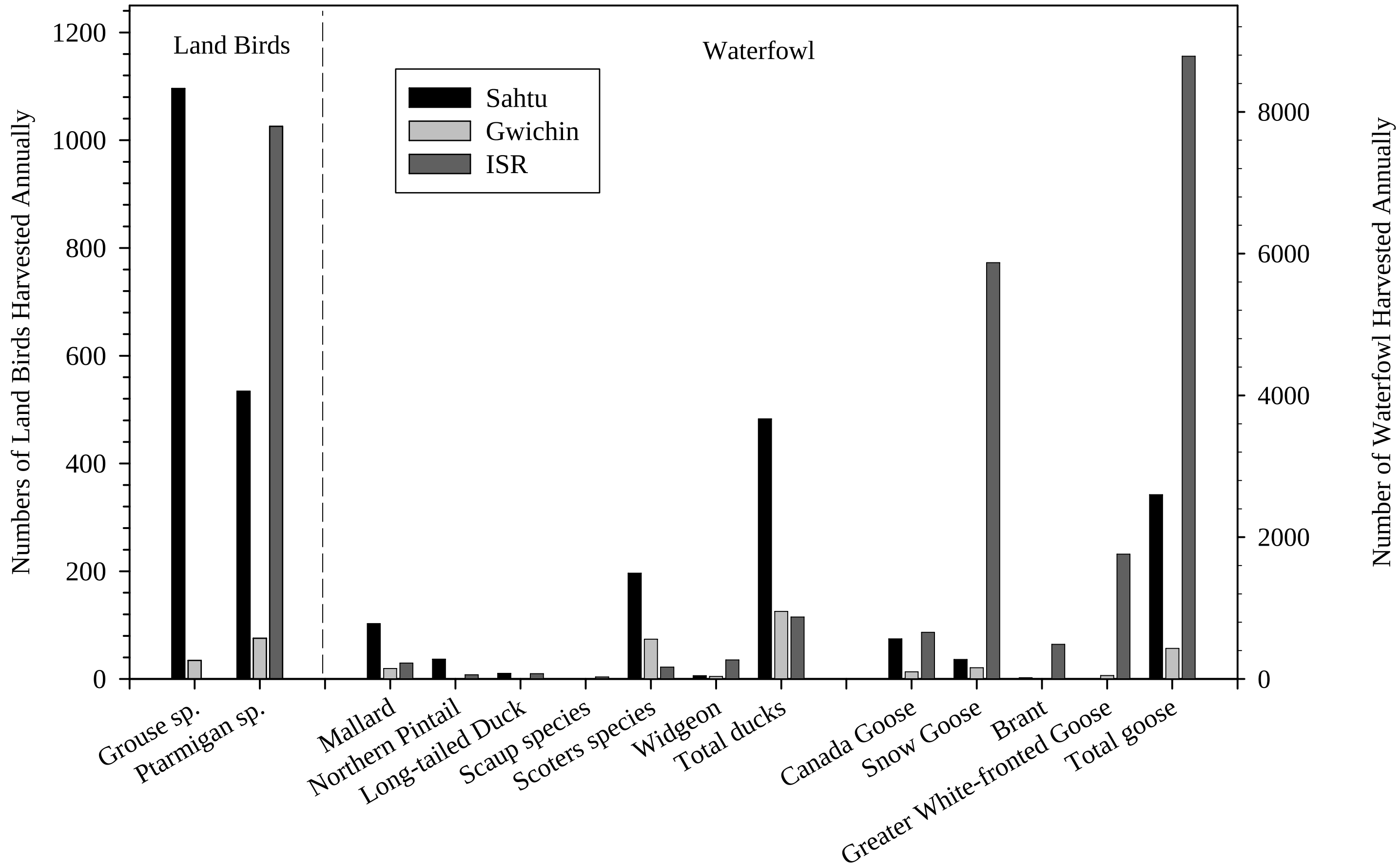
FIGURE 5.2-3
SUMMARY OF ANNUAL HARVEST LEVELS OF MAJOR MAMMAL SPECIES IN THE GWICH'IN AND SAHTU SETTLEMENT AREAS AND THE INUVIALUIT SETTLEMENT REGION



Source: (Joint Secretariat 2003).

FIGURE 5.2-4

SUMMARY OF ANNUAL HARVEST LEVELS OF MAJOR LANDBIRD AND WATERFOWL SPECIES IN THE GWICH'IN AND SAHTU SETTLEMENT AREAS AND THE INUVIALUIT SETTLEMENT REGION



Source: (Joint Secretariat 2003)

5.3 TERRESTRIAL ENVIRONMENTAL QUALITY (TEQ) INDICATORS

Environmental monitoring programs use the concept of indicators to determine the state of the environment. These indicators undergo changes that reflect alterations in their environment and long-term trends in the status of the indicator are related to larger changes in the environment. Examples of useful indicators in the physical environment are air temperature, air quality, humidity and snow depth because they are easily measured and reflect the status of the physical environment.

Indicators of the status of the biological community are more difficult to select because of the large number of plant and animal species present, particularly over an area as large as the NWT, which includes sections of six ecozones. In addition, there are a large number of potential measurements that can be made on each indicator. Indicator species are chosen because of their ecological, societal or scientific value. Ecologically significant species tend to be keystone species that play a central role in the structure of the terrestrial food web. One example of a keystone species in the NWT is the barren-ground caribou, which covers large areas of tundra and is preyed upon by wolves, grizzly bear and golden eagles and harvested by virtually all communities. Large changes in herd size will have far-reaching implications. Similar arguments can be made for waterfowl because of their large numbers and influence on several other species. Several species that are representative of the wildlife harvested in the communities are evaluated in this assessment of the current status of the environment.

Based on these data, four indicator species were used for this assessment of the status of the terrestrial environment:

- Barren-ground caribou;
- Moose;
- Landbirds (grouse, ptarmigan); and,
- Waterfowl.

The indicator species were chosen primarily because of their importance to First Nations, the Inuit and Métis, but also because there was sufficient information available for each species to allow an assessment of their status. Advantages of using these species are that they are of great importance to northerners, there are extensive resources available to allow a scientific evaluation of their status and barren-ground caribou and waterfowl are considered keystone species. Two of the species are expected to be negatively affected by climate change (caribou, waterfowl) while the other two are boreal species and may benefit by warming conditions. The assessment was conducted by developing specific markers of the current condition of each of the indicator species.

In addition to the above, vegetation was considered as plant species distribution is expected to be impacted by large-scale environmental change. There is little high quality information available however, on the distribution of single species, so the best indicator of the distribution of species is on a landscape scale. Hence, vegetation was not included in this assessment although it is recognized that it should be considered in future assessments.

The species listed in Table 5.3-1 integrate the effects of environmental changes and are important to the traditional economy, have been studied in the region, and may provide a useful indicator of the state of the environment through time. Among the potentially useful indicators, only those with the most useful data records are discussed below.

TABLE 5.3-1
RATIONALE FOR SELECTION OF CANDIDATE TERRESTRIAL SPECIES AND INDICATORS OF ENVIRONMENTAL QUALITY AND TRENDS

Candidate Species for Valued Ecosystem Component	Indicators*	Rationale
Mammals		
Caribou (Barren-ground, Woodland, Mountain)	• **Population Size** • **Male:Female ratios** • **Cow:calf ratio** • **Body condition/Disease** • **Harvest Rate** • Contaminants	• Primary concern of communities • Keystone species of taiga and tundra biomes • Extensive database of monitoring and research
Moose	• **Population Size** • **Harvest Rates** • **Cow/calf Ratio** • **Male/Female Ratio** • Condition of habitat • Contaminants (esp. cadmium)	• Major concern of communities in western NWT. • Indicator of the health of the boreal system • Population distribution may affected by cumulative impacts by avoidance behaviour, increased hunting, etc.
Furbearers (marten, mink, lynx, fisher, wolverine)	• **Population size** • **Harvest/trapping rates** • Habitat condition	• Trapping continues to be a major source of income for some groups in communities • Small mammal populations can reflect changes from cumulative impacts
Birds		
Landbirds (incl. Grouse/Ptarmigan)	• **Population size and diversity** • Habitat condition	• Major food species in many communities • Population health an indicator of environmental quality
Waterfowl (geese, ducks) and Shorebirds	• **Population size** • **Long-term trends in population** • Nesting Habitat Condition • Contaminants	• Major food species in many communities. • Large database of population trends and health for several species.

*key indicators are in bold type.

5.3.1 TEQ Indicator - Barren-Ground Caribou

Several thousand barren-ground caribou are harvested annually through subsistence, resident and non-resident hunts in the NWT (Figure 5.2-3). The health and availability of barren-ground caribou is a continuing concern to residents of the NWT and the effect of any development on the ecology of the herds is significant. For this reason, maintaining the size and condition of the herds and understanding the reasons behind herd declines are of critical importance.

(i) What is being measured?

The major criterion used to monitor caribou herds is the total population size (Table 5.3-2). Generally, herd size is estimated using several techniques, including radio-collared female caribou and aerial surveys during calving when females congregate on the calving grounds, or post-calving in July. Additional measurements of herd condition include cow:calf ratio and male:female sex ratio that provide an estimate of the number of females available for reproduction and the ability of the herd to increase. Detailed estimates of calf survival in the first month after birth, rates of predation in young calves and the numbers of calves entering the breeding population in their second year provide critical information on the recruitment rate in the herd (Griffith *et al.* 2002). When used together, these indicators provide a good summary of herd dynamics and may provide the reasons behind a declining herd.

TABLE 5.3-2
SUMMARY OF INDICATORS FOR EVALUATION OF BARREN-GROUND CARIBOU STATUS

Indicator	Description
Population size	Total number of individuals indicates long-term trends in the herd. May be measured directly or estimated from number of breeding females on calving grounds.
Male:female sex ratio	Indicates the number of females available for reproduction in the current year relative to the number of males in the herd.
Cow:calf ratio	The number of calves relative to females. Other indicators indicate calf recruitment and calf net productivity.
Body condition	Several indicators of body condition (subcutaneous fat, kidney fat, intestinal fat, marrow condition) report the nutritional status of individual animals.
Habitat or range condition	Some investigators use estimates of range quality, or the date of green-up in spring, to predict herd condition.
Harvest rate	Generally should not exceed 5% of the known population, although some biologists recommend a level of 3%.
Disease	Proportion of the herd with active or positive signs of disease, or the incidence of disease level of (e.g., number of parasites, or bot/warble fly larvae).

Another series of indicators can be used to estimate the nutritional status of the herd. A workshop on monitoring body condition in caribou was held in 2000 (Kofinas *et al.* 2002) to determine the best set of indicators that could be used to estimate the health, or condition, of individual animals in a herd. The indicators would use a set of measurements from harvested animals (i.e. subcutaneous fat, kidney fat, intestinal fat, marrow condition) (Gerhart *et al.* 1996) with interviews and assessments from hunters. The body measurements were vital to the assessment because the body condition of females has been correlated with the body weight, survival of calves at birth and the ultimate success of the calves entering the reproducing population (Cameron *et al*. 1993, Cameron and ver Hoef 1994).

Several initiatives have been proposed to standardize the methods of monitoring the condition of caribou herds and to coordinate the programs in various jurisdictions (Kofinas *et al.* 2002). The most comprehensive system termed the Body Condition Study was developed for the Porcupine herd (Allaye Chan 1991, Allaye Chan-McLeod *et al.* 1999) and appears to be one of the most complete because of the amount of research used to develop the indicators. Several data sets on body condition are available for the various herds and the initiative to standardize and coordinate the programs is important. One of the protocols proposed for determining caribou condition at the 2000 Workshop is listed in Table 5.3-3.

