
Great Bear Lake

State of Knowledge of the Terrestrial Environment

Prepared for:

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Summary

The Great Bear Lake watershed occupies about 1.5×10^5 km, or 13% of the land area of the Northwest Territories, and provides drainage to Great Bear Lake at a ratio of approximately five times land area to one of water surface. Three of Canada's 15 ecozones are represented in the watershed: the Taiga Plains in the western half of the watershed, the Taiga Shield to the southeast, including the Camsell River drainage area, and the Southern Arctic ecozone that forms the northeastern rim of the lake. Within these ecozones, the lands can be further classified to 9 ecoregions and a total of 22 ecodistricts, or Land Resource Units. Each of these smaller areas has a distinct combination of landforms, permafrost, soils, climate and biological communities that give them a unique character. The residents of Déline are well aware of the unique nature of these areas, which forms part of their traditional knowledge of the lake. For example, Sayhoue/Edacho, Caribou Point, Whitefish River and the Johnny Hoe River system are culturally significant areas and are in different ecodistricts under the land classification scheme.

Background information from federal and territorial agencies provides some technical information to help describe these areas, however most of the data are from remote sensing and estimated by extrapolation from the closest monitoring stations. Few data are gathered from the watershed itself. It is not clear how accurate the data are without ground truthing and installing several stations within the watershed. Overall, surface waters form about 33% of the area of the watershed, with the lowest levels in the areas around the Dease Arm (12 to 15%) and the uplands to the south. Elevation is relatively uniform, with the highest average elevation in the Dease Arm Plain (375 m above sea level, a.s.l.) and the Keller Lake Plain to the south. Permafrost is predominantly discontinuous (50-90%) in the southern half of the watershed to continuous (>90%) around the Dease Arm. Ground ice ranges from low (<10%) in the Great Slave Lake Plain to small areas of high (>20%) in the Norman range to the east. Forests are primarily transitional, with forest comprising <50% of the land area, however large sections of tundra and sparsely vegetated land are present in the ecodistricts surrounding the Dease Arm.

Local climate varies considerably between the ecodistricts. Hours of daily sunlight and solar radiation are relatively uniform over the watershed, however monthly air temperature, wind speed, and growing season vary significantly. Ecodistricts around the Dease Arm experience higher wind speeds, less precipitation, lower monthly temperatures and less extreme maximum and minimum temperatures than other parts of the watershed. Over the watershed, average annual precipitation is 277 mm, of which about 40% is snowfall and 60% as rain. Estimates of evapotranspiration place an annual area-weighted average of 389 mm for the watershed, with a

deficit of 96 mm of moisture. Growing season, defined by the number of days with air temperatures $>5^{\circ}\text{C}$, is also relatively short.

There have been no large scale inventories of species present in the Great Bear Lake drainage area to establish the current biodiversity, however several limited surveys of smaller areas and single species, particularly the large mammals, provides some information on population trends. In general, populations of the Bluenose-East and Bluenose-West caribou herds and muskox to the north appear to be stable, however the Bathurst herd appears to have undergone a significant decline from over 300,000 individuals to $< 200,000$ since 1996. A survey of the Bluenose-east caribou herd in 2000 placed the size of the herd at 104,000, which should be able to support the current harvest rates of 5,000 caribou per year. Resources, Wildlife and Economic Development (RWED) has also provided a data base on the status of plants, birds and mammals in the NWT by ecozone, and evaluated the status of each species based on their numbers, distribution, and the extent of threats to the populations. Of the 54 mammal species potentially present in the Great Bear Lake watershed, 37 are considered to be secure, and 6 are considered “sensitive” meaning there are few individuals, they have a limited distribution or there are significant threats. One species that could be in the Great Bear watershed, the fisher, is categorized as “may be at risk” until more data are available. Of the 190 bird species possibly present in the watershed, 101 species are “secure”, 30 are “sensitive”, 2 species “may be at risk” and 2 species are “at risk”. Assessments of waterfowl report that populations of pintail and scoters are much lower than historic levels, although mallard and Canada goose remain relatively stable. Several hundred plant species are considered to be in the watershed but the status of few of them has been assessed. Major tree species like jack pine, black and white spruce and tamarack are all considered to be secure.

The impact of climate change appears to be the major concern and model predictions indicate that average air temperatures will probably increase by about 5°C over the next 50 years and precipitation will probably also increase. Higher temperatures may also lead to greater moisture deficits in the watershed. It is difficult to predict the full impact of climate change because of the lack of data and the nature of climate modelling, but it is important that the issue be monitored in the watershed. Development does not yet appear to have a large impact on wildlife habitat in the watershed however the local impacts of many of the abandoned mines in the Coppermine River uplands and the cumulative effects, have not been assessed. Port Radium is currently being assessed for its potential impact which is probably restricted to the footprint of the tailings and waste rock on the site.

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1.0 Introduction

The Great Bear Lake Working Group was established in 2002 to begin the process of developing a Management Plan for Great Bear Lake and its watershed. Indian and Northern Affairs began the development of a long-term strategic plan for Great Bear Lake in partnership with other federal and territorial agencies and co-management boards established under the Sahtu Dene/Métis Comprehensive Land Claims Agreement. The development of the plan has included open workshops with the community in Déline in October 2002, March 2003 and January 2004 to discuss the steps necessary to develop a management plan and to resolve community concerns.

The members of the Great Bear Lake Working Group understand the role of the people of Déline in using and understanding the land and waters of the Sahtu and have actively sought their views on what is needed for monitoring and research in the proposed management plan. Ultimately, the management plan will provide a framework to manage the development and activities in the watershed of the lake. The goal of the plan is to maintain the health and integrity of the Great Bear Lake system. The community of Déline is a major stakeholder in the Working Group since it is the only community on Great Bear Lake and the people who are now settled in Déline have traditionally used the resources of the land and water for thousands of years. Because of this, the residents have a unique insight to the lake and its resources.

This report is one of a pair of reports that provide background information on the state of the knowledge of the aquatic and terrestrial components of the Great Bear Lake watershed. The objectives of the reports are to summarise the current state of knowledge and to identify gaps in the information needed to protect the lake. Initially, the management plan focused only on the waters of Great Bear Lake, however the Working Group decided that the terrestrial component of the watershed needed to be considered in the protection of the lake because the cumulative effects of development and modifications within the drainage basin could have significant impacts on the lake itself. Also, changes to the land could change the use of those lands by the residents of Déline, who do not differentiate between the land and water and use both equally.

The objective of the present report is to summarise the available information on the physical and biological components of the terrestrial environment. It is intended to act as a companion document to the assessment of the state of knowledge of the aquatic environment, which was completed for the Great Bear Lake Working Group in 2003 (MacDonald *et al.* 2003). The aquatic state of the environment covered topics such as the limnology, water quality, fisheries

management in Great Bear Lake and potential stressors to the aquatic environment. An additional report also summarized comments from the residents of Déline regarding their views of the state of the environment of the lake and surrounding lands, changes that they have found during their lifetimes, and their view of priorities for issues to be addressed in future monitoring and research programs. Together, the reports will provide a comprehensive background on the Great Bear Lake and its watershed in 2004 from the perspectives of both western science and the elders and other residents of Déline.

2.0 Scope of the Report

The objective of this report is to provide a comprehensive summary of the terrestrial environment in the watershed of Great Bear Lake and to identify major gaps in the quality or quantity of information. The key to preserving Great Bear Lake and the surrounding lands is to understand its current status and, as best as possible, to understand the possible stressors that could lead to changes in the physical environment or the biological community. This report will use information from several sources, but mostly from government databases that are available as reports or as raw data available through electronic means. Many of the references are listed in (Sirois 2001). The quality of the data is sometimes mixed, or unknown, and may lead to incorrect or inappropriate conclusions if accepted indiscriminately. Whenever possible, only the data that are of known quality will be used, but the reader is advised that some assumptions have to be made to acquire data since few studies are available specifically for the watershed.

This report is designed to provide a technical background of the physical and biological environment of the watershed. As such, it does not formally include traditional knowledge from the people of Déline, but the areas of emphasis are based on concerns and interests of the people of Déline put forth in focus groups in Déline in February 2003, and in the community workshops where the future of Great Bear Lake was discussed.

3.0 The Terrestrial Environment

3.1. Land Classification

During the 1990's, a system of classifying and describing the biological and physical features of the terrestrial environment was developed by several federal and territorial agencies. The initiative resulted in a report entitled "A National Ecological Framework for Canada" (Wilken 1996) (the report is available at www.ec.gc.ca/soer-ree/English/Framework/default.cfm). The underlying principle for the national framework is to describe lands in terms of ecosystems which are comprised of the physical (abiotic) and biological (biotic) components of a region.

More importantly, the framework provided a consistent, national spatial context within which ecosystems at various levels of generalization could be described, monitored, and reported on. For the Great Bear Lake watershed, the land classification system provides a system of describing the environment which parallels and complements the traditional or local knowledge of the Sahtu Dene. The land classification will be used in this report to describe the landscape as it is understood by Environment Canada.

The land classification system describes the character of an area which is a combination of landforms, soil, climate, vegetation, water and the presence of people. The combination of these factors results in an ecosystem which is unique because of all the factors that influence the land and its features and the biological community that lives within it. The land classification system uses data collected from remote sensing, like satellite data, to define the physical structure of the environment. Vegetation coverage, land and water composition and rock strata are also available. Some climate measurements from weather stations in the region are used to estimate climate in areas where no measurements are available.

The levels of classification include:

Ecozone	The largest level of classification which is representative of large and very generalized ecological units characterized by interactive and adjusting abiotic and biotic factors. There are a total of 15 ecozones in Canada, three of which are represented in the Great Bear Lake watershed
Ecoregion	This is part of an ecozone that is characterized by distinctive regional ecological factors, including climatic, physiography, vegetation, soil, water, fauna, and land use. There are 194 ecoregions in Canada, nine of them in the watershed.
Ecodistrict	The smallest unit of classification (part of an ecoregion) that is characterized by distinctive assemblages of relief, geology, landforms and soils, vegetation, water, fauna, and land use. There is a total of 1031 ecodistricts in Canada, 22 of which are in the GBL watershed. Ecodistricts are also termed Land Resource Units.

3.2. Great Bear Lake Watershed Classification

The Great Bear Lake watershed covers a total of 150,000 km² (Water Resources Institute 1998) and includes a diverse range of landforms, climate, and biological communities. Because of this diversity, the drainage basin includes three ecozones of the 15 that are present in Canada, and includes nine of Canada's 194 ecoregions (Table 1, Figures 1 and 2). Seven ecoregions form the

major part of the watershed and several minor ecoregions (e.g., Great Slave Plain, Colville Hills and Coronation Hills) have relatively minor contributions to the total watershed. The combination of these elements results in ecosystems which are familiar to the Déline Dene, but are described here to provide a basis for understanding the various regions within the watershed.