TABLE 5.3-3
ONE PROPOSED SCHEME FOR DETERMINING CARIBOU CONDITION FROM HARVESTED ANIMALS

Level 1: Visual Appraisal	Level 2: Field Form	Level 3: Field Collection and Measurements
• Date	• Include everything from lower level	• Field measurements (include everything from lower levels)
• Location	• Lactating/pregnant	• Shoulder weight
• Age	• Abnormalities - liver, wounds, limping, joint condition, lesions in organs, etc.	• Level 3: Field Collection and
• Sex	• Body condition score	• Level 3: Field Collection and
• 3/5 classes of overall visual assessment (from “skinny” to “fat”)	• Back fat depth	• Abnormal tissue samples
• Comments	• Bone marrow colour/consistency	• Contaminant tissue samples
	• Kidney fat	• Blood sample
	• Brisket fat	• Fecal sample
	• Opportunistic tissue samples	• DNA sample (skin) for herd identification

Source: (Kofinas et al. 2002).

An important initiative in the monitoring of caribou is the development of programs to use observations and measurements of hunters to monitor caribou condition. Hunter surveys could provide large numbers of samples (i.e. several thousand animals sampled per year for some herds) on a continuing basis. The range of observations that could be provided by hunters is listed in Table 5.3-4. Community-based input to the herd monitoring could be organized through the community hunts and provide the input of traditional knowledge throughout the process.

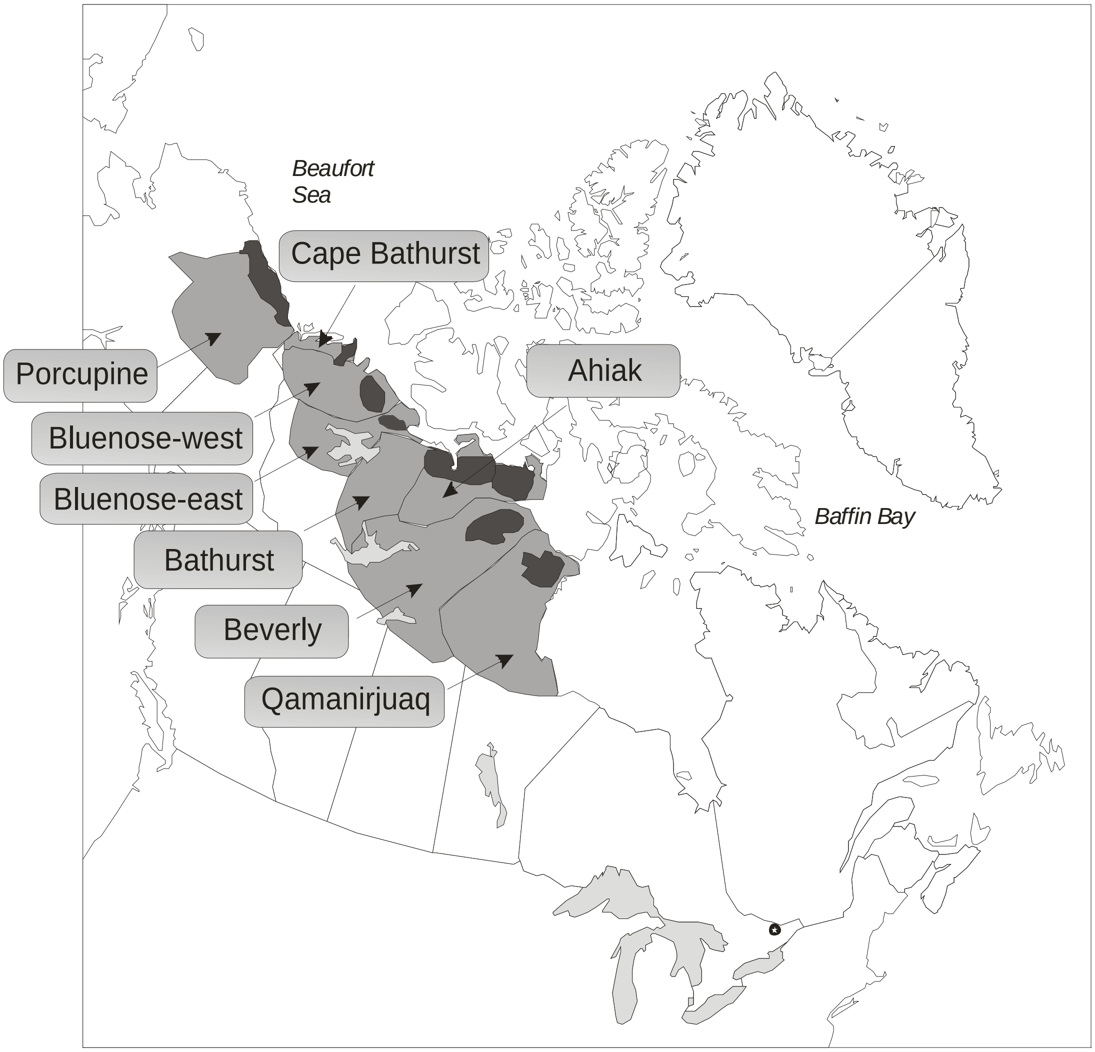
TABLE 5.3-4
SERIES OF MEASUREMENTS THAT COULD BE COLLECTED BY HUNTERS TO MONITOR THE CONDITIONS OF A CARIBOU HERD

Indicator	Measurement
Indicators hunters look for when selecting caribou	Size of rump
	Gait or waddle of walk
	Whiteness of mane
	Size of rack
	Symmetry & overall shape of rack
	Number of configurations or points on rack
	Size & shape of shovel
	Greyness of rack
	Social role of individual in group
	Posture of animals when moving
Post-mortem indicators of caribou health	Quantity of "backfat" (i.e. rump)
	Quantity of stomach fat
	Colour of marrow
	Tone & colour of lungs (lungs stuck to chest indicate poor health)
	Colour of kidneys and liver
	Absence of pus bags on kidneys
	Absence of "water" in muscles (water produced when animal is worked)
	Contents of stomach (grass-filled may indicate sick animal)
	Presence of parasitic larvae in kidneys

Source: Kofinas, G.P. 1998. The cost of power sharing: community involvement in Canadian Porcupine caribou co-management. Ph.D. dissertation. University of British Columbia, Vancouver.

There are eight major barren-ground caribou herds that occupy some area in the NWT during the year (Figure 5.3-1). A summary of the sizes and status of the individual herds is listed in Table 5.3-5, with the estimated harvest rate. Because of the different research and monitoring programs and management schemes, each herd will be assessed independently. Long-term trend data for five of the herds are summarised in Figure 5.3-1.

FIGURE 5.3-1
MAP OF CANADA SHOWING THE APPROXIMATE RANGE AND CALVING GROUNDS OF THE EIGHT MAJOR BARREN-GROUND CARIBOU HERDS IN THE NWT



Source: [Map is redrawn from Russell et al. 2002.]

TABLE 5.3-5
MOST RECENT CENSUS DATA ON NWT BARREN-GROUND CARIBOU HERDS AS REPORTED BY THE CIRCUMARCTIC RANGIFER MONITORING & ASSESSMENT NETWORK[1]

NWT Herd	Current Estimated Size	Status	Last Census Date	Next Proposed Date	Estimated Rate of Harvest
Bathurst	186,400	Declining	2003	Unknown	Estimate of ~14,000 in 1996.
Beverly	286,000	Unknown	1994	2000	14,000[1]
Qaminirjuaq	496,000	Unknown	1994	2000	-
Ahiak	200,000	-	1996	Unknown	unknown
Bluenose East	66,600	Declining	2005	-	5,000[2]
Bluenose West	20,800	Declining	2005	-	5,000[2]
Cape Bathurst	2,400	Declining	2005	-	-
Porcupine	123,000	Declining	2001	-	3,000

[1] – estimate is probably for both the Beverly and Qamanirjuaq herds.
2 – total estimated harvest of Bluenose East, Bluenose West and Cape Bathurst herds.

ii) Bathurst Herd

The Bathurst herd is one of the largest of the NWT herds and is more accessible to people than any other NWT herd (Case *et al.* 1996). Approximately 10 aboriginal communities, and the city of Yellowknife, lie within the range of the herd, which covers about 250,000 km^2. The herd over winters in the region of the NWT to the north and east of Yellowknife, migrates north in the spring, and calves to the south of Bathurst Inlet in Nunavut (Figure 5.3-1). Several abandoned mines and two diamond mines are currently present within the territory covered by the herd.

The background information on the herd is extensive, with many papers in peer-reviewed journals, traditional knowledge of the herd (Dogrib Treaty 11 Council 2001, 2002) and many published and unpublished reports relating to aspects of the biology and ecology of the herd. Knowledge of the herd is based on several scientific studies on herd numbers, movements (Dogrib Treaty 11 Council 2001) and body condition. A summary of research relating to the Bathurst herd was prepared by Gartner Lee Limited for the North Slave Métis Alliance (Gartner Lee Limited 2002), although the review is very selective in the references it includes. Many studies from the Government of the Northwest Territories, science journals and traditional knowledge studies were not included.

[1] http://www.rangifer.net/carma/about.html

A large step in the management of the Bathurst herd was taken when a management plan for the herd was finalized in November 2004 by the Bathurst Caribou Management Planning Committee[1]. The management committee is a partnership of 11 parties from the NWT and Nunavut, including DIAND, GNWT, Nunavut's Department of Sustainable Development, the Dogrib Treaty 11 Council, The Lutsel K'e First Nation, the Yellowknives Dene First Nation and the North Slave Métis Alliance from the NWT. The Department of Environment and Natural Resources is seeking comment on the Plan until April 15, 2005.

The management plan outlines a detailed strategy for monitoring and management of the herd, protection of the caribou habitat and the management of the harvest. Additional actions are recommended when the herd size is declining or lower than historic levels. Several objectives for maintaining herd size and condition are outlined, with specific monitoring actions. The actions include monitoring several indicators of the fitness of the herd, harvest rates and the influence of predators. Community input on the status of the herd and the harvest rate are a major portion of the plan. It is important that the commitments by all parties be followed in the level of priority listed in the Plan, given the reduction in the size of the herd during the 1990s.

Population estimates for the Bathurst herd extend back to the early 1950s (Banfield 1954), however estimates using standardized census methods began in the 1970's, when the herd was estimated at about 150,000 animals (Figure 5.3-2). The most recent survey of the Bathurst herd by the Department of Environment and Natural Resources shows that the number of pre- and post-parturient cows in the Bathurst herd declined significantly to approximately 80,756 from levels of about 150,000 in 1990 and 1996 and 204,000 in 1986 (Gunn *et al.* 2004). The survey was conducted in June 2003 using standard visual and photographic aerial survey methods and the error estimates around the population estimate are much smaller than both the 1990 and 1996 surveys and are close to those observed in 1986. The smaller error measurements provide more confidence in the population estimate and may provide a better indicator of long-term trend than by using the 1990 and 1996 data. Using male:female sex ratios and pregnancy rates from earlier studies, the total herd size was estimated to be 186,000 individuals in 2003, down substantially from 320,000 in 1996. Although the total population in 2003 is substantially lower than surveys in the 1980s and 1990s, current estimates place the size of the herd similar to those during the 1970s (Case *et al.* 1996). The study concludes that the herd has declined significantly since 1986 survey, at a rate of roughly 5% per year.

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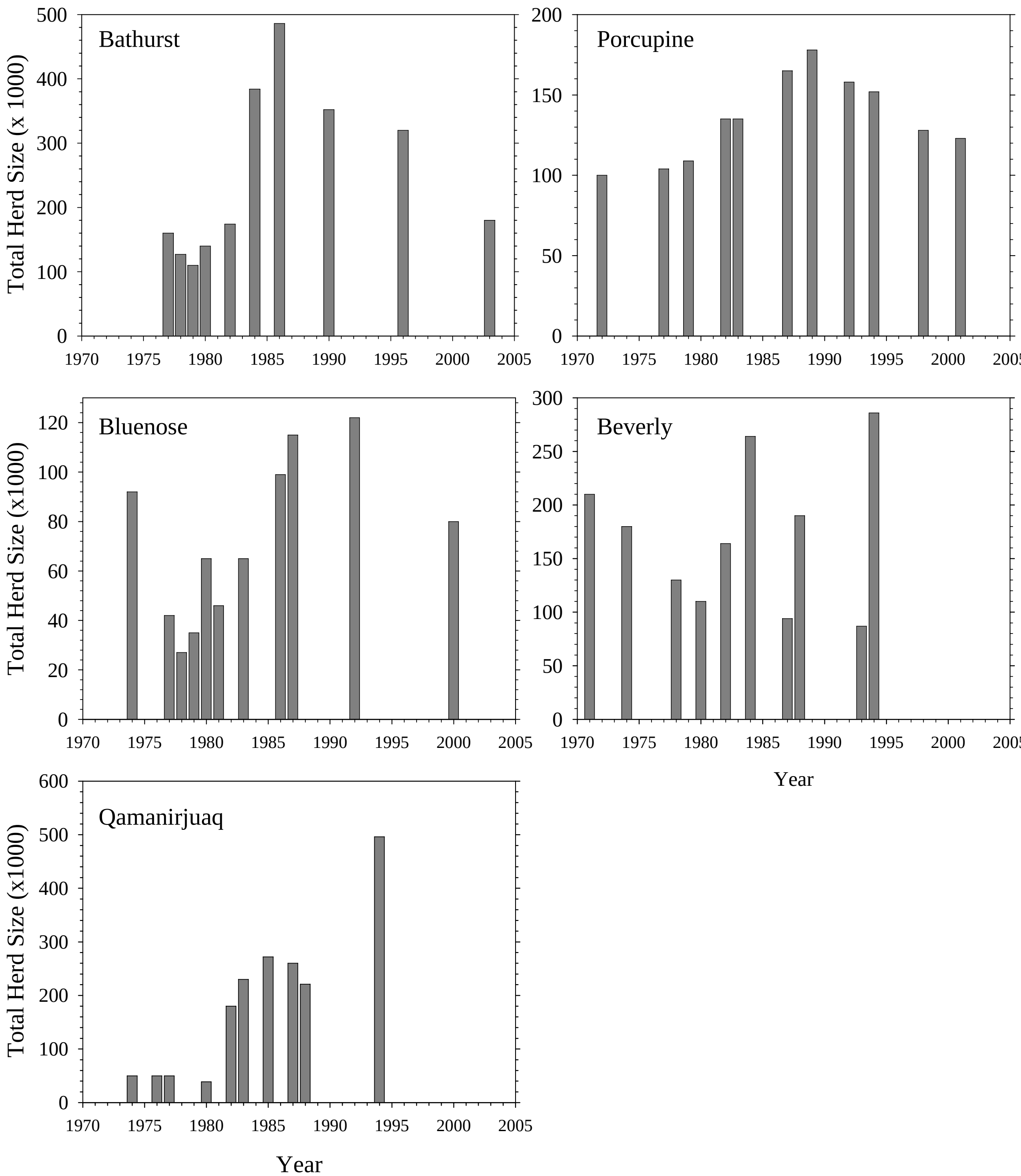
1 http://www.nwtwildlife.rwed.gov.nt.ca/NWTWildlife/caribou/Bathurst%20Caribou%20Management%20Plan%20Nov%2008%20RC.pdf

FIGURE 5.3-2
LONG-TERM TRENDS OF POPULATION ESTIMATES FOR THE MAJOR BARREN-GROUND CARIBOU HERDS IN THE NWT



Source: CARMA 2005[1]

[1] http://www.rangifer.net/carma/

The census of the number of females in the Bathurst herd was conducted using the most modern techniques and have been improved with discussions from other biologists (Gunn *et al.* 2004). It is not clear if more recent sex ratio and cow:calf ratios data are available for the Bathurst herd which makes it difficult to determine the reasons behind the observed decline. This leaves open the question of whether the decline is due to poor body condition of the females, losses of adults due to high harvesting rates, loss of calves due to high predation or weather during or post-calving or emigration from the herd to surrounding herds. If these data are not currently available, it is important that a program be conducted as indicated under the Bathurst Herd Management Plan to collect demographic data on the herd.

The Management Plan is a major step in collecting information on the herd in an organized and detailed fashion. It will formalize the collection of harvest rates, and place commitments on the territorial government to collect information relating to herd health. ENR has reported on its website[1] that the total number of Bathurst caribou hunted by resident and non-resident hunters was about 2000 to 2500 animals/year between 1996 and 2002. The total harvest, which includes the aboriginal and commercial harvest, was estimated to range from 14,500 to 18,500 in 1996, with a management objective at the time of 16,000 annually (Case *et al.* 1996). This was based on a total population estimate of about 350,000 for the herd, with a herd size of 300,000 to 600,000 needed to support the objective. These general objectives for the harvest rates are about 10 years old, and will need to be re-examined with the new census data, as it is unlikely that these rates could be maintained in the current declining population.

It is clear that there will be increasing pressure to increase development in the range of the Bathurst herd even though the effects of the development are largely unknown. Research in both Europe and Alaska has shown that roads, pipelines, airstrips, etc., can have a major impact on the movement and distribution of caribou and reindeer at some times during the annual cycles (Nellemann and Cameron 1996, 1998, Vistnes *et al.* 2001, Cameron *et al.* 2005). The most significant changes appear to occur in females during the calving period, who tend to avoid the infrastructure associated with development and may move to suboptimal habitat to calve if the level of development becomes too great. The clearest example of this may be occurring in Alaska with the Central Arctic herd (Cameron *et al.* 2005). Similar displacement could occur in the Bathurst herd, particularly if a permanent road is built to Bathurst Inlet and the number of mines continues to increase. Indicators should be developed and monitored in the herd to provide early warning signs of effects due to development.

[1] http://www.nwtwildlife.rwed.gov.nt.ca/NWTWildlife/caribou/bathurstharvest.htm

iii) Porcupine Herd

The Porcupine herd has been the subject of intensive study in the last 15 to 20 years because of its international distribution and the location of its calving ground in the Arctic National Wildlife Refuge (ANWR) on the Alaskan North Slope. The range of the herd covers about 250,000 km^2 in northeastern Alaska, and the Yukon and Northwest Territories. The herd calves on the Alaskan North Slope, but disperses to over winter in the northern NWT, Yukon and northeastern Alaska. Research on the herd has been conducted by both Canadian (Russell *et al.* 1993) and Alaskan (Griffith *et al.* 2002) research groups, often in collaboration with each other (Fancy *et al.* 1994). The herd has drawn considerable interest because the herd size has continued to decline since 1989, and is the only major herd on the North Slope to show a decline in numbers since oil and gas development in the 1970s began in earnest.

The Porcupine herd is managed by the Porcupine Caribou Management Board (PCMA) through the Porcupine Caribou Management Agreement. There is currently an International Conservation Agreement (1987) and an international plan with the United States for the conservation of the herd. The Plan outlines specific duties for the governments of the two countries in the interest of conserving the Porcupine herd, such as sharing harvest data and protecting the habitat. The Porcupine Caribou Management Agreement was signed in 1985 and is an agreement between the federal and territorial governments, the Council for Yukon Indians, the Inuvialuit Game Council, the Dene Nation and Métis Association of the Northwest Territories. The active role of the Arctic Borderlands Ecological Knowledge Society (ABEKS) is also important in sustaining the discussions between communities and First Nations about changes in the herd and the environment, and in helping to determine harvest rates.

The latest population census for the Porcupine herd was taken in 2001 and places the total herd at 123,000, or about the 8^{th} largest in North America (Porcupine Caribou Management Board 2004). This level has continued to decline since the herd reached a maximum of almost 180,000 individuals in 1989. Griffith *et al.* (2002) report that the herd size appears to go through 30-40 year cycles but, if the current decline continues, the herd will reach the lowest levels ever recorded in 2005-2010. The herd appears to have a slower inherent growth rate than other herds on the North Slope, possibly due to higher rates of mortality in adults. The decline in herd size has occurred despite high rates of calf survival and productivity (Russell and McNeil 2002). Two recent bad years where calves were born during the migration caused lower than average rates of survival during the first month of life (Russell and McNeil 2002). The PCM Board reports that the total harvest is about 2,000 to 3,000 animals annually, or about 2-3% of herd size, with wolves taking an additional 3-5%. Detailed current information on the calving rate, calf survival, parturition rate are available to help determine the reasons behind the observed decline (Griffith *et al.* 2002).

The major concern with the Porcupine herd has to be the effect of expanding development in and around the calving grounds in ANWR. Displacement of calving females from optimal habitat could result in lower growth rates and survival in calves, and an increase in predation from grizzly bears, wolves and golden eagles (Murphy and Lawhead 2000). The use of sub-optimal calving habitat may have serious implications for the long-term status of the herd. While studies have reported extensive use of oil field roads and gravel pads during summer to avoid harassment by insects (Noel *et al.* 1998), the benefits of these open areas probably don't balance the potential loss of large areas of the calving ground. Other developments (Table 5.2-2) in the area include mines and roads in the wintering grounds in the northern Yukon and NWT.

(iv) Cape Bathurst Herd

The barren-ground herd that was traditionally known as the Bluenose herd because of its calving ground near Bluenose Lake has been classified into three separate herds based on separate calving grounds and genetics (Nagy et al. in prep.). The three herds are now called the Cape Bathurst, Bluenose-West and Bluenose-East herds, based on the placements of the calving grounds (Figure 5.13). Total harvest from the original Bluenose herd exceeded 5,000, of which 90% is for subsistence use.

The Cape Bathurst herd covers the smallest range of the three herds, with calving grounds on the Cape Bathurst Peninsula and the summer and winter range extending to the west (Figure 5.12). The annual range extends through the Mackenzie Delta. Population estimates indicate the herd size at 14,500 in 1987 and about 10,000 in 2000 when the herd was surveyed as a separate entity. A 2005 survey shows the herd has declined significantly to 2400, a decline of about 80% since the last survey. Although the decrease is considered to be part of the natural fluctuation in herd size, there are few data on the demography of the herd available to support that conclusion.

(v) Bluenose-west

The calving grounds of the Bluenose-west herd are to the immediate east of the Cape Bathurst herd, with the summer and over-wintering ranges extending to the west and south. There is considerable overlap of this herd with the summering and over-wintering range of the Cape Bathurst herd. The Bluenose-west herd has varied from a low of 27,000 in 1978 to a maximum of 122,000 in 1992 (Figure 5.13) and 75,000 in 2000. The most recent population estimate of 20,800 in 2005 represents a significant decrease in herd size. The SRRB also reports a calf recruitment study of the herd to update data collected in 2000. At that time, calves comprised 19.3% of caribou, which indicates a healthy rate of recruitment and an expanding herd.

(vi) Bluenose-east

The calving grounds of the Bluenose-East herd are to the east of Bluenose Lake and range to the west of Kugluktuk in Nunavut (Figure 5.12). The herd range extends south to Great Bear Lake, where some members over winter to the south of the lake. The herd is the major source of caribou for the community of Déline during the winter.

The Bluenose-east herd was designated as a separate entity in 2000, when the herd was estimated to be 100,000 animals. A census of the herd during post-calving was conducted in 1999-2000 using radio-collaring and aerial photo-census (Patterson et al. 2004). Part of the justification for the census was the concern that 5,000 to 6,000 animals were being harvested from the population annually, a rate that was not sustainable if the herd was substantially smaller than expected. A total of 84,412 adult caribou were photographed during the census, and a total population of 104,000 was estimated using published models. A second model gave a much higher population estimate, however the 104,000 figure is more widely accepted as being the most accurate. The census was conducted during post-calving, which is considered by the authors to be superior to those taken during calving. The recent 2005 survey indicates a decline in the herd size to 66,000, which is less of a decline than in the Bluenose-west and Cape Bathurst herds. It is important that the demographics and body condition of these herds be monitored.

(vii) Beverly/Qamanirjuaq

The Beverly and Qamanirjuaq herds have been co-managed through the Beverly-Qamanirjuaq Caribou Management Board (BQCMB) [1] since 1982. The Board is made up of a diverse group of community members from Nunavut, Manitoba and Saskatchewan, and officials from ENR and Nunavut’s Department of Environment. One Dene and one Métis member from the South Slave are also on the Board. This representation reflects the roughly 20 communities on or near the range of the herds that harvest from it. The population in these communities is expected to grow from 10,000 in 1999 to 14,000 by 2020 (BQCMB 1999). The Board administers the Beverly and Qamanirjuaq Caribou Management Plan, which first came into effect in 1987 and was revised in 1996. A major project of the Board has been the mapping of the range of the Beverly-Qamanirjuaq herds, including the calving grounds, from historic records.