A brief summary of each ecozone and the major ecoregions is given here, followed by a section of physical descriptions of major features and climate data for the individual ecoregions. The original text is taken from the Environment Canada sites after the report by Wilken (1986) http://www.ec.gc.ca/soer-ree/English/Framework/Nardesc/canada_e.cfm and is modified and adapted here for this report.

3.2.1 Southern Arctic Ecozone

This ecozone extends across northern Canada, with over 80% of its land area west of Hudson Bay. One section of the ecozone (Dease Arm Plain) makes up the north shore of Great Bear Lake and provides habitat for major species like the Bluenose-east and -west caribou herds and muskox. The terrain consists largely of broadly rolling uplands and lowlands and is underlain for the most part by Precambrian granitic bedrock. Cryosols are the dominant soils, and are underlain by continuous permafrost with active (thaw) layers that are usually moist or wet throughout the summer. This ecozone represents a major area of vegetative transition between the taiga forest to the south and the treeless arctic tundra to the north. Typical shrubs include dwarf birch, willow, and heath species; these are commonly mixed with various herbs and lichens. It is also a major breeding and nesting ground for a variety of migratory birds. Representative species include the yellow-billed, arctic, and red-throated loon, whistling swan, snow goose, long-tailed duck, gyrfalcon, willow and rock ptarmigan, northern phalarope, parasitic jaeger, snowy owl, hoary redpoll, and snow bunting.

Ecoregion #35 - Dease Arm Plain

The Dease Arm Plain covers the upland from just east of the Mackenzie Delta to Dease Arm of Great Bear Lake. Tall shrub tundra, usually consisting of dwarf birch and willow, is the most common vegetative cover. The southern boundary of the ecoregion meets the Great Bear Lake Plain of the Taiga Plains ecozone which forms the northern shore of Smith and Dease arms of Great Bear Lake. Dominant plant species in the Dease Arm Plain consist of stunted stands of black spruce and tamarack with secondary quantities of white spruce and ground cover of dwarf birch, willow, cottongrass, lichen, and moss. The rolling landscape is

Table 1 Summary of ecozones, ecoregions and ecodistricts that form the Great Bear Lake watershed. Map showing the placement of the ecodistricts is shown in Figure 2.

						Ecoregions With a Large Fraction in the Great Bear Lake Drainage Area		
Ecozone Name	Ecoprovince	Ecoregion Number	Ecoregion Name	Ecodistricts in GBL Watershed	Contribution to GBL Drainage Area	Approximate Area of Ecoregion in Drainage Area (ha)	Percent Land in Ecoregion	Elevation
Southern Arctic	Amundsen Lowlands	35	Dease Arm Plain	148, 149	Major	1.64×10^6	84.0	375 (229 – 672)
		36	Coronation Hills	151	Minor	Not estimated	85.2	436 (39 – 814)
Taiga Plains	Great Bear Lowlands	52	Great Bear Lake Plain	202, 203, 204, 205, 206, 207	Major	6.62×10^6	51.6	250 (112 – 542)
		54	Colville Hills	215	Minor	Not estimated	69.6	302 (161 – 700)
		55	Norman Range	217, 218, 219	Major	3.71×10^6	88.0	307 (102 – 929)
		57	Grandin Plains	223, 224	Major	9.76×10^6	70.6	286 (185 – 544)
		58	Franklin Hills	225	Minor	Not estimated	97.3	448 (3 – 1512)
		59	Keller Lake Plain	227, 228, 229	Major	2.69×10^6	80.5	344 (187 – 701)
		60	Great Slave Lake Plain	231	Major	6.16×10^5	92.3	319 (152 – 609)
Taiga Shield	Western Taiga Shield	68	Coppermine River Upland	255, 257	Major	6.33×10^6	59.3	326 (153 – 636)

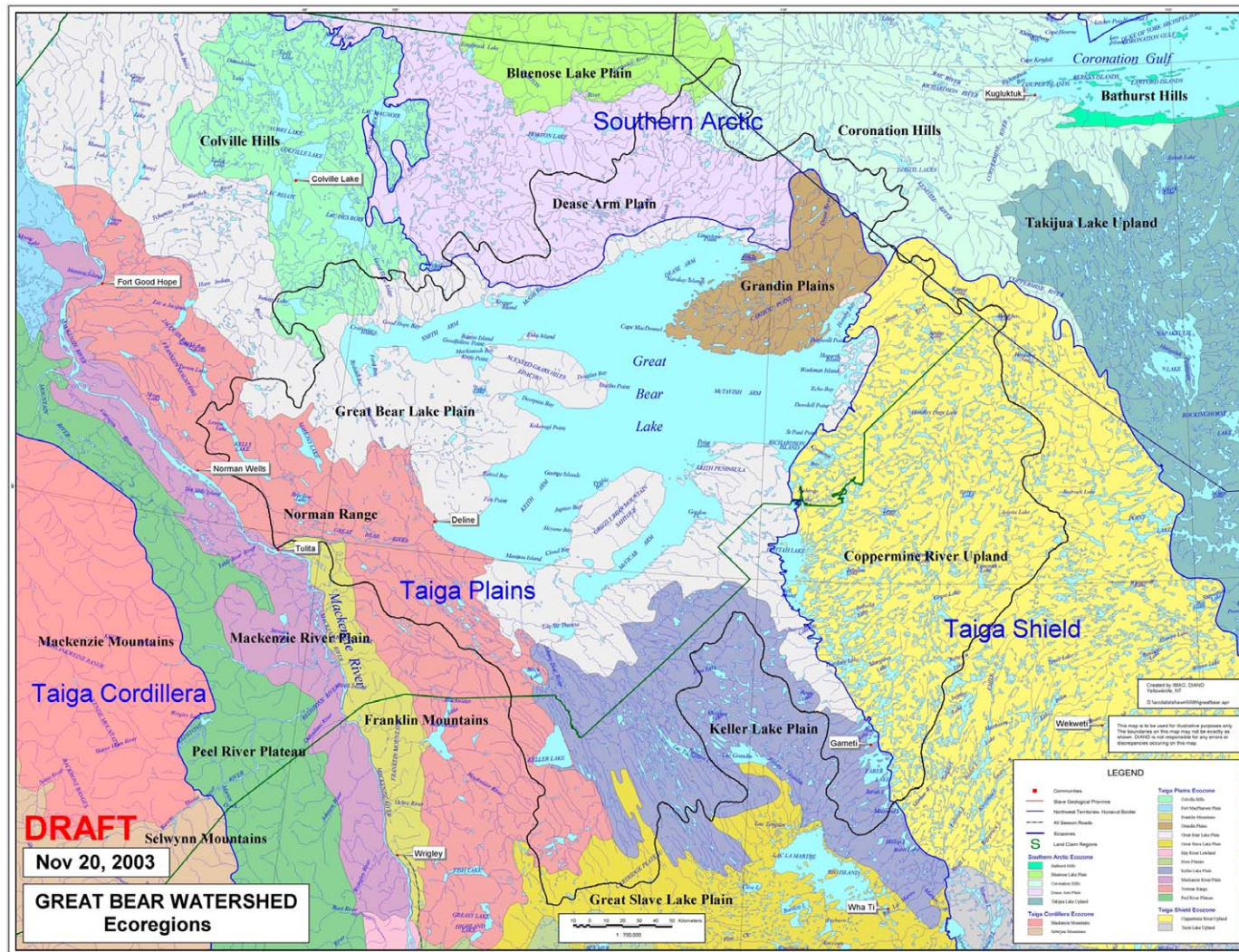


Figure 1 Map of Great Bear Lake watershed showing ecozones and ecoregions. Map is from Information Management, DIAND, Yellowknife

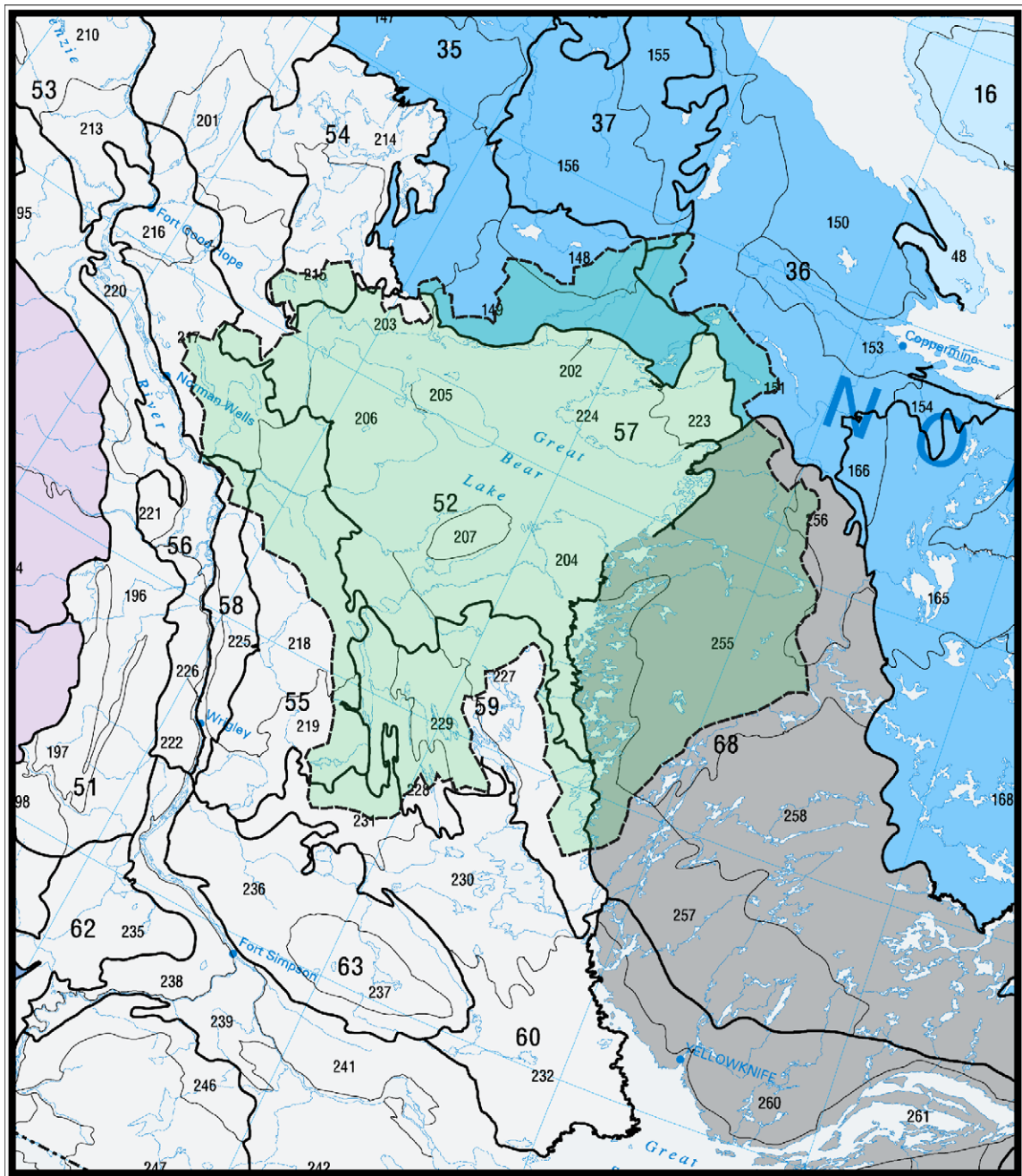


Figure 2 Map of the Great Bear Lake watershed (approximate; shaded green) with the placement of ecodistricts. The ecodistricts included in the calculation of physical features are shown in Table 1.