One objective of the Board is to maintain both the Qamanirjuaq and Beverly herds at an optimum size of 300,000 and a crisis level of 150,000. If either herd drops below the crisis level then recommendations will be provided to governments to protect the herd. The last census of the Qamanirjuaq herd was in 1994, when the when the herd size was estimated to equal 496,000.

[1] http://www.arctic-caribou.com/

At that time the Beverly herd stood at 286,000; however, a recently completed survey places the size at 89,800.
The total (subsistence and commercial) harvest in 2001 was estimated at 18,500 caribou, for an estimated 850,000 kg of meat. It is not clear if this harvest is from one or both of the herds but the harvest represents about 3% of the total of the two herds at the 1994 level or approximately 4 to using the updated herd size estimate for the Beverly herd.

Mineral exploration and mines are some of the major developments that could affect the herds, including uranium mines in northern Saskatchewan, where the herd over winters. The largest proposed development was the Kiggavik uranium mine about 75 km west of Baker Lake however the mine did not proceed. Roads, pipelines, and power lines are all potential stresses on the herd. The Board has developed a rating system, based on the biology of the herd to identify the most sensitive times during its life cycle (Table 5.3-6). The rating system is useful for defining the times that the herd could be susceptible to development pressures and can also apply to other herds in the NWT.

TABLE 5.3-6
SENSITIVITY OF CARIBOU AND RANGE OF THE BEVERLY AND QAMINIRJUAQ HERDS TO DEVELOPMENT

Caribou Life Cycle Period	Caribou Sensitivity Rating[1]	Range Sensitivity Rating[1]	Caribou-range Sensitivity Rating[2]
Spring migration	Moderate (3)	Moderate (3)	Moderate (6)
Calving	Very high (5)	Very high (5)	Very high (10)
Post-calving	High (4)	High (4)	High (8)
Late summer	Low (2)	Low (2)	Low (4)
Fall migration/rut	Low (2)	Low (2)	Low (4)
Early winter	Very low (1)	Low (2)	Low (3)
Late winter	Low (2)	Low (2)	Low (4)

Notes:
1 Ratings range from 1 (very low) to 5 (very high).
2 Caribou-range sensitivity rating = (caribou sensitivity rating) + (range sensitivity rating). Ratings range from 3 (low) to 10 (very high).
Source: [Calving remains the most sensitive time of the caribou life cycle. (BQCMB 1999)]

In summary, measuring the condition and health of a caribou herd is complex because several factors must be accounted for. The total size of the herd is the most common indicator of herd status but it may not reflect the true health of the herd. Other indicators such as the body condition of individual animals, the number of pregnant females or the rate of survival of newborn calves provide a better indicator of the ability of the herd to maintain the current rate of productivity. Traditional and local knowledge, which relies on ongoing assessments from hunters, is also a very important aspect of herd assessment. Disease rates (e.g., brucellosis) and parasite loads in major herds have also been tested by Environment and Natural Resources.

(viii) What is happening?

Currently in the NWT, three major herds (Bathurst, Beverly and Porcupine) are in a declining phase. The recently completed survey of the three herds that make up the Bluenose herd, indicates a significant decline in the size of all three herd compared to prior survey findings appear to be stable or increasing.

(ix) Why is it happening?

The reasons behind the declines in the Bathurst, Beverly and Porcupine herd are not clear. Several indicators of reproduction in the Porcupine herd suggest that calf production is the same as when the herd was expanding in the 1990s and that the condition of the females is good. This rules out calf mortality as the major cause of the decline; however other factors need to be tested.

(x) What does it mean?

It is difficult to interpret what the declines in the the major herds mean. As in all species of wildlife, caribou undergo cycles that are caused by natural factors. For example, a herd that is too large will overgraze its range and begin to decline as the herd birth rate and the condition of the individual animals declines. Climate, insect harassment and a large number of density-dependent and density-independent factors may come into play. Because of the possible effects of large-scale stresses like climate change, UV-B radiation and large-scale development, it is vital that research be continued into herd ecology and demography to aid in determining the reasons behind the decline.

(xi) What is being done about it?

There are major collaborative international research projects being conducted on the Porcupine herd and research is continuing into its status. A census was conducted on the Cape Bathurst, Bluenose-east and Bluenose-west herds in 2005. In addition, collaborative programs, such as the CircumArctic Rangifer Monitoring and Assessment Network, which was established under the Conservation of Flora and Fauna (CAFF) of the Arctic Council, are very important initiatives to exchange information between scientists and to help coordinate and standardize methods of herd assessment.

(xii) What are the information gaps?

Major information gaps include the need for census data for the Qamanirjuaq herd and current measurements of population demography of the Bathurst herd, if they are not currently available. A standardized approach to collecting information on herd condition, such as that discussed by CARMA, should be considered to ensure uniformity in monitoring methods between herds.

5.3.2 TEQ Indicator - Moose *(Alces alces)*

Moose are the largest in the deer family of mammals and are among the least social, which makes surveying populations difficult as individual animals must be counted separately. Moose are distributed throughout the NWT although very few are hunted above the treeline in the ISR where densities can be very low because it is at the northern edge of its range. There is some evidence that the range of the moose has recently extended further above the treeline and individual moose have been reported near Kugluktuk. Environment and Natural Resources reports a total population of about 20,000 moose in the NWT[1] however a population of >10,000 is suggested in the profile of the moose in the NWT Species Monitoring Infobase[2]. Fires in the Sahtu and Gwich'in areas were expected to decrease the populations in those areas, although the populations were expected to recover quickly.

(i) What is being measured?

Considering the importance of moose to traditional Dene diets (Morrison *et al*. 1995), there is very little published in the scientific literature on the status of the moose herd in the NWT. Most of the information is in small reports from co-management boards and usually covers moose populations in very small areas. Virtually all studies have been regional in nature and there does not seem to be an overall assessment of the species status available. A recent intensive survey[3] of moose in the North Slave region reported an average density of about 3/100 km^2. Of the two subregions surveyed, one region had a reasonable calf:cow ratio of 0.64, while the other region had a considerably lower ratio of 0.16. It was not reported if the different values indicate different conditions of the herd, problems with the survey or whether one population is declining.

The Gwich'in Renewable Resource Board has conducted several aerial surveys of moose populations in the GSA and report sex ratios and cow:calf ratios that indicate a healthy,

[1] http://www.nwtwildlife.rwed.gov.nt.ca/NWTwildlife/moose/populationstatus.htm.
[2] http://www.nwtwildlife.rwed.gov.nt.ca/rwed_infobase/asp/full.asp?SpecID=5.
[3] http://www.nwtwildlife.rwed.gov.nt.ca/pdf/NSRmoosesurveyposter.pdf.

sustainable population (Benn 1999, 2001). Similarly, the Wildlife Advisory Council (North Slope)[1], in conjunction with the Aklavik Hunters and Trappers, reported that the population on the North Slope between the Mackenzie Delta and the Blow River had increased substantially during the 1990s and the healthy male:female ratio and high calf recruitment indicate an expanding population.

The Gwich'in Moose Management Plan (GRRB 2000) reviewed the state of knowledge for the GSA and lists several concerns that are probably typical of each of the Settlement Areas and the Deh Cho. These concerns include the fact that population estimates are not available for the entire GSA, the status of the moose population is unknown and that the effects of the harvest on the population are unknown. This information is vital to understanding the state of the population and the effects of changing environmental conditions and development in the area. The effect of hunting on the population is also uncertain, as hunters may select for specific ages and sex that influence the rate of productivity. Approximately 40 moose were harvested annually in the GSA during the 1990s, although the total population in the GSA is not clearly defined. Environment and Natural Resources reports that resident and non-resident hunters hunt about 200 moose per year[1] over the entire NWT. The ISR harvest study reports about 28 moose are taken annually in the harvest, while about 200 are taken in the Sahtu (SRRB 2002, 2003)

The size of the moose population in the regions, and the NWT as a whole, gives a reasonable estimate of herd health, although species indicators such as sex ratios, calving rates and body condition estimates are important. There are also several research papers in the literature relating to the levels of disease in moose because of the influence of parasites and disease on local populations.

(ii) What is happening?

Moose are a large, nutritional part of the Dene/Métis traditional diet, but its overall status within the NWT is largely unknown. Because moose harvesting remains relatively successful, the population is assumed to be healthy and robust. Management of the species is through management plans in the individual Settlement regions, but because of its solitary nature and low density, collecting census data is difficult. The effect of disease (e.g., winter tick, *Parastrongylus* sp.) is also a major concern for the health of the moose but is probably only a significant problem on a local or regional level.

[1] http://taiga.net/wmac/consandmanagementplan_volume3/moose.html.

(iii) Why is it happening?

Fires in the Sahtu probably affected local moose populations; however, the population will probably recover with the habitat. Other populations of moose are probably affected by hunting, predators, particularly wolves, and disease.

(iv) What does it mean?

Overall, the NWT moose population is robust and the current rates of harvest can probably be maintained; however, the lack of NWT-wide data make this conclusion conjectural. Population surveys are probably not precise enough to determine desirable harvest rates accurately. For this reason, habitat condition, animal condition, calf productivity and population size should be monitored more closely.

(v) What is being done about it?

Management boards, in conjunction with Environment and Natural Resources, are conducting surveys on local moose populations in smaller areas of the NWT. In addition, harvest statistics are reporting the numbers of moose taken near communities and information on the age and sex of the harvested animal. This information is important for providing some data on the local population. The prevalence of disease in moose populations is being studied by research projects.

(vi) What are the information gaps?

Several gaps in information need to be addressed to assess the condition of moose in the NWT. Most of these gaps are summarized in the Gwich'in Moose Management Plan (GRRB 2000) but probably apply to other regions that are managing local moose populations, and to the whole of the NWT as well. Accurate population estimates are not available for the NWT or the regions, the health of the population in the regions is generally not known and the effects of the current rate of harvest are not known. Also, the condition of the habitat and the size of the home range, seasonal movements of moose and habitat selection are not well known in the NWT. In addition, the rates of predation are largely unknown. Although the moose is one species that may benefit from a warming climate, there is need to collect and analyze data from across the NWT for this species.

[1] http://www.nwtwildlife.rwed.gov.nt.ca/NWTwildlife/moose/harvestlevels.htm

5.3.3 TEQ Indicator - Landbirds (Grouse and Ptarmigan)

Landbirds make up a significant portion of traditional diets in the north (Morrison *et al.* 1995, Berti *et al.* 1998). The dominant species are sharp-tailed grouse (*Tympanuchus phasianelus*), spruce grouse (*Dendragapus canadensis*) and ruffed grouse (*Bonasa umbellus*) (commonly called "chickens") and willow (*Lagopus lagopus)* and rock ptarmigan (*Lagopus mutus*). These five species are members of the galliform order of birds and have several adaptations that allow them to survive in the north. Harvest survey data from the three Settlement Areas indicate that over a thousand of either grouse or ptarmigan are harvested annually (Figure 5.2-4). Grouse and ptarmigan do not migrate and hence are considered resident birds, which remain in a small range throughout the year.

(i) What is being measured?

Several national and international programs have been developed to monitor the status of landbirds in North America. The objective of most of these programs is to provide a consistent methodology to record the presence and numbers of birds at a given time and habitat every year in order to determine long-term trends. Many of these programs have been incorporated into the Canadian Landbird Monitoring Strategy[1] that is coordinated by the National Wildlife Research Center of the Canadian Wildlife Service, and run cooperatively with the US Geological Survey's Patuxent Wildlife Research Centre. These programs are very successful in the southern Canada and the U.S. where there is a high density of surveys for both summer breeding bird and Christmas bird counts. Surveys sites are widely scattered in the NWT (Normal Wells and Yellowknife provide the best data sets within the NWT) and only provide useful information for some species. For this reason, the current status of grouse and ptarmigan can best be determined by extrapolating trends from the boreal taiga that extends to the south and from harvest statistics.

Unlike waterfowl that are managed through international conventions and are monitored with extensive survey programs (see below), the status of landbirds is conducted through *ad hoc* programs using volunteers and professional biologists. One of the most important records of the status of birds is the North American Breeding Bird Survey (BBS) that has been conducted in Canada since 1967 but has only been active in the NWT for 10-15 years. The survey provides abundance, distribution and population trends for more than 400 bird species including many landbirds (Downes and Collins 2003). Volunteers and biologists conduct surveys of bird activity at approximately the same time every year. Several dozen routes are run in each province while very few are conducted in the NWT.

The survey is useful for determining the long-term abundance of many species. For example, some species of warblers and finch have declined steadily over the past few decades, while some

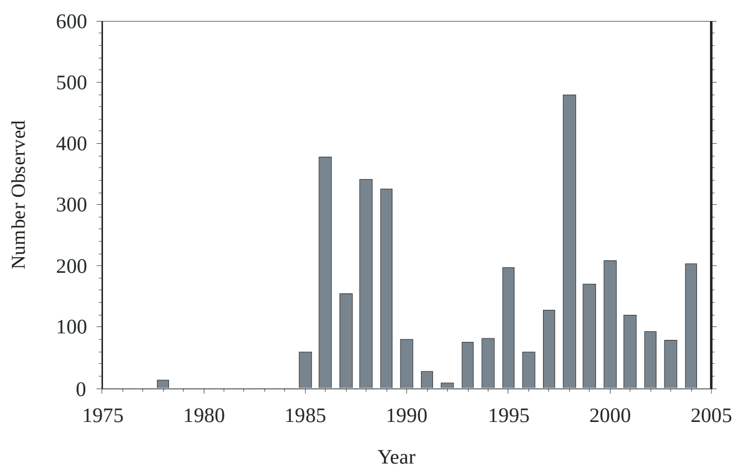
[1] http://www.cws-scf.ec.gc.ca/nwrc-cnrf/migb/01_1_3_e.cfm.

ducks, the crow and some warblers have been increasing in numbers at the same time. Within the ptarmigan and grouse species evaluated here, data are only available for the ruffed and sharp-tail grouse. Nationally, the ruffed grouse increased by 4.4% between 1991 and 2000, however in the boreal taiga plains[1], the species declined about 6% during the same time period. Nationally, the spruce grouse has declined marginally (5%) over the past ten years.

The Audubon Christmas Bird Count[2] (CBC) also provides some information on the abundance of species. The CBC takes places annually around Christmas and provides a yearly record of the birds present in a given area. Grouping together survey data within a region gives some indication of the long-term status of a species.

Although the Christmas Bird Count is very useful in determining long-term trends when several surveys are combined within small regions, very few data are available for grouse or ptarmigan species and no clear trends can be extracted from the information. There are approximately ten CBC sites designated within the NWT; however there are only about four sites for which long-term data are available. When all the data from 1970 to 2004 for the NWT are grouped, the number of ruffed grouse varied from zero to a maximum of five, with the latter value reported in 1994. Numbers of spruce grouse and sharp-tailed grouse were higher in some years than the ruffed grouse, reaching a maximum of 25 sharp-tailed grouse in one year, with the number of each species reported slightly higher in more recent years. Similarly, only eight rock ptarmigan have been reported between 1980 and 2004, all in 1994, for the entire NWT counts. The number of willow ptarmigan is extremely variable ranging from zero up to several hundred per year (Figure 5.3-3). These data do not provide suitable data to estimate population trends throughout the NWT.

FIGURE 5.3-3
NUMBER OF WILLOW PTARMIGAN OBSERVED IN ALL NWT CHRISTMAS BIRD COUNTS FROM 1978 TO 2004



1 http://www.cws-scf.ec.gc.ca/birds/Trends/species.cfm?lang=e&species_ID=3000.
2 http://www.audubon.org/bird/cbc/index.html.

Source: Audobon Christmas Bird Count

Hence, although the CBC has been widely accepted as an important survey tool for detecting long-term trend data of certain species, its usefulness is restricted in the NWT because of the few surveys conducted and the variability of the numbers reported. The numbers of observations are far too low to establish trends with any statistical confidence and the few surveys conducted over the NWT make this a poor method of detecting trends. It is more likely that harvest statistics within each community and region provide better indictors of population status and should be examined for evidence of long-term trends.

In summary, the populations of grouse and ptarmigan are being assessed by breeding Bird Counts, Christmas Bird Count and through harvest surveys. None of these methods provide enough comprehensive data to determine the status of these species across the NWT. There are no dedicated census programs for these species. The status of the species relies almost entirely on local knowledge and harvest data. Harvesters provide a record of local availability of these species but the information is restricted to local areas. It is important to note that there do not seem to be any landbird species that are being monitored with the precision and accuracy required to detect long-term trends.

(ii) What is happening?

It is difficult to assess the status of these species of landbirds and the variability of the long-term survey data is too inconsistent to speculate about trends in the population. It is assumed that the populations in the NWT are robust and can withstand the current harvest rates.

(iii) Why is it happening?

The poor base of data to evaluate population trends is a result of the biology and ecology of the landbirds and the difficulty in assessing the population density. The large land area of the NWT also makes it difficult to detect trends.

(iv) What does it mean?

It is not possible to conclude anything about population trends of these species because of the lack of data. Continuing harvest levels suggest a long-term stability of the populations but this could change with significant change in the climate.

(v) What is being done about it?

Harvest data are one of the better methods of tracking the presence of these birds near communities and should be continued. There is a good chance that these species benefit from warming climate if the plant species that provide their browse become more common.

(vi) What are the information gaps?

The information gaps have been discussed above. There are no dedicated censuses for these species so their general status is derived from the continuing harvest. There are also no surveys of their habitat. Both the Breeding Bird Survey and Christmas Bird Counts provide critical information on bird species and their presence should be expanded in the NWT.

5.3.4 TEQ Indicator - Waterfowl

Waterfowl are a major resource in the NWT and several waterfowl species are used in traditional diets in all regions of the territory (Figure 5.2-4). The term “waterfowl” refers collectively to species of ducks, geese and swans. Waterfowl are managed as an international resource more than any other group of wildlife considered here. Agencies in the U.S. and Canada, as well as in the NWT, are dedicated to understanding the status of waterfowl species. Hence, degradation of the over-wintering habitat in the south or high harvest rates during migration will directly influence the size and condition of the waterfowl populations in the NWT. Adaptive management strategies have also been implemented (Nichols *et al.* 1995, Johnson *et al.* 2002) to constantly assess the status of the populations, their habitats and the rate of harvest. Hence, although this report provides a single observation on the status of some waterfowl species, it is important that NWT continue to monitor the resource through these agencies. There are also several non-governmental organizations such as Ducks Unlimited, Bird Studies Canada, Bird Life International, the Nature Conservancy and the Canadian Nature federation that support research and initiatives such as the designations of Important Birding Areas (IBA)[1]. Currently there are 19 IBAs in the Northwest Territories.

(i) What is being measured?

In Canada, the Canadian Wildlife Service regulates the harvesting of waterfowl and produces three reports per year on the population status of migratory game birds (CWS 2004), proposals to amend the Canadian Migratory Bird Regulations for hunting regulations, and hunting regulations for the year. The major act of legislation in this area is the Migratory Birds Convention Act[2] (1994) which places responsibilities on the parties to monitor populations and establish harvest

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[1] http://www.ibacanada.com/.
[2] http://www.cws-scf.ec.gc.ca/legislations/laws1_e.cfm.

rates of the resource. Regulations in the Act designate the times of the year and areas in which hunting can take place, the species and number of migratory game birds that can be hunted, the manner and equipment that can be used and the periods of the year in which a person may have game birds in their possession. The current Regulations in the Act do not regulate subsistence harvests.

Annual monitoring of the status of waterfowl populations is necessary because of the influence of environmental factors, such as long-term drought and climate change on waterfowl habitat and the intensive harvesting of the population in the south. For example, large changes in duck populations in the 1990s were directly related to the drought on the prairies. Similarly, a very late spring in the NWT in 2004 resulted in very low productivity in many waterfowl species (see below) which resulted in a decrease in early nesting species like the mallard and northern pintail. For this reason, continuous monitoring of nesting habitat in the NWT and elsewhere, the size of the breeding population, and the sex and age characteristics of the harvested birds is vital to predicting the long-term status of the individual species.

The methods used to conduct the census of waterfowl breeding populations are described in U.S. Fish and Wildlife (USFWS 2004). The 2004 survey is typical of the surveys conducted for several decades, giving consistency to the quality of the data obtained. In total, the surveys cover over four million square kilometres in western and northern Canada and the U.S.A. and are conducted by territorial, federal or provincial teams. The 2004 survey of the NWT waterfowl populations was conducted between May 20 and June 8, 2004. The surveys in the NWT cover several large tracts of the NWT, termed strata. Data reported by the U.S. Fish and Wildlife and Canadian Wildlife Service include two areas in northern Alberta (e.g., the Peace-Athabaska Delta) that are also assessed with the NWT data. The flyovers assess the indicated number of breeding pairs. There is no detailed habitat assessment in the NWT. The US waterfowl surveys regularly assess ponds in the south but this is not done in the north. However, the waterfowl habitat in the NWT was described as good in 2004 but it was noted that it was the latest spring in recent record with little open water in many of the parts of the NWT during the survey in June (U.S. FWS 2004).

A wide range of waterfowl species is hunted by residents and non-residents in the NWT and are important components of traditional diets. This assessment evaluated the status and harvest levels of two major species, total ducks and geese, all of which are harvested. Monitoring total duck species allows an assessment of general habitat conditions (total habitat area). The summary of population indicators is listed in Table 5.3-7. The species used as indicators were:

- Mallard (*Anas platyrhynchos*)
- Northern pintail (*Anas acuta*)
- All duck species

- Canada goose (*Branta canadensis)*

TABLE 5.3-7
INDICATORS OF THE STATUS OF WATERFOWL POPULATIONS IN THE NWT

Indicator	Description
Population	Number of individuals in the population; usually assessed as the number of breeding individuals
Harvest rate	Number of birds harvested locally, nationally and internationally on the same population
Juvenile:adult ratio in harvest	Number of young-of-the-year harvested relative to the number of adults harvested
Sex ratio in harvest	Number of males harvested to number of females
Habitat quality and area	The area of nesting habitat and the quality/suitability for nesting waterfowl.