generally below about 300 m asl (above sea level) elevation and is covered by glacial drift and outwash. A wide range of cryosolic soils, as well as eutric and dystic brunisolic soils, have formed on hummocky to undulating, loamy glacial till. Characteristic mammals include caribou, moose, black and grizzly bear, lynx, red and arctic fox, and snowshoe hare. Representative birds include sparrow, songbirds, spruce grouse, osprey, and waterfowl.

3.2.2 Taiga Plains Ecozone

The ecoregions of this ecozone make up the majority of western portions of the Great Bear Lake watershed. Overall, the ecozone extends from the Beaufort Sea southward to northern Alberta and includes the Mackenzie River Basin. This ecozone is the northern extension of the flat Interior Plains and has relatively low relief. The broad lowlands and plateaus contain major rivers that can show elevational differences of several hundred meters. The ecozone is underlain by horizontal sedimentary rock (limestone, shale and sandstone). Low-lying wetlands cover 25–50% of the zone. A large portion of the area is underlain by permafrost which acts to perch the surface water table and promote a regional overland seepage system. The predominant tree species is black spruce. Shrubs include dwarf birch, Labrador tea, and willow. Upland and foothill areas and southerly locales are characterized by white and black spruce, lodgepole pine, tamarack, white birch, trembling aspen, and balsam poplar. White spruce and balsam poplar grow to sizes comparable to the largest in the boreal forests to the south. Mammal species include moose, woodland caribou, wood bison, wolf, black bear, marten, lynx, and arctic ground squirrel. Common bird species include the common redpoll, gray jay, common raven, red-throated loon, northern shrike, sharp-tailed grouse, and fox sparrow. The Mackenzie Valley forms one of North America's most travelled migratory corridors for waterfowl (ducks, geese, and swans) breeding along the Arctic coast.

Ecoregion #52 - Great Bear Lake Plain

The southern portion of this ecoregion makes up the majority of the shoreline of Great Bear Lake and includes Sayhoue/Edacho. The ecoregion is classified as having a high subarctic ecoclimate. The northern limits of tree growth are reached along its northern boundary. The predominant plants are black spruce and tamarack with secondary quantities of white spruce and a ground cover of dwarf birch, willow, shrubs, cottongrass, lichen, and moss. Poorly drained sites usually support tussocks of sedge, cottongrass, and sphagnum moss. Low shrub tundra, consisting of dwarf birch and willow, is also common. As elevations gradually increase southward, entrenched river channels lie some 60–150 m below the surrounding surface. Soils consist of turbic cryosols with static and organic cryosols developed on organic deposits with deep permafrost. Wildlife includes

caribou, moose, black bear, wolf, red fox, snowshoe hare, and beaver. Common birds include spruce grouse, raven, osprey, and waterfowl.

Ecoregion #55 Norman Range

This ecoregion extends from Fort Good Hope on the east side of the Mackenzie River to Willowlake River south of Great Bear Lake. Vegetation is dominated by open stands of black spruce with an understory of dwarf birch, Labrador tea, lichen, and moss. Drier and warmer sites tend to have more white spruce, paper birch, and some aspen. The Norman Range forms a series of north-south-trending, linear, relatively low ridges, largely of resistant Palaeozoic carbonates, and reaching elevations of about 1040 m asl. The surface of the ecoregion is covered with steeply sloping to undulating glacial drift, colluvium, and organic deposits in the form of polygonal peat plateaus. Turbic and organic cryosols, as well as eutric brunisols, are the dominant soils. In the area northeast of Fort Good Hope, ice wedges and pingo ice are more abundant. Characteristic wildlife includes caribou, moose, grizzly and black bear, wolf, coyote, beaver, snowshoe hare, muskrat, and red fox. Common birds include spruce grouse, raven, and osprey.

Ecoregion #57 - Grandin Plains

This ecoregion occurs between the Dease and McTavish arms at the northeast corner of Great Bear Lake and includes Caribou Point, a culturally significant area to the people of Déline. The latitudinal limits of tree growth are reached along its eastern boundary which runs along the eastern edge of the Sahtu Settlement Area. The predominant vegetation consists of open, stunted stands of black spruce and tamarack with white spruce, and a ground cover of dwarf birch, willow, cottongrass, lichen, and moss. Wetlands cover approximately 25% of the ecoregion, and are characteristically peat plateau bogs, and ribbed and horizontal fens. Characteristic wildlife includes moose, black bear, beaver, fox, wolf, snowshoe hare, raven, and spruce grouse.

Ecoregion #59 - Keller Lake Plain

This ecoregion encompasses the culturally significant area of the Johnny Hoe River and lakes Taché and Grandin south of the McVicar Arm of Great Bear Lake. The predominant vegetation consists of open stands of black spruce with an understory of dwarf birch, Labrador tea, lichen, and moss. Drier and warmer sites tend to have more white spruce, paper birch, and some aspen. The ecoregion is composed of Cretaceous shale, its surface is generally below 310 m asl and is covered by undulating, peat-covered glacial drift and outwash deposits. Turbic and organic cryosols, developed on organic and loamy morainal deposits, are the dominant soils in the ecoregion. Wetlands cover over 25% of this ecoregion,

which also includes the southeastern portion of Great Bear Plain. Characteristic wildlife includes caribou, moose, black bear, wolf, red fox, coyote, beaver, snowshoe hare, muskrat, spruce grouse, raven, and waterfowl.

3.2.3 Taiga Shield Ecozone

This ecozone lies on either side of Hudson Bay and below the southern Arctic ecozone. The segment to the west of Hudson Bay extends from the southeastern edge of Great Bear Lake south to northern Manitoba. The section of the ecozone that lies within the Great Bear Lake drainage area makes up the ecoregion termed the Coppermine River Upland. This ecoregion falls outside the Sahtu Settlement Area and is in the traditional lands of the TliCh'o but provides much of the drainage for the Camsell River, the major inlet to Great Bear Lake. Many of the abandoned mines (e.g., Terra mine) in the Great Bear Lake watershed are also in the Coppermine River upland.

The Taiga Shield ecozone is largely defined by two very large biophysical features, the Taiga Forest and the Canadian Shield. The world's oldest rocks are found on the Taiga Shield north of Great Slave Lake. Most of this ecozone consists of broadly rolling terrain composed of a mosaic of uplands and associated wetlands. It is dominated by Precambrian bedrock outcrops and discontinuous hummocky and ridged morainal deposits.

Ecoregion #68 - Coppermine River Upland

This ecoregion extends from the McTavish Arm of Great Bear Lake to Howard Lake in the central District of Mackenzie in the Canadian Shield. Many of the abandoned mines in the Great Bear Lake watershed are situated in these uplands. The ecoregion is part of the tundra and boreal forest transition, where the latitudinal limits of tree growth are reached. The predominant vegetation consists of open stands of black spruce and tamarack with secondary quantities of white spruce and a ground cover of dwarf birch, willow, ericaceous shrubs, cottongrass, lichen, and moss. Poorly drained sites usually support tussocks of sedge, cottongrass, and sphagnum moss. Low shrub tundra, consisting of dwarf birch and willow, is also common. Bare rock outcrops are common, and dystic brunisols with some turbic, static, and organic cryosols are the dominant soils in the ecoregion. The soils have formed on discontinuous veneers and blankets of hummocky to rolling, sandy morainal, fluvio-glacial, and organic deposits. Characteristic wildlife includes caribou, moose, grizzly and black bear, snowshoe hare, fox, wolf, beaver, muskrat, osprey, raven, spruce grouse, and waterfowl.

3.3. The Physical Environment

The general descriptions of the individual ecoregions listed above provide some general information on the major features of the ecological areas making up the Great Bear Lake Watershed, however more detailed information on the physical environment is available at the ecodistricts level from the Agriculture and Agri-Foods Canada web site. The Great Bear Lake watershed intersects with about 22 ecodistricts, although some, such as those from the Colville Hills and Coronation Hills of the Southern Arctic ecozone make a very small contribution to the watershed. Many of the physical measurements and climate for the abiotic component of each ecodistrict are available. The data are available at

http://sis.agr.gc.ca/cansis/nsdb/ecostrat/data_files.html#summary_table. In total, data are available for 26 attributes of the ecozones, usually by ecodistricts, including area, climate, physical landscape characteristics, land cover and population (Marshall *et al.* 1999). The raw or derived data are summarised below for the major ecoregions and for the watershed itself.

3.3.1 Land and Water Area

Land and water data for the individual ecodistricts show some of the differences in the general character of the ecoregions in the watershed. The data base includes lakes with surface areas of more than 1 km² and hence overestimates the land fraction slightly and underestimates the water fraction. The percent land in each of the ecodistricts, is presented in Table 1. The percent land data for the ecoregions has been adjusted to account for the areas of the ecodistricts within the watershed. The percent land ranges from a low of 52 % for the lands immediately surrounding the lake to over 92% in the Great Slave Lake Plain. Over the watershed, approximately 67% of the area is land and 33% water.

3.3.2 Elevation

The elevation of the ecoregions within the watershed is relatively uniform, although some areas show greater extreme values. The mean elevation (uncorrected for the size contribution of the individual ecodistricts) for the drainage basin is 316 m a.s.l. (above sea level), with a minimum mean of 102 m a.s.l. in the Norman Range and a maximum mean of 229 m a.s.l. in the Dease Arm Plain. Greater elevations are present in the Colville Hills ecoregion (700 m) and the Franklin Hills (1512 m), however both these regions sit beyond the northern and western boundaries, respectively, of the watershed. The major ecoregions that form the majority of the basin for the watershed have mean elevations of about of 250 m (Great Bear Lake Plain) to 375 a.s.l. in the Dease Arm Plain. The elevation difference (the difference between minimum and

maximum elevation) remains relatively consistent throughout the watershed at 400 to 500 m a.s.l.

3.3.3 *Permafrost*

The quantity and quality of permafrost and ground ice in the ecodistricts has been obtained from satellite imagery. Permafrost is defined as a state of the ground, whether soil or rock, that remains below a temperature of 0 °C. Ground ice occurs as water frozen to soil particles, thin veins and lenses of ice and as larger sheets of ice.

All ecoregions in the Great Bear Lake watershed contain permafrost and ground ice, although the type and extent varies (Figure 3). The southern ecoregions and the Great Bear Lake watershed contain mostly discontinuous permafrost (>90%) with varying levels of ground ice (10-20%). Continuous permafrost and medium and high (>20%) levels of ground ice are present in the Great Bear Lake Plain and the Norman Range areas. The area-weighted average for the watershed (Figure 3) indicates that discontinuous permafrost extends over 50-90% of a large portion of the land with smaller areas of continuous permafrost and 10-20% ground ice.

Although these data provide a general indication of the extent of permafrost and ground ice, it is unlikely that the methods used to define coverage are precise or accurate enough to predict the effects of climate warming on the permafrost on the Great Bear Lake watershed. More precise data, with higher resolution are needed to be able to predict the effects of global warming on the general structure of the permafrost, and the releases of moisture from thawing permafrost and ground ice.

3.3.4 *Land Cover*

Types of land cover are determined across Canada using very high resolution imagery. For the data included in the national ecological framework, data from 1988 to 1991 were combined to allow classification and interpretation. The methods are limited because of the relatively large scale of features needed for identification (maximum resolution of 1 km), the timeframe needed for cloud free scenes and the limited number of land cover categories.

The database identified a total of five types of coverage for the ecoregions, ranging from tundra and sparsely vegetated/barren land (primarily in Grandin Plain) to a mixed forest of conifers and broadleaf in the Norman Range (Figure 4). The most dominant type of land cover was the

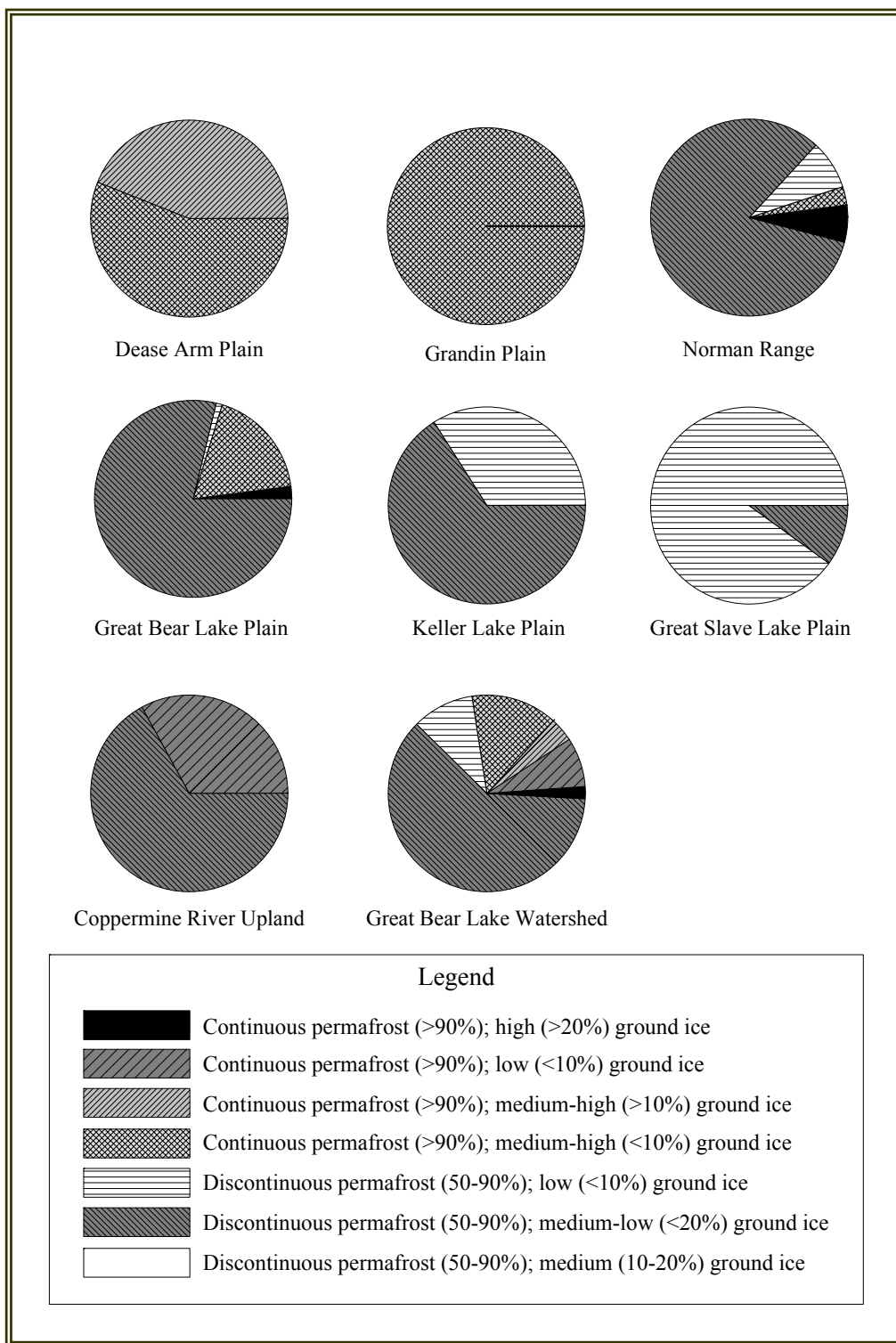


Figure 3 Levels of permafrost present in the ecoregions of the Great Bear Lake watershed. Data are from Agriculture and Agri-Food Canada

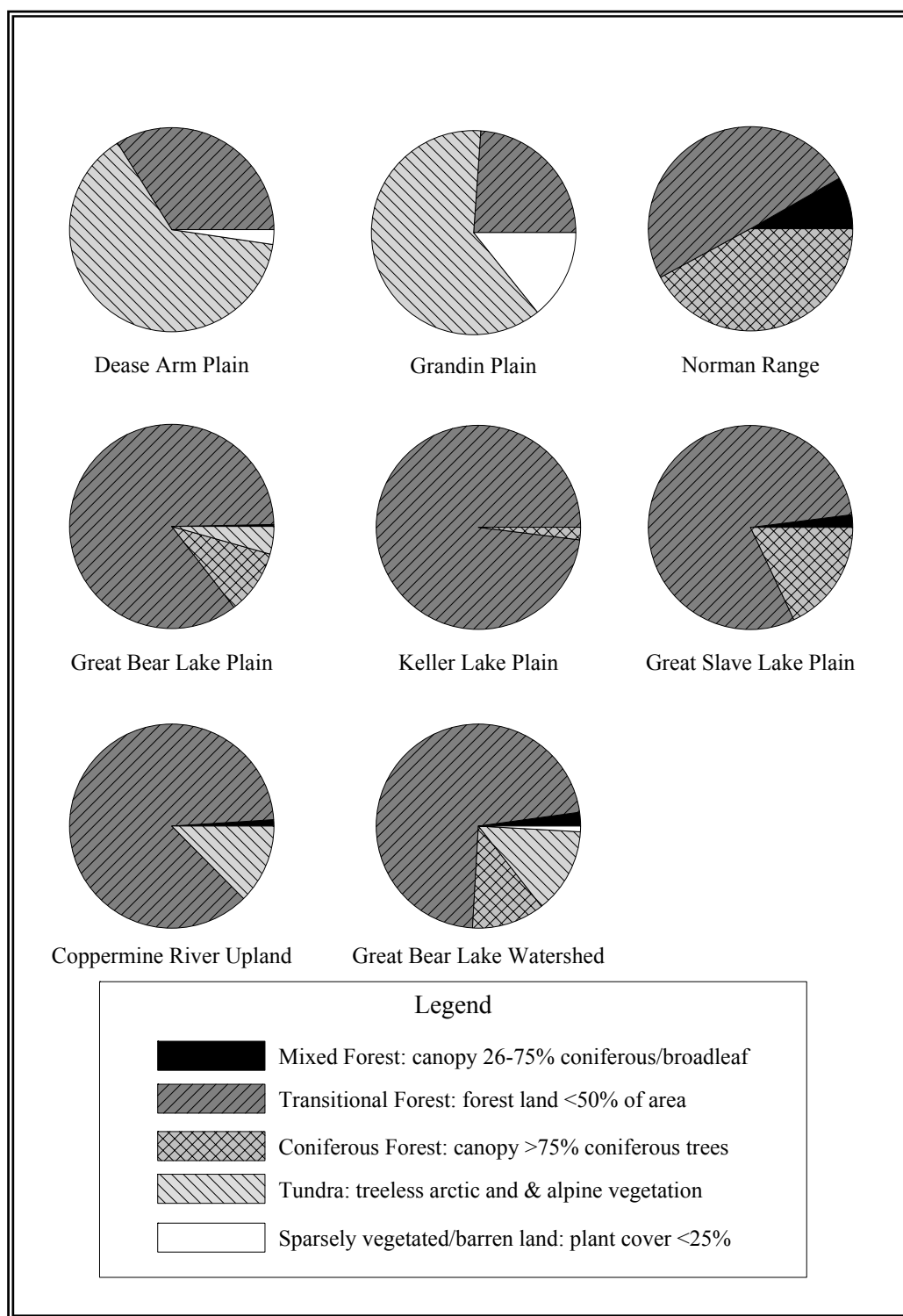


Figure 4 Description of ground cover for individual ecoregions and the average for the Great Bear Lake watershed. Data are from Agriculture and Agri-Food Canada.

transitional forest, which covered <50% of the land area. The land-area weighted proportions for the watershed showed that the transitional forest was the dominant cover type (72%), followed by tundra (13.5%) and coniferous forest (11.5%). The sparsely vegetated/barren area, which is found only in the lands surrounding the Dease Arm, accounts for about 1% of the total watershed.