Mallard

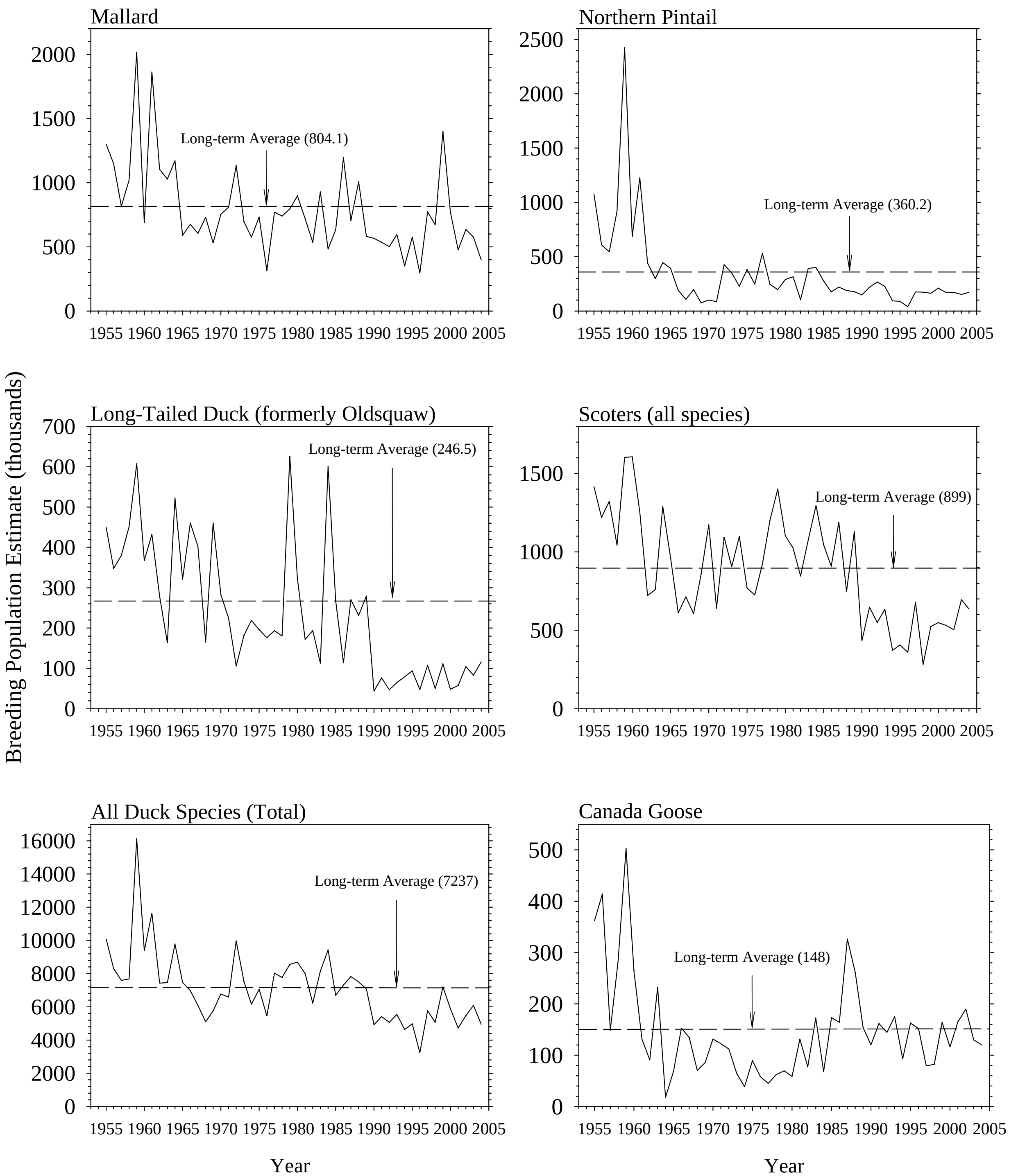
The mallard has been shown to undergo considerable changes in population size, largely because of the quality of nesting habitat and the weather during the nesting season. Nationally, the population of mallards dropped below the target level of 8 million birds designated by the North American Waterfowl Management Plan (NAWMP) in 2001 (CWS 2004). Much of this decline for the North American population is due to very low levels of production on the Canadian Prairies caused by drought conditions. There was a significant increase in the populations on the American prairies and in Alaska during the 1990s. It is expected that it may take several years of average rainfall in the prairies to recover many of the small lakes after several years of drought.

The NWT breeding population comprises about 10% of the mid-continent population of mallards in North America and follows the same general trends as the population on the Canadian Prairies. The breeding population has declined significantly since 2001, after reaching a major peak in 1999 (Figure 5.3-4). The 2004 population was estimated to be well below the 10-year and long-term mean (Table 5.3-8) although there appears to be no clear trend over the long-term from 1961 to 2004 (CWS 2004). Mallards are generally considered to be an early nesting species and hence may have been more affected by the exceptionally late spring in NWT in 2004 than other duck species. The high populations of mallards in both Alaska and the American prairies suggest that the NWT population will recover when the habitat and spring weather conditions are more favourable.

The NWT harvest surveys indicate that over 200 mallards are harvested annually in the ISR (Joint Secretariat 2003), about 700 annually in the Sahtu (primarily in the spring) (SRRB 2002), and about 150 in the Gwich'in Settlement Area (GRRB, pers comm.). Similar harvest rates in the

Deh Cho, Tli Cho and Akaitcho areas would put the total harvest level at about 2000 birds annually. Kruse (2004) reports total mallard harvests in the NWT between 1972 and 2003 at

FIGURE 5.3-4
LONG-TERM TRENDS IN BREEDING POPULATIONS OF MAJOR WATERFOWL SPECIES IN THE NWT AND NORTHERN ALBERTA



Source: (USFWS 2004)

TABLE 5.3-8
WATERFOWL POPULATION ESTIMATES FOR NORTHERN ALBERTA AND NORTHWEST TERRITORIES FOR 2002, 2003, 2004 AND THE 10-YEAR AND LONG-TERM AVERAGE POPULATION ESTIMATES

Species	Estimated Population (x 1000)					2004 Population Estimate as % Change From	
	2002	2003	2004	10-year mean	Long-term mean (1955-2004)	10-year mean	Long-term Mean (1955-2004)
Mallard	635.6	576.8	398.4	652.8	796.0	-39%	-50%
Northern Pintail	171.7	151.5	171.4	143.2	352.1	19.7%	-51.3%
Long-tailed duck	104.3	83.2	116.3	78.3	240.3	48.6%	-51.6%
Scoter (all species)	503.6	695.2	635.3	490.6	886.8	29.5%	-28.4%
Merganser	74.5	114.3	41.3	83.2	74.9	-50.3%	-44.8%
All dabbling ducks	2522.4	2770.7	2094.4	2398.8	2937.5	-12.7%	-28.7%
All diving ducks	2270.5	2432.6	2061.0	2257.1	3037.1	-8.7%	-32.1
All duck species	5475.3	6087.1	4948.3	5307.8	7177.2	-6.8%	-31.1%
Canada Goose	189.9	129.8	120.2	133.3	148.4	-9.8%	-19.0%

Notes:
Dabbling duck species included: mallard, American black duck, gadwall, American wigeon, American green-winged teal, blue-winged teal, northern shoveler, northern pintail.

Diving duck species included: redhead, canvasback, scaups, ring-necked duck, goldeneyes, bufflehead, ruddy duck.
Source: U.S. Fish and Wildlife Service (2003, 2004)

about 3,000 annually, although the numbers in later years are considerably lower than those in the 1970s when over 10,000 birds were harvested. In contrast, the total harvest of mallards across the continent is about 5 million birds in the U.S. and 500,000 in Canada. The total North American harvest in 2003 (5.53 million birds) was slightly higher than the 2002 level. The harvest levels in the NWT are clearly a very small fraction of the total number taken. U.S. FWS records report that the ratio of immature/adult mallards taken in the southern hunt is about 0.70, indicating that more adults than juveniles are taken. Most of this is due to the higher harvest rate of male adults (about four times higher than females), as an equal number of immature and adult female mallards are taken (Kruse 2004).

Northern Pintail

The Northern American northern pintail population underwent a significant decline during the 1980s, recovered during the 1990's and has begun to decline again since the 1990s (Figure 5.3-4) (CWS 2004). In 2004, the total population in North America fell to 2.18 million birds, far below the North American Waterfowl Management Plan 1998 target value of 5.6 million birds (NAWMP 1998). Much of this decline could be related to the fact that over 60% of the North American population of pintails is on the Canadian Prairies and drought and habitat loss affect the entire population. Unlike the mallard, which has shown declines in some populations and increases in others, the decline in the pintail appears to be occurring in all areas of North America. The harvest of the pintail has also followed the population trend, declining in the 1980s and increasing in the 1990s.

In the NWT, the northern pintail population has remained relatively stable over the last 30 years (Figure 5.3-4), however the numbers are much lower than the peak in the early 1960s. The breeding population estimate in 2004 was 171,400, about 50% lower than the long-term average, which includes the high levels in the 1960s (Table 5.3-7). The 2004 level was about 20% higher than that in 2003. In general, the number of pintails in the NWT reflects the same lower levels that are found throughout North America. The continental harvest of the pintail remains at about 389,000 birds, with about 48,000 of those in Canada. In contrast, about 60 birds (range of 10 to 268) are harvested annually in the ISR, 20-30 in the Gwich'in SA and 100 to 500 in the Sahtu (SRRB 2003).

Geese

Goose species are among the most heavily hunted waterfowl species in the NWT, numbering thousands of birds per year. Of these, the Canada and snow geese are hunted most heavily however other species, such as the greater white-fronted goose (*Anser albifrons*) or "yellowlegs", are also hunted in the ISR. Harvest surveys show that several thousand snow and greater white-fronted geese are hunted annually in the ISR, along with several hundred Canada geese (Figure 5.2-4). The same three species are harvested in the Gwich'in, although the numbers of each species harvested are considerably lower. With the several thousand geese harvested in the Sahtu (SRRB 2003), the total numbers of geese harvested in the NWT may approach 20,000, clearly a major source of nutrition and a major staple in the traditional diet.

Based on the various sizes, colouration and breeding habitats, the goose species known as the Canada goose has been divided into several subspecies of Canada goose (*Branta canadensis*) and cackling goose (*Branta hutchinsii*). The major species nesting in the NWT are the lesser Canada goose subspecies termed the short grass prairie Canada goose (*Branta canadensis parvipes*) and one form of cackling goose (*Branta hutchinsii hutchinsii*). The two species nest primarily in the ISR, on the mainland, Banks Island and Victoria Island. Surveys in the 1990s placed the number of geese at about 80,000 birds, however the 2004 spring waterfowl survey estimated 97,000 geese which was about 14% greater than in 2003 (U.S. FWS 2004). The estimates of this population have remained relatively stable over the last twenty years (Figure 5.3-4), although the 2004 estimate was about 20% below the long-term average (Table 5.3-7). The total level of harvest in the Central Flyway, which includes the NWT goose populations, remains at about 550,000 geese annually, with about four times more adults than immatures harvested (Kruse 2004).

The most commonly hunted goose species in the ISR is the lesser snow goose (*Chen caerulescens caerulescens*), which nests primarily on Banks Island. CWS (CWS 2004) estimates that more than 95% of the western Arctic population of lesser snow goose nest on Banks Island, with smaller breeding populations at the Anderson River and Kendall Island. The total population has increased from about 105,000 birds in 1960 to 165,000 in 1976 to over 479,000 in 1995 and well over 500,000 birds in 2002 (CWS 2004). Both the Anderson River population and another population on Wrangel Island, which migrates through western Canada, appear to be declining. The habitat on Banks Island may have reached the point where it cannot support the number of geese and the population may have to be stabilized. This overabundance of breeding birds in the nesting habitat is also seen in the greater snow goose nesting areas in the eastern Canadian Arctic, where the expanding population is destroying large areas of wetland. Several special measures are being undertaken in the provinces to increase the success rate of hunters and increasing the limits allowed per hunter. About 250,000 snow geese are harvested in the Central Flyway of the U.S. annually (Kruse 2004).

In summary, several indices are measured to determine the status of waterfowl populations. Surveys of breeding birds are conducted by federal, provincial and territorial agencies annually to determine the suitability of nesting habitat and the number of breeding birds. These methods have been used consistently for over forty years and provide a good long-term record for each species. Harvest records are also collected in some settlement areas in the NWT, nationally and in the U.S. Harvest records in the U.S. and Canada report the male:female and immature:mature ratios which are important for evaluating the effect of the harvest on breeding birds in the NWT.

(ii) What is happening?

Goose species are stable or are increasing significantly over historic levels. Several other waterfowl species are below their long-term averages; however this only seems to be a major factor for species such as the northern pintail and the scoters that are significantly below the long-term average for a long time.

(iii) Why is it happening?

The reason for the decline in some waterfowl species is unclear. Populations of some species that nest on the prairies declined with the onset of the drought; however, populations of the same species in other areas improved due to favourable local conditions. The northern pintail has declined significantly from its long-term trends. Other species are also below long-term trends and it is not clear whether the numbers will increase again in the future if current harvest rates continue

(iv) What does it mean?

The major impact of declining waterfowl populations is that some species would not be available for spring or fall harvest. However, because of the number of species present on lakes and in wetland areas, hunters can probably hunt other species opportunistically. Goose species are currently plentiful and are increasing.

(v) What is being done about it?

Several parties are acting together and independently to study the ongoing status of waterfowl species in the NWT. The Canadian Wildlife Service and the U.S. Fish and Wildlife Service maintain surveys of northern breeding areas and harvest levels in the south. There is a large amount of cooperation between the Canadian Wildlife Service and the U.S. Fish and Wildlife Service in collecting data, setting hunting limits and assessing the condition of individual species. Ducks Unlimited provides significant support for the program and some research projects.

(vi) What are the Information Gaps?