3.3.5 *Surface Material*

The ecological framework designates surface material into five major categories, including ice and snow, urban areas, organic soils, rock and mineral soils. Three of the major classes are represented in the Great Bear Lake watershed. Mineral soils (defined as predominantly mineral particles with <30% organic matter) dominate across the watershed, with an area-weighted average of 65.6% of the land. Organic soils (contains >30% organic matter by weight) comprise 29% of the total, while rocks make up about 5%.

Surface material composition varies considerably between ecoregions. Surface materials in the Dease Arm Plain and Grandin Plains are predominantly mineral soils (>80%) with few organic soils (<20%). In contrast, surface materials in the southern region have lower proportions of mineral soils (50-55%) and higher levels of organic soil (40-45%). The highest proportion of rock as surface material is found in the Coppermine River upland at 18%.

3.4. Climate

The climate of a region is a major factor in determining the type of ecosystem present and the types of plants and wildlife that can be sustained. The composition of the biological community, which includes all forms of plant, invertebrate and vertebrate species requires a stable climate and consistent growing season to provide the energy necessary for survival. More importantly, significant changes in the climate, which may lead to higher or lower extreme temperatures, a drying landscape or extreme weather events can have a major impact on the health and viability of the biological community.

The summarised climate values for each of the ecodistricts that make up the Great Bear Watershed are available through the Agriculture and Agri-food Canada website <http://sis.agr.gc.ca/cansis/nsdb/ecostrat/district/climate.html>. The data summarise the major climate measurements between 1961 and 1990 for each of the ecodistricts in Canada. Because weather stations are not present in all ecodistricts, various methods were used to extrapolate to each ecodistrict from three to four of the closest weather stations in the region. For the Great Bear Lake watershed, the large distances between the meteorological stations produces increased

uncertainty in the reported values for the remote ecodistricts, however they should provide some indication of the relative levels of important climate variables for the watershed. The data are important for establishing some levels of baseline data before the effects of local and global climate change can be detected, however the most accurate method to monitor climate is to establish more meteorological stations within the watershed.

Available data range from direct measurements of air temperature (average, maximum and minimum), precipitation (total, rainfall and snowfall), wind and solar radiation on a daily, monthly and annual basis, to derived variables that are calculated from the direct measurements using several widely accepted methods. These derived variables include precipitation surplus and deficits, growing degree days and water losses through evapotranspiration. In general, the derived variables have greater application in agricultural areas and heavily forested areas, however they also provide some background on the dynamics of the environment suitable for plant growth in the Great Bear Lake watershed. A detailed description of the methods used to calculate many of the indicators are presented at the Ecodistrict Climate Normals website of Agriculture and Agri-Food Canada.

3.4.1 Air Temperature

The predicted air temperature for the individual ecoregions and the annual mean are presented in Figure 5. The lowest mean winter and summer temperatures are found on the Grandin Plains, which includes Caribou Point, and Dease Arm Plains ecoregion, in the far northeast areas of the watershed. Extreme minimum temperatures range from -30 to -35 °C during January and February. For the whole watershed, the mean temperatures during the winter months are generally at -25 to -30 °C while summer temperatures are in the 10 to 15 °C range. The lowest average summer temperatures for the ecoregions considered here are found in the Dease Arm (7-8 °C), probably because of the moderating influence of the Great Bear Lake surface waters.

Mean air temperature is also one of the major variables that will be affected with climate change. These data provide some background for determining the long-term average temperatures however better data, and additional indicators, are probably required to be able to detect changes due to warming in the Great Bear Lake watershed.

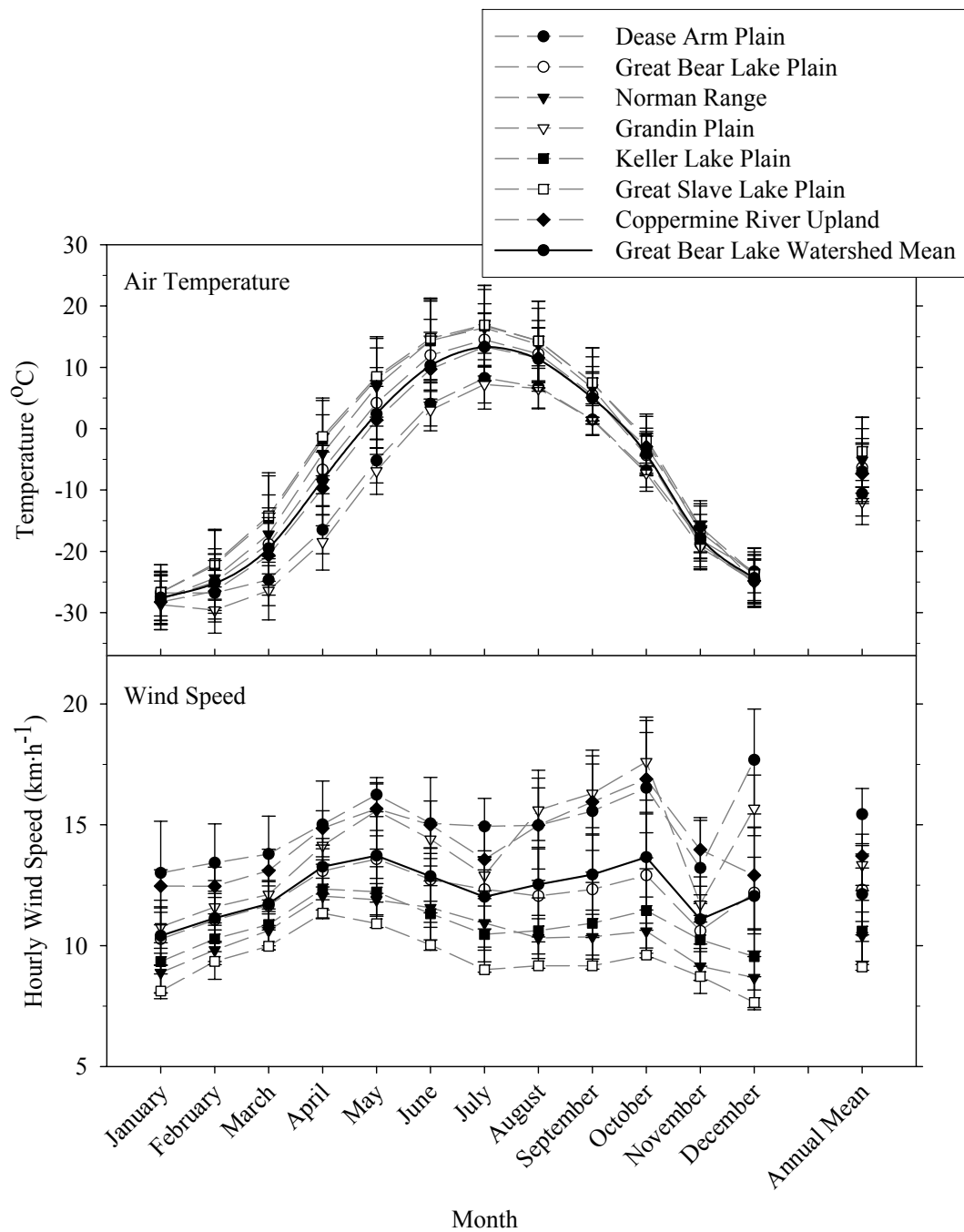


Figure 5 Air temperature and wind speed in each of the ecoregions of the GBL watershed. The average for the watershed in each of the graphs is represented by a solid line. The annual mean for each ecoregion is shown on the far right.

3.4.2 *Wind speed*

Average monthly wind speeds are presented in Figure 5 (lower panel). The highest average wind speeds are found in the two ecoregions surrounding the Dease Arm, but also in the Coppermine River Uplands that make up a large portion of the southeastern part of the watershed. Wind speeds also show significant trends through the year, reaching a maximum in October and then declining for November for the three ecoregions with the highest average speeds. The average wind speed for the ecoregions ranges from a maximum of $15.4 \text{ km}\cdot\text{h}^{-1}$ for the Dease Arm Plain to about $9 \text{ km}\cdot\text{h}^{-1}$ on the three ecodistricts of the Great Slave Lake Plain.

3.4.3 *Daily Solar Radiation*

The daily solar radiation is a major indicator of the energy available for primary productivity in water and on land and in the rate of drying and evaporation of surface waters and precipitation (Figure 6). Although the levels of daily solar radiation are relatively uniform over the watershed, slightly higher levels are observed in the more southern regions. Slight differences are also evident during the spring and summer months, however little difference is observed during the peak time of solar radiation at the end of June.

3.4.4 *Bright Sunshine*

Bright sunshine shows more variability than solar radiation, with the more southern areas having 20-30 hours more bright sunshine in the summer months than in the northern ecoregions. Similarly, the amount of bright sunshine, a major determinant of water evaporation and plant growth, remains relatively uniform over the watershed (Figure 6). Bright sunlight per year amounts to about 2000 hours over the watershed.

3.4.5 *Precipitation*

Estimates of precipitation show considerable spatial variability over the watershed (Figure 7). The highest rates of precipitation are reported for the Great Slave Lake Plain and the Norman Range, most in the form of rainfall during the summer months. Much lower rates of precipitation are reported for the Dease Arm Plain and Grandin Plain, which have about five times less precipitation in winter than the southern areas of the watershed. Over the watershed, average annual precipitation is 277 mm., of which about 40% is snowfall and 60% falls as rain.

3.4.6 *Evapotranspiration*

Evapotranspiration is an estimate of the amount of moisture lost from the ground to the atmosphere, either by evaporation or by the respiration of plants. Air temperature, humidity, solar radiation and wind all have significant effects on the rate of evapotranspiration.

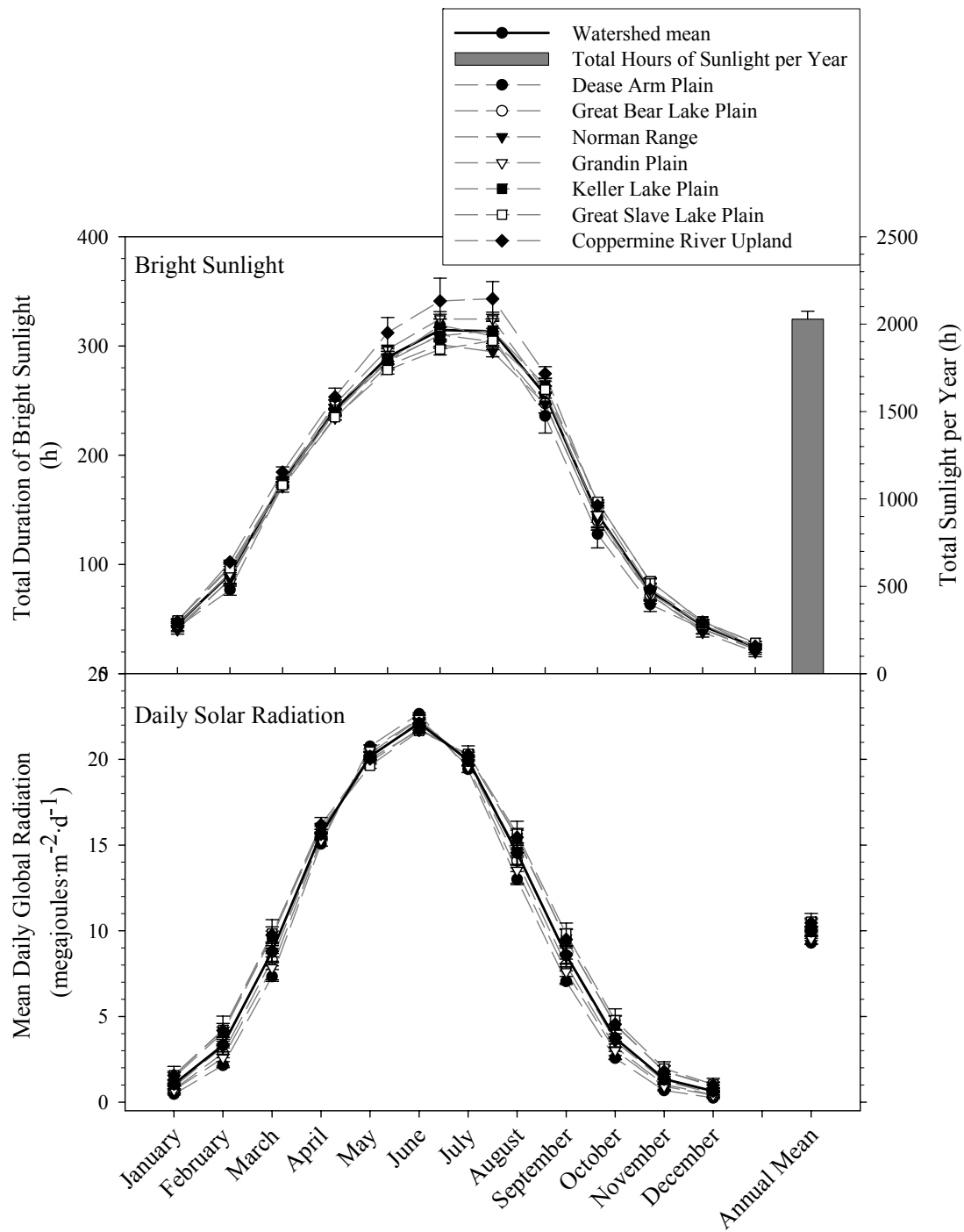


Figure 6 Monthly bright sunlight and daily solar radiation for the ecoregions in the Great Bear Lake watershed. Bar in the upper figure is the total number of hours of sunlight annually for the watershed.

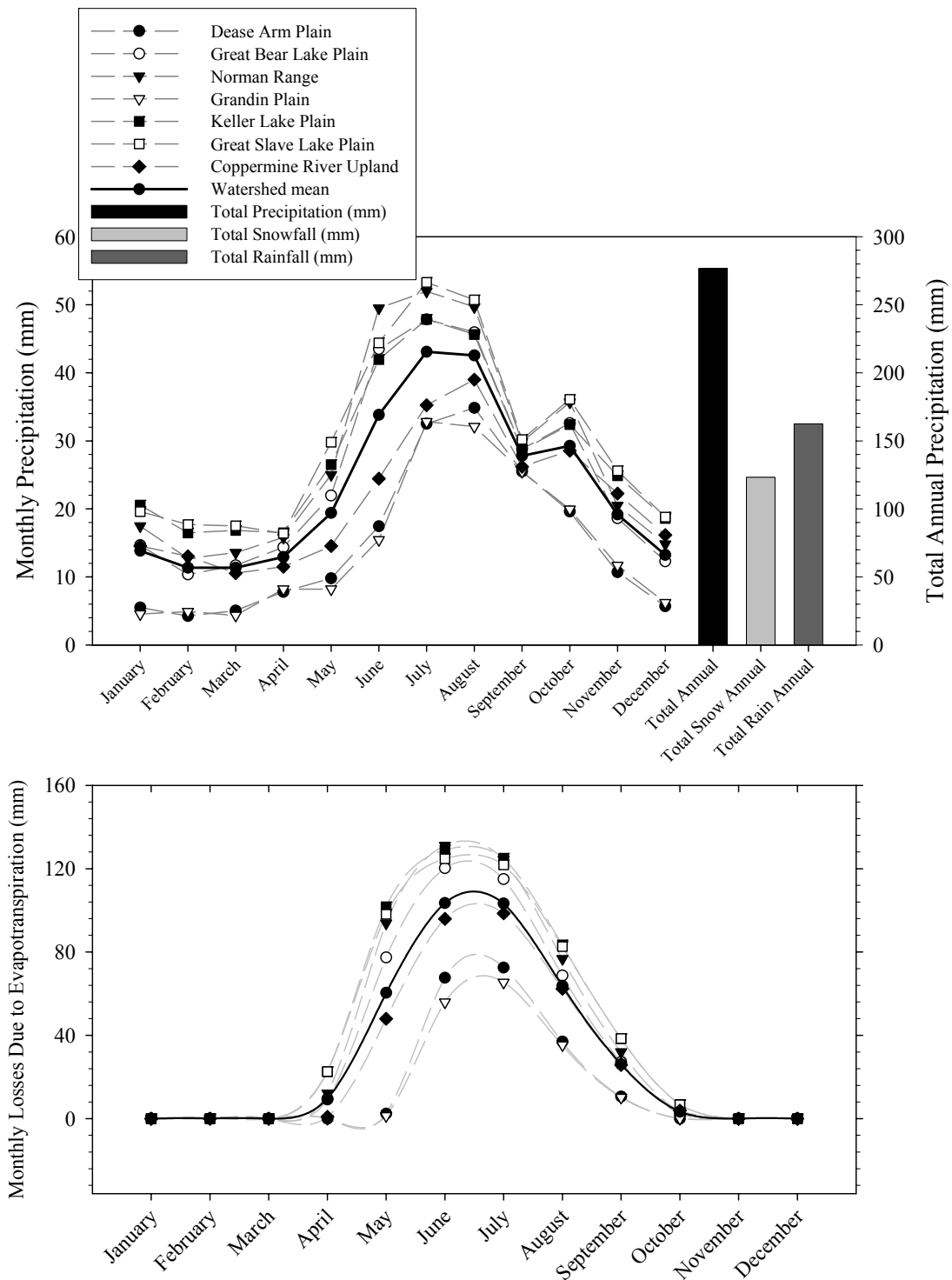


Figure 7 Monthly and annual precipitation and evapotranspiration in the Great Bear Lake watershed ecoregions. The same symbols are used for each ecoregion in both graphs.

It is calculated from losses due to evaporation from soils to the air and the water vapour that is respired by plants after it is taken up from the soil. The numerical values are estimated using several methods; the values here have been estimated using the Penman method.

Evapotranspiration ranges from zero during the winter months across the watershed to over 120 mm in the western and southern ecoregions during June and July (Figure 7). The ecoregions surrounding the Dease Arm have much lower rates of evapotranspiration, and reach a maximum of only 40 to 50 mm of moisture per month. The annual weighted average for the watershed is 389 mm of moisture.

3.4.7 Water Balance (Precipitation Surplus/Deficit)

Moisture balance, which is the difference between precipitation and evapotranspiration, varies considerably over the watershed and reaches a maximum during the summer months when sunlight, temperature, wind speed and plant growth are at their maximum levels. The highest rates of water loss are in the Keller Lake Plain and the Norman Range, which have higher elevation than the ecoregions adjacent to the lake. On an annual basis, Grandin Plain is the only region expected to have a slight water surplus. Precipitation is low in this area, however losses due to evapotranspiration are also expected to be low. On average, the area-weighted balance for the watershed indicates generally drying conditions, with a water deficit of 96 mm of moisture annually (Figure 8).

3.4.8 Degree Growing Days

Temperature data are used to estimate the length of the growing season for each ecodistrict, and the number of days that air temperatures remain above 0, 5, 10 and 15 °C. The growing season is calculated as the number of days that air temperatures are predicted to remain above 5 °C. The data are used to provide an estimate of the number of days for plant growth, either agricultural crops or forests. Another variable, termed the effective growing degree-days (EGDD), is calculated from the number of days above 5 °C adjusted for the growing season and day length (Figure 9). The longer days in the north tend to provide high values of EGDD because of the long hours of daily sunlight during the summer.