There are currently a large number of programs and resources dedicated to monitoring the status of the populations and habitats of these species. Information gaps include more research programs on the reasons for the declines in some species of waterfowl.

5.4 CONCLUSIONS AND RECOMMENDATIONS

The objective of this review was to evaluate the status of several terrestrial species in order to assess the general condition the NWT terrestrial environment. Indicators for the key species included measurements of the size, abundance and demography of the population; however the effort and resources used to monitor and conduct research on the species were also assessed. These are important considerations for determining whether it is possible to detect significant changes in a species in an environment undergoing stresses such as climate change and increasing development. Vegetation monitoring was not included in this assessment but should be an integral part of cumulative effects assessment because of the extensive changes to the arctic landscape expected with climate change.

This assessment concludes that the status of barren-ground caribou herds is mixed, with two of the major herds (Porcupine, Bathurst) declining significantly over the last decade for largely unknown reasons. Natural climatic, ecological and environmental factors probably contribute to the decline; however potential development in the calving grounds of the Porcupine herd may significantly alter the fundamental ecology of the herd. Increasing development in the form of mines, power lines and potential permanent roads in the range of the Bathurst herd may have similar effects. The three herds comprising the former Bluenose herd are stable at relatively large herd sizes and a census in 2005 will update the data available for the herds. The potential for oil and gas development near the Cape Bathurst and Bluenose West herds may place significant stress on the herds in the future. The status of the Beverly and Qamanirjuaq herds is difficult to assess because of the lack of recent census data although harvest rates continue at historic levels. Given the evidence of changing climate, it is recommended that a census be conducted on the major herds every five years and that research and monitoring programs on the stresses on the herds and their habitat be continued.

The status of waterfowl species is assessed annually by a team of Canadian and U.S. researchers, and the hunting levels set accordingly. Major duck species are lower than historic levels but the populations are abundant enough to support harvest rates in the NWT. Major goose species are continuing to expand and may have to be controlled to avoid the destruction of nesting habitat in the NWT and Nunavut. Landbird (grouse, ptarmigan) numbers are difficult to assess because of the small number of surveys in the Breeding Bird Survey and long-term data on the populations are not available. The best indicator of landbird species abundance is the harvest survey data which may provide some long-term record of species availability. However, changes in traditional lifestyle and variability in annual harvest rates make any population assessment difficult.

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ATTACHMENT 5A

NWT BIODIVERSITY ACTION PLAN

WILDLIFE-RELATED MONITORING PROGRAMS IN THE NORTHWEST TERRITORIES

APPENDIX 5A

NWT Biodiversity Action Plan

Wildlife-related Monitoring Programs in the Northwest Territories[1].

The NWT conducts a host of wildlife-related monitoring programs that help in determining changes in biodiversity and better understanding functional linkages in ecosystems.

A list of many of these monitoring programs can be found below.

The list includes monitoring conducted by federal and territorial governments, as well as non-governmental organizations and Aboriginal groups. This list does not include monitoring conducted by private industry.

In these programs, **Wildlife** includes any animal or plants.

Monitoring is defined as an activity undertaken at regular intervals and expected to continue on a long-term (e.g., 10+ years) or undetermined basis. The objective of monitoring is to detect changes -- sometimes still of an unknown nature, whereas the objective of research is to test hypotheses.

Research was defined as project that is expected to end when hypotheses were tested or when the objectives were completed. Research projects were not included in the monitoring list.

If tracking is done to investigate specific questions on, for example, movement or habitat use, then tracking is research. If tracking is expected to continue indefinitely so that it can be used as a tool to monitor movement, use, dispersion, population parameters etc. in a changing environmental context, then tracking may be considered Monitoring.

[1] http://www.nwtwildlife.rwed.gov.nt.ca/Biodiversity/news.htm

Detail list - Wildlife-related Monitoring Programs in the Northwest Territories.

Title	Schedule	Collaborators[1]
Ungulates and associated predators		
Moose Population Estimates and Population Composition (Fort Good Hope, Tulita, Norman Wells)	Every 5 years	RWED Sahtu Region
Census and Composition - **Dall's Sheep** (Katherine Creek and Palmer Lake study areas)	Annually	RWED Sahtu Region
Cumulative effects - **Northern Mountain Caribou** – (South Nahanni herd)	Annually	RWED Wildlife and Fisheries Parks Canada Yukon Renewable Resources
Population Trend – **Northern Mountain Caribou** (South Nahanni herd)	Every 5-6 years	RWED Deh Cho RWED Wildlife and Fisheries Parks Canada Yukon Renewable Resources
Population Survey - **Dall's Sheep** (Richardson Mountains NWT and Yukon)	Every 5-6 years	RWED, Inuvik Region DRR, Dawson GRRB VGFN
Calving Ground survey - **BG Caribou** (Beverly)	Every 5-6 years	Gov. of Nunavut RWED Wildlife and Fisheries
Calving Ground survey - **BG Caribou** (Bathurst)	Every 5-6 years	Gov. of Nunavut RWED Wildlife and Fisheries
Calving Ground survey - **BG Caribou** (B-Q)	Every 5-6 years	RWED Wildlife and Fisheries Gov. of Saskatchewan Gov. of Manitoba Gov. of Nunavut BQ Board
Photocensus - **BG Caribou** (Cape Bathurst and Bluenose-West)	Every 5-6 years	RWED, Inuvik Region RWED, Sahtu Region GRRB SRRB
Productivity - **BG Caribou** (Cape Bathurst and Bluenose-West)	Annually	RWED, Inuvik Region Parks Canada, Western Arctic Field Unit
Recruitment - **BG Caribou** (Cape Bathurst and Bluenose-West, Bathurst herd)	Annually	RWED, Inuvik Region Parks Canada, Western Arctic Field Unit GRRB SRRB

Title	Schedule	Collaborators[1]
		Department of Resources, Wildlife and Economic Development HQ
Cumulative effects – **BG Caribou** - (Bathurst herd)	Annually	RWED Wildlife and Fisheries WKSS
Site Use and Behaviour - **BG Caribou** surveys (Bathurst herd near Ekati)	Annually	BHP Billiton
Fall Composition - **BG Caribou** (Cape Bathurst and Bluenose-West) Bathurst herd	Every 5-6 years	RWED, Inuvik Region Parks Canada, Western Arctic Field Unit Department of Resources, Wildlife and Economic Development HQ
Commercial Harvest Survey - **BG Caribou** (Inuvialuit Settlement Region and Gwich'in Settlement Area)	Annually	RWED, Inuvik Region
Contaminants - **BG Caribou** (Cape Bathurst and Bluenose-West)	Every 5 years	RWED, Inuvik Region RWED, Yellowknife
Outfitter Questionnaire - **Caribou** Health	Annually	RWED Wildlife and Fisheries
Environmental Contaminants in Caribou (Bathurst, Beverly & Cape Bathurst herds)	Every 5 years	RWED Wildlife & Fisheries RWED Inuvik Region RWED North Slave Region RWED South Slave Region
Population surveys **- Bison** (Mackenzie herd)	Every 2 years	RWED South Slave Region
Population surveys - **Bison** (Slave River Lowlands herds)	Every 2 years	RWED South Slave Region Parks Canada – Wood Buffalo National Park
Population surveys - **Bison** (Nahanni herd)	Every 5 years	RWED South Slave Region RWED Deh Cho Region
Composition (calf productivity & yearling recruitment) - **Bison** (Mackenzie, Slave River Lowlands, Hook Lake herds & Nahanni)	Annually	RWED South Slave Region RWED Deh Cho Region RWED Wildlife and Fisheries
Hunt monitoring **- Bison** (Mackenzie)	Annually	RWED South Slave Region Fort Providence Resource Management Board
Summer anthrax surveillance flights and monitoring of Brucellosis & Tuberculosis **-Bison** (Mackenzie bison)	Annually	RWED South Slave Region RWED Wildlife and Fisheries
Control Area surveys - **Bison**- - associated **Woodland Caribou, Moose & Wolf** (South Slave Control Area)	Annually	RWED South Slave Region Parks Canada – Wood Buffalo National Park
Population survey - **Peary Caribou, Muskoxen, and Arctic Wolves** (Banks Island)	Every 4-5 years	RWED, Inuvik Region Parks Canada, Western Arctic Field Unit
Population survey - **Peary Caribou, Muskoxen, and Arctic Wolves** (NW Victoria Island)	Every 4-5 years	RWED, Inuvik Region

Title	Schedule	Collaborators[1]
Productivity and Recruitment - **Peary Caribou** and **Muskoxen** (Banks Island)	Annually	RWED, Inuvik Region Parks Canada, Western Arctic Field Unit
Productivity and Recruitment - **Peary Caribou** (Melville Island)	Annually	RWED, Inuvik Region Parks Canada, Western Arctic Field Unit
Late winter body condition and diet - snow urine study - **Peary Caribou and Muskoxen** (Banks Island)	Annually	RWED, Inuvik Region
Prevalence and Intensity of Infection of gastrointestinal parasites - **Peary Caribou and Muskoxen** (Banks Island)	Annually	RWED, Inuvik Region RWED, Wildlife & Fisheries, Yellowknife Western College of Veterinary Medicine
Harvest Survey - **Peary Caribou** (Banks Island)	Annually	RWED, Inuvik Region
Population Survey - **Muskoxen** (Mainland in Inuvialuit Settlement Region)	Every 5 years	RWED, Inuvik Region Parks Canada, Western Arctic Field Unit RWED Sahtu Region (usually)
Harvest Survey - **Muskoxen** (Inuvialuit Settlement Region -including commercial tags, subsistence harvest and sport hunts)	Annually	RWED, Inuvik Region
Fur-bearers, Carnivores and Small Mammals		
NWT **Small Mammal** Survey (across NWT)	Annually	RWED Wildlife and Fisheries Gov. of Nunavut, RWED Regions, RWED Forest Management University of Alberta, University Laval, University of British Columbia, Gwich'in Renewable Resource Board University of Alaska Museum
Lemming monitoring-**Collared and Brown Lemmings** (Aulavik National Park)	Annually	Parks Canada, Western Arctic Field Unit
Hare Survey (Forested NWT)	Annually	RWED Wildlife and Fisheries RWED Regions RWED Forest Management Gwich’in Renewable Resource Board
Beaver Lodge Densities (Willow Lake, Oscar Lake, Ramparts River)	Every 4 years	RWED Sahtu Region
Harvest/Hunting effort Questionnaire - Mountain **Grizzly Bears** (Mackenzie Mountains)	Annually	RWED (all regions) RWED Enforcement & Legislative services

Title	Schedule	Collaborators[1]
		RWED Wildlife and Fisheries
Harvest monitoring (problem bears killed, subsistence harvest, and sport hunts) - **Grizzly Bears** (Inuvialuit Settlement Region and Gwich'in Settlement Area)	Annually	RWED, Inuvik Region DRR, Dawson Gwich'in Renewable Resource Board
Problem bear monitoring - **Grizzly Bear, Polar Bear, and Black Bear**	Annually	RWED, Inuvik Region RWED, North Slave Region RWED, Deh Cho Region RWED, South Slave Region
Population surveys **- Grizzly Bear** (Inuvialuit Settlement Region and northern Gwich'in Settlement Areas)	Every 20-25 years	RWED, Inuvik Region GRRB DRR, Dawson
Site use and behaviour – **Grizzly, Wolf, Wolverine** surveys (near Ekati)	Annually	BHP Billiton
Population surveys - **Polar Bear** (South Beaufort, North Beaufort, and Viscount-Melville Sound)	Every 20-25 years	RWED, Inuvik Region DSD, Nunavut US Fish &Wildlife CWS
Harvest Monitoring **- Polar Bears** (Inuvialuit Settlement Region) problem bears killed, subsistence harvest, and sport hunts	Annually	RWED, Inuvik Region Wildlife Management Advisory Council (NWT)
Carcass Collection - **Marten** (Fort Good Hope area)	Annually	RWED Sahtu Region
Harvest Survey- **Arctic Wolves** (Banks Island and NW Victoria Island) (number, age, sex, and diet of wolves harvested)	Annually	RWED, Inuvik Region
Carcass Collection - **Lynx** (all regions)	Annually	RWED Wildlife and Fisheries RWED Sahtu Region RWED South Slave Region RWED North Slave Region RWED Inuvik Region
NWT-wide **Rabies** Monitoring	Annually	RWED Wildlife & Fisheries RWED Regions including RRO's GNWT Health & Social Services
Monitoring of **Cougar** sightings	Annually	RWED Wildlife and Fisheries RWED Sahtu Region RWED South Slave Region RWED North Slave Region RWED Inuvik Region