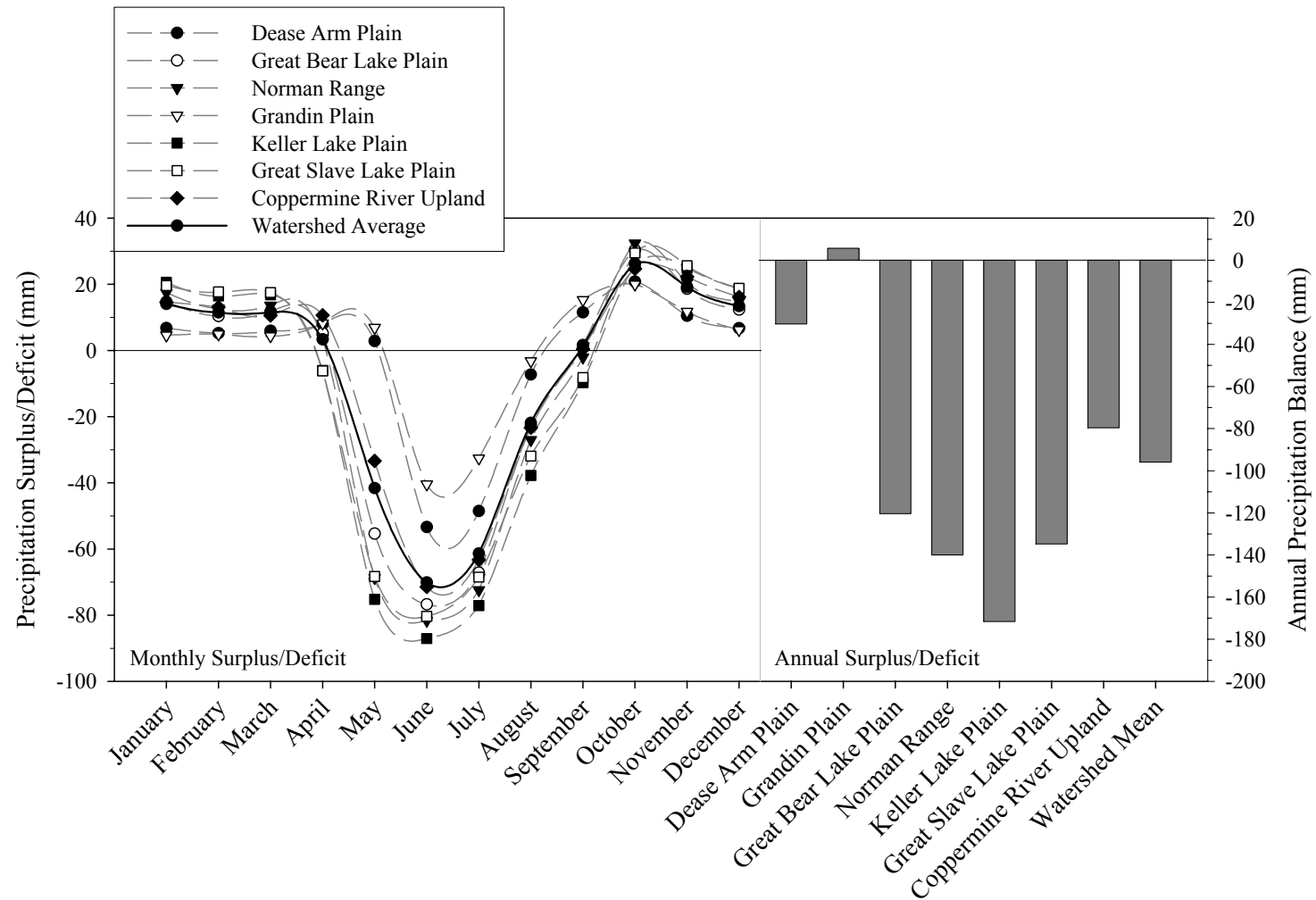


Figure 8 Precipitation surplus/deficit for the individual ecoregions of the Great Bear lake watershed. Values are calculated as the difference between precipitation and evapotranspiration (Figure 7).

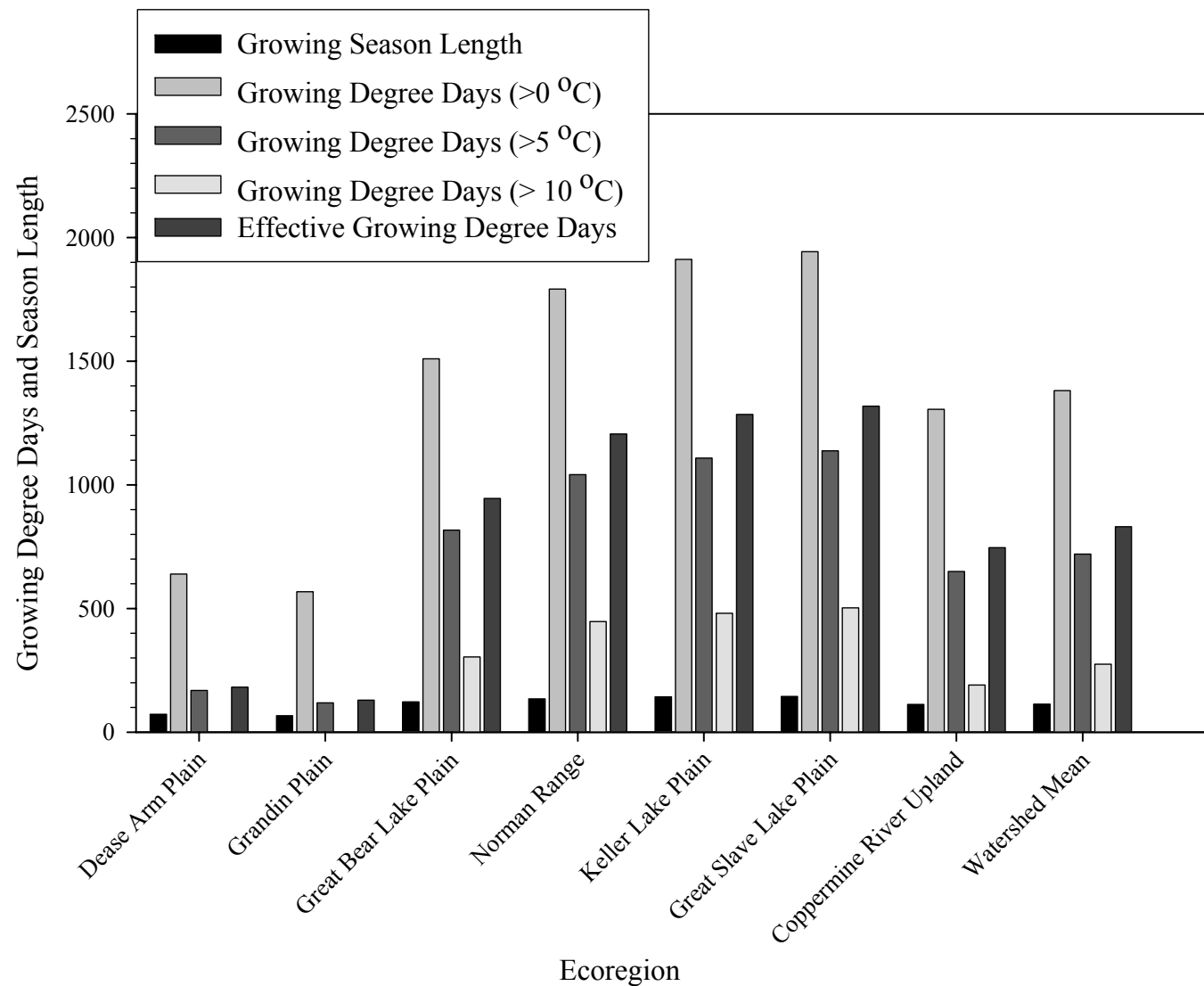


Figure 9 Growing season length (days with air temperature >5 °C) and effective growing degree days, which are calculated from the growing season and day length.

4.0 Biological Community

The diverse ecoregions of the Great Bear Lake watershed provide habitat for a wide range of plant and animal species. The varied terrestrial habitats and the presence of large and small inland lakes and rivers supply an environment typical of northern boreal forests and taiga plains, with little pressure due to the loss of habitat at this time. Although harvest statistics indicate that hunters and trappers in the Sahtu probably harvest about 20 large and small mammal species and 30 bird species annually (see below), this probably represents a fraction of the total number of species present in the watershed. Similarly, plants used for foods and medicines also probably represent a small fraction of the plant species present. Clearly, the numbers and status of the plants and animals are of major importance to the people of Déline, but maintaining the health and integrity of all species in the watershed is vital to sustaining its biodiversity. Focus groups in Déline in 2003 reiterated the importance of caribou to the community and the need to continually monitor harvesting and the health of the caribou herds. However, several individuals noted changes in the numbers and types of other species present on a day to day basis and recognized the need to monitor the health of all species.

4.1. Harvest Statistics

Bird and mammal harvests are monitored in the Sahtu under a requirement in the Sahtu Dene/Métis Comprehensive Land Claims Agreement to establish the minimum rates of harvest required by the Dene and Métis over a period of five years. Reports of the numbers and species of birds and mammals harvested in each of the Sahtu communities are collected by local community interviewers and compiled by the Sahtu Renewable Resources Board. The statistics provide important information on the species present in the watershed and also some data on the trends of populations of those species through time.

4.1.1 Large Mammals

In total, the residents of Déline reported the harvest of 1470 caribou in 2000, 1602 in 2001 and 1153 in 2002, clearly the most hunted species for those years (Figure 10). Adult and juvenile female caribou comprised over 95% of the caribou harvested, followed by adult and juvenile males. Thirty-two woodland caribou were reported harvested in 1999 however this value dropped to only 1 individual in 2002. Sixteen moose were also harvested in 1999 and 12, all females, in 2002.

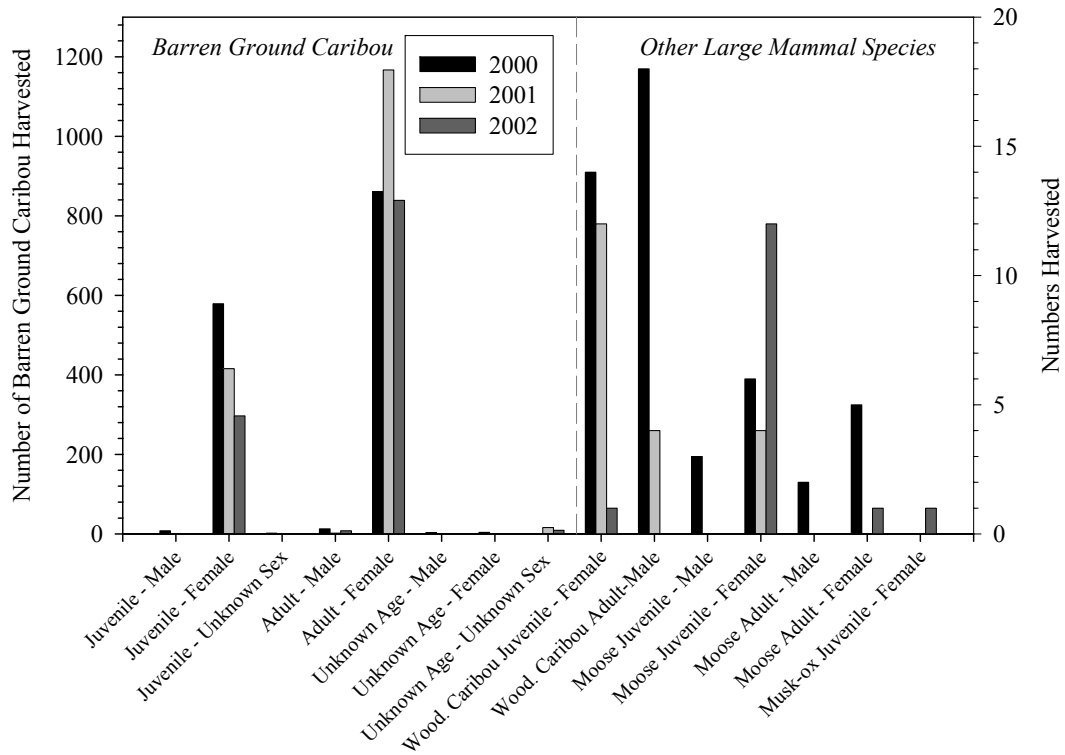


Figure 10 Numbers of caribou and other large mammals harvested by the residents of Déline from 2000 to 2002. Data are from the Sahtu Renewable Resources Board.