Title	Schedule	Collaborators[1]
Marine fishes, mammals and other species		
Beluga Harvest monitoring program	Annually	DFO Fisheries Joint Management Committee
Marine Mammal Stock assessments	Annually	DFO
Marine Fish harvest rates, abundance and health part of Tariuq (Ocean) Monitoring Program – sites including near Aklavik, Shingle Point, Tuktuyaktuk harbour, and Hendrickson Island.	Annually	Inuvialuit and Gwich'in communities and organizations DFO
Fish, Amphibians and Aquatic invertebrates		
Frog Watch NWT	Annually	Ecology North EMAN-North EMAN GNWT Private volunteers (Lead: Mike Fournier)
Contaminant monitoring in fish populations	Annually in different pops.	DFO
Rat River Char Monitoring – **Dolly Varden** stock (Rat River watershed)	Annually	Gwich'in Renewable Resource Board DFO
Birds		
Duck banding project (Willow Lake)	Annually	US Fish and Wildlife RWED Sahtu Region
Duck banding project (Mills Lake)	Annually	US Fish and Wildlife
Inventory of **Snow and Ross' Geese** - Vertical Aerial Photography	Every 5 years	CWS, Yellowknife
Snow Goose banding at Banks Island, Kendall Island and Anderson River colonies	Annually	CWS, Yellowknife
White-fronted Goose breeding surveys in the Mackenzie Delta/Tuktoyaktuk Peninsula areas	Every 3-5 years	CWS, Yellowknife
Thick-billed Murre Survey – part of Seabird monitoring strategy of the Canadian Arctic (Cape Parry) part of Canada's Conservation Plan for Seabirds and Colonial Waterbirds.	Every 5-10 years	CWS, Yellowknife
Trumpeter Swan Survey	Every 5 years	CWS, Yellowknife
Boreal **Ducks and Grebes** monitoring – productivity and habitat use (east of Yellowknife, North Arm of Great Slave Lake)	Annually	CWS, Yellowknife DU INAC Arctic Hydrometric Surveys Division, EC

Title	Schedule	Collaborators[1]
Boreal **Lesser Scaup** monitoring - Population Ecology (east of Yellowknife, North Arm of Great Slave Lake)	Annually	CWS, Yellowknife University of Saskatchewan Delta Waterfowl Foundation GNWT, DOT DU
Boreal **Songbird** monitoring – population and habitat use (Liard Valley)	Annually	CWS, Yellowknife GNWT INAC Acho Dene Koe First Nation Industry
Christmas **Bird** Count [3] (Norman Wells) part of North American Christmas Bird Count program.	Annually	RWED Sahtu Region Private volunteers
Christmas **Bird** Count [3] (Yellowknife) part of North American Christmas Bird Count program.	Annually	Ecology North Private volunteers
Christmas **Bird** Count [3] (Fort Smith) part of North American Christmas Bird Count program.	Annually	Private volunteers
Christmas **Bird** Count [3] (Fort Simpson) part of North American Christmas Bird Count program.	Annually	Parks Canada, Nahanni National Park Private volunteers
Peregrine Falcon Survey (Mackenzie River) part of 5-year North American Peregrine Falcon survey, and of Recovery Strategy.	Every 5 years	RWED Wildlife and Fisheries RWED Regions (Sahtu and Inuvik) RWED Forest Management Canadian Wildlife Service (part of North American-wide surveys)
Peregrine Falcon Survey (Aulavik and Tuktut Nogait National Parks) part of 5-year North American Peregrine Falcon survey.	Every 5 years	Parks Canada, Western Arctic Field Unit Canadian Wildlife Service RWED Inuvik Region (part of North American-wide surveys)
Raptor and breeding bird surveys (southern arctic near diamond mine sites)	Annually	BHP Billiton Diavik Diamond Mines RWED, Wildlife and Fisheries
White Pelican **Monitoring (Fort Smith and northern Alberta)**	Annually	Private volunteers (coordinator J. Van Pelt) Alberta Sustainable Resource Development – NE Region RWED, South Slave Region Wood Buffalo National Park
Breeding **Bird** Survey (Daring Lake)	Annually	RWED Wildlife and Fisheries Private volunteers (coordinator S Matthews)

Title	Schedule	Collaborators[1]
Whooping Crane Monitoring (in Wood Buffalo National Park and surroundings) part of Whooping Crane Recovery Strategy.	Annually	Wood Buffalo National Park CWS, Edmonton Whooping Crane Recovery Team USFWS University of Alberta
Bird monitoring - Spring Arrival Dates (Yellowknife)	Annually	RWED Wildlife and Fisheries Canadian Wildlife Service Private volunteers (coordinator R. Bromley)
Raptor Survey - Daring Lake	Annually	RWED Wildlife and Fisheries
Breeding **Bird** Survey (Norman Wells) part of North American Breeding Bird Survey	Annually	RWED Regions (Sahtu) Canadian Wildlife Service Private volunteers (coordinator A. Veitch)
Breeding **Bird** Survey (Yellowknife) part of North American Breeding Bird Survey	Annually	Cygnus Consulting Private volunteers (coordinator J Bastedo)
NWT-Nunavut **Bird** Checklist Survey-Incidental observations of birds are recorded for the NWT-Nunavut Bird Checklist Survey (NWT-wide)	Annually	Canadian Wildlife Service Parks Canada Private volunteers
Arctic **Shorebird** Monitoring Program (currently in test phase- anticipated start in next 2-3 years) part of Program for Regional and International Shorebird Monitoring (PRISM)	Annually, rotating among zones of BCR 3	Canadian Wildlife Service
Boreal and Taiga **Shorebird** Monitoring Program (currently in development phase- anticipated start of test phase in 1 year) part of Program for Regional and International Shorebird Monitoring (PRISM)	Annually, rotating among zones of BCRs 6 and 7	Canadian Wildlife Service
Terrestrial ecosystems – Forest and Tundra		
International Tundra Experiment - Canadian **Tundra and Taiga** Experiment on Phenology (Daring Lake)	Annually	RWED Wildlife and Fisheries EMAN-North Northern Ecosystem Initiative (Environment Canada) Gov. of Yukon
Tree **Phenology** study (Inuvik Region)	Annually	RWED Forest Management - Inuvik Region
Satellite monitoring of **plant productivity**	Annually	Parks Canada, Western Arctic Field Unit
Acid Rain National Early Warning System (ARNEWS), **Forest Health** Plot (4 plots in the NWT)	Annually first 5 years, every 5 years following	RWED Forest Management - Inuvik Region Gwich'in Renewable Resource Board Canadian Forest Service
Smithsonian Institute /Man and the Biosphere - **Forest**	Every 5 years	RWED Forest Management - Inuvik Region

Title	Schedule	Collaborators[1]
Plots (Inuvik Region)		Gwich'in Renewable Resource Board Aurora College Inuvik Campus
Forest - Permanent Sample Plots (Inuvik Region)	Every 10-15 years	RWED Forest Management - Inuvik Region
Forest - Regeneration plots (Inuvik Region)	Annually first 5 years, every 5 years following	RWED Forest Management - Inuvik Region
Vegetation Contamination Survey – as part of the Wildlife Effects Monitoring Program (Survey is related to gas and dust emissions, Ekati Mine sites and control sites)	Every 3 years	BHP Billiton
Post-fire Vegetation plots - (in various burns throughout Inuvik Region)	Annually	RWED Forest Management - Inuvik Region Gwich'in Renewable Resource Board
Tibbitt Lake **Post-Fire** Study (Vegetation transects - near Yellowknife and Gordon Lake - associated wildlife, micro-climate and hydrological monitoring).	Annually first 5 years, every 2-3 years following.	RWED Wildlife and Fisheries RWED Region - North Slave RWED Forest Management Indian and northern Affairs Department of Fisheries and Oceans Environment Canada High Schools
Ocean ecosystem		
Beaufort sea monitoring – biophysical oceanography (Temperatures, currents, depth, salinity)	Annually	DFO Institute of oceanographic Sciences (Sidney, NS) World Climate Research Programme World Weather Watch
Insects		
Beaufort Sea monitoring – biophysical oceanography (Temperatures, currents, depth, salinity)	Annually	DFO Institute of oceanographic Sciences (Sidney, NS) World Climate Research Programme World Weather Watch
Native Forest Insect Monitoring - **Spruce Budworm** (all forested regions)	Annually	RWED Forest Development - Hay River RWED Forest Management - Inuvik Region Canadian Forest Service
Native Forest Insect Monitoring **-Forest Tent Caterpillar**, **large Aspen Tortrix, Spruce Beetle** (some forested regions)	Annually	RWED Forest Development RWED Forest Management - Inuvik Region Canadian Forest Service

Title	Schedule	Collaborators[1]
Survey of Invasive Alien[2] Insects - **Larch Sawfly** (across forested regions in the NWT)	Annually	RWED Forest Development
Survey of Invasive Alien[2] Insects - **Birch Leaf Miner** (Yellowknife and Hay River)	Annually	RWED Forest Development City of Hay River City of Yellowknife RWED Wildlife and Fisheries Canadian Forest Service Canadian Wildlife Service (in YK only)
Multi-species - General		
General Status Ranks of Wild **Species** in the NWT– part of Accord for the Protection of Species At Risk in Canada (NWT-wide)	Every 5 years	RWED Wildlife and Fisheries Gov. of Nunavut RWED Regions Department of Fisheries and Oceans Canadian Wildlife Service Sahtu Renewable Resources Board Gwich'in Renewable Resource Board Wildlife Management Advisory Council (NWT) Fisheries Joint Management Committee Private volunteers
Community-based Ecological Monitoring – **multi-species** and bio-physical (Gwich'in Settlement Area)	Annually	Gwich'in Renewable Resource Board Arctic Borderlands Ecological Knowledge Society (Co-op) Private volunteers
Non-resident Hunter **Harvest** - Mackenzie Mountains	Annually	RWED Deh Cho Region
Outfitter **Harvest** – Mackenzie Mountains	Annually	Mackenzie Mountain Outfitters Association RWED Deh Cho Region
Resident Hunters **Harvest** Survey (NWT-wide) - associated fur-bearer and migratory birds information.	Annually	RWED Wildlife and Fisheries
Outfitter-Hunter **Wildlife** Observations – Mackenzie Mountain	Annually	Mackenzie Mountain Outfitters Association RWED Deh Cho Region
Pipeline **Wildlife** Monitoring - Enbridge Pipeline Right-of-Way (Norman Wells to Zama, AB)	Weekly	Enbridge RWED Sahtu Region RWED Deh Cho Region
Wildlife cards-Incidental observations of all species of wildlife are documented in and around Aulavik and Tuktut Nogait National Parks.	Annually	Parks Canada, Western Arctic Field Unit

Title	Schedule	Collaborators[1]
Deh Cho Territorial Parks **Wildlife** Observations (Territorial parks in Deh Cho Region)	Annually	RWED Deh Cho Region
Wildlife Disease Monitoring - Harvested Wildlife (NWT-wide)	Annually	RWED Wildlife & Fisheries RWED Regions incl. RRO's Canadian Cooperative Wildlife Health Centre
Winter Road - **Wildlife** Questionnaire (Yellowknife to Slave Geological Area)	Annually	RWED North Slave Region

Notes:

1 Shared budget or provided in-kind help.

2 Alien = Not native to North America.

In the NWT, non-governmental organizations or private citizen supervise Christmas Bird Counts (CBCs) locally. Birds Studies Canada supervises CBCs at the Canadian level (http://www.bsc-eoc.org/national/cbcmain.html), whereas the Audubon Society supervises them at the North American level .(http://www.audubon.org /bird/cbc/index. html).