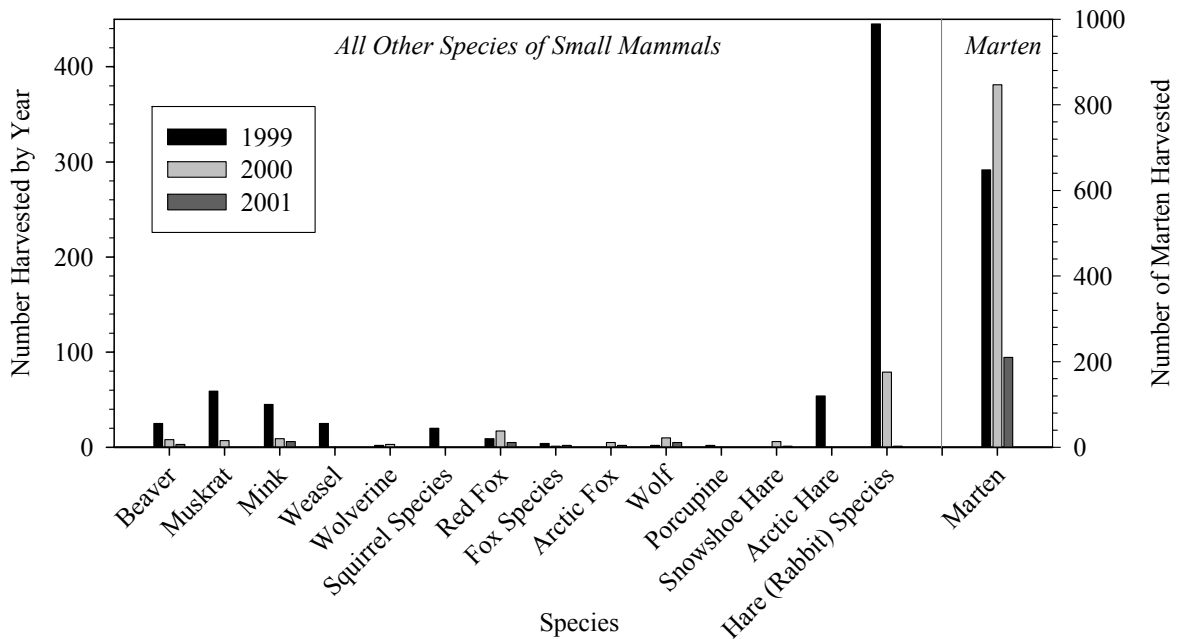


Figure 11 Number of small mammals harvested by the community of Déline from 1999 to 2001.

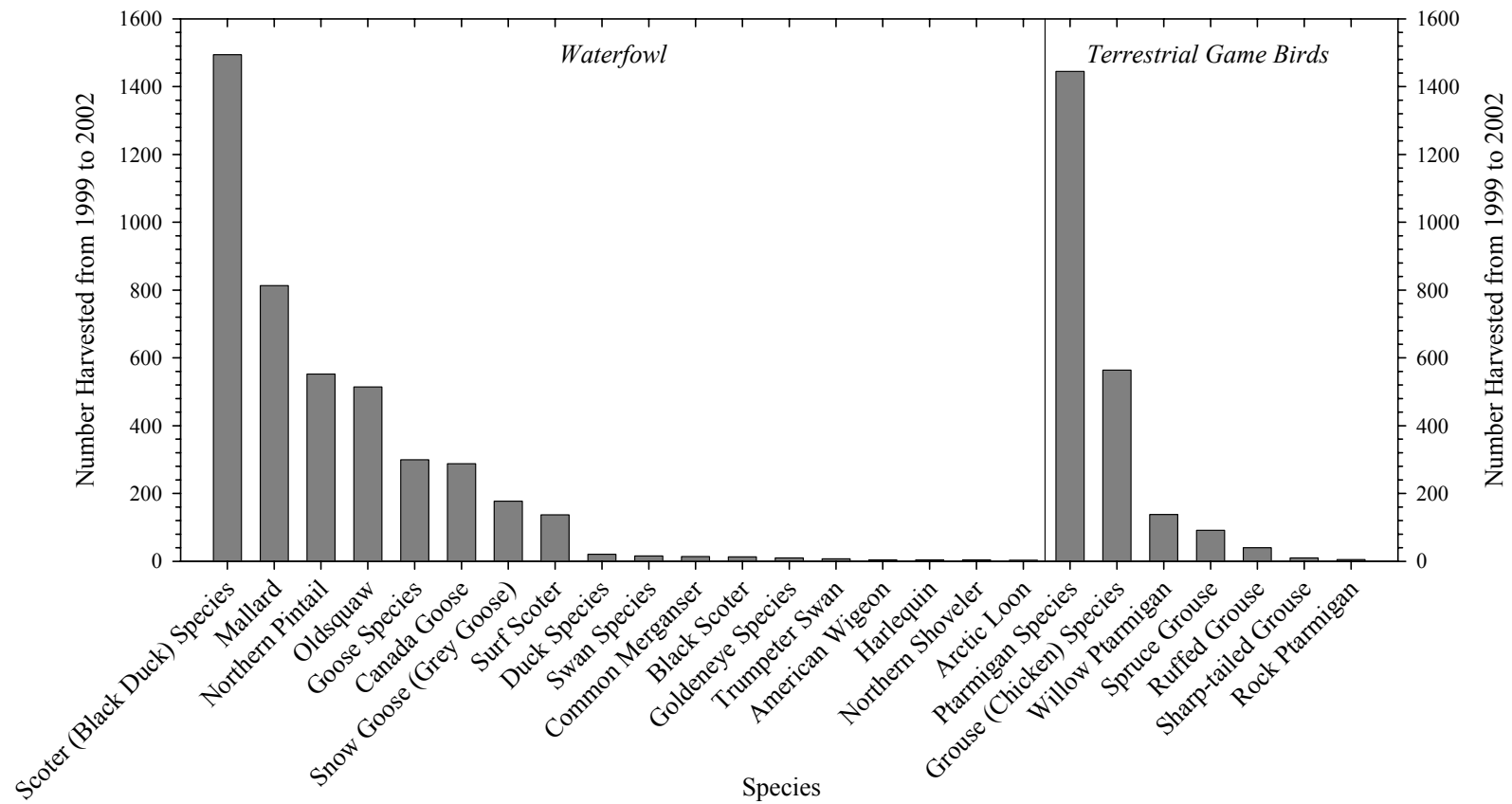


Figure 12 – Number of waterfowl and terrestrial game birds harvested by Déline residents from 1999 to 2002.

4.1.2 *Small Mammals*

Small mammals are primarily trapped for fur, however some individuals may also eat some species, particularly hare, as part of a traditional diet (Figure 11). The most individuals of any species harvested were marten, for which 847 were reported in 2000. A total of 445 hare were reported harvested in 1999, the second highest species. This value dropped markedly to a single individual in 2001, possibly due to natural fluctuations in the population, or changes in the reporting of the results. In total 15 species are reported to have been harvested, although the numbers taken are very small for some species.

4.1.3 *Birds*

Over thirty species of waterfowl and terrestrial game birds were reported to have been harvested between 1999 and 2002, giving a total of 6,670 individual birds (Figure 12). Most of these were either ptarmigan (not identified to species) or scoter (black duck). Other major species included grouse or chicken, mallard, pintail, long-tailed duck or oldsquaw, and geese. Almost an equal number of waterfowl and terrestrial species were harvested between 1999 and 2002.

4.2. The Status of Birds and Mammals

4.2.1 *Mammals*

4.2.1.1 Barren-ground Caribou

Major reviews of caribou numbers and distributions have been published (Kelsall 1968) and have reported some of the large fluctuations in numbers that some of the caribou herds are known to have undergone in the past. The Great Bear Lake watershed provides habitat for three major herds of barren-ground caribou, the Bathurst herd to the southeast, the Bluenose-east herd which overwinters to the southwest of Great Bear Lake and the Bluenose-west, which overwinters to the north of Great Bear Lake. All three of these herds have gone through major fluctuations in numbers in the past (Banfield 1954) although early assessments used different criteria for individual herds and may not be directly comparable.

The Bathurst herd, the largest in the NWT, covers the area between Great Slave Lake and Great Bear Lake. Recent estimates by RWED indicate about 180,000 individuals in the herd, sharply down from 350,000 in the early 1990's (Case *et al.* 1996) and 350,000 to 450,000 suggested by Williams and Heard (1986) during the mid-1980s. During the 1990s, both the Bathurst herd and its range were considered to be in good condition, with the major stresses being hunting, natural predation by wolves and insect harassment. Annual harvest during the 1990's was estimated to be about 15,000 per year, although the herd could possibly withstand a total allowable harvest of

23,000 (Case *et al.* 1996). The new population estimate from 2003 will probably affect estimates of total allowable hunting.

The Bluenose herd, which remains primarily north of Great Bear Lake and calves near Bluenose Lake, has recently been subdivided into smaller herds on the basis of genetics and the presence of several separate calving areas. Early estimates for the size of the herd ranged from 5,000 to 92,000 however most of the data are considered to be unreliable (Latour and Heard 1985). Surveys during the 1980s, indicate 38,000 individuals over 1 year for the whole herd (Latour and Heard 1985), which is lower than the value of 50,000 to 80,000 reported by Williams and Heard (1986). A survey in 2000, placed the minimum size of the Bluenose-east herd at 104,000 (95% CI 84,412 – 126,100), considerably larger than previous estimates (Patterson *et al.* 2004). The authors suggested that close monitoring of the health of the Bluenose-east herd is needed because of the possibility that the herd may be too large for the size of the range and may decline due to food shortage. The new population estimate places the total harvest of about 5000 /year from the Bluenose-east herd at a reasonable, sustainable level.

4.2.1.2 Muskox

Historically, muskox were distributed across the tundra of northern Canada, however because of commercial hunting they were reduced to several hundred individuals by the turn of the 20th century. Protective legislation allowed them to increase to approximately 14,000 by 1960 (Barr 1991) and 139,000 by 1999 (Fournier and Gunn 1998). After being virtually extinct north of Great Bear Lake during much of the last century, Kelsall *et al.* (1971) reported a population of about 425 north of the Lake, followed by an estimate of about 3,000 individuals by McLean (1992) in a 1987 survey. A survey in 1997 (Veitch 1997) placed the number of muskox at 1460 non-calf individuals north and northeast of Great Bear Lake in the Sahtu Settlement Region. The range of the muskox in the Sahtu also appears to be expanding.

4.2.1.3 All Other Mammals

RWED has assessed the status of plant, bird and mammal species found in the NWT and provided a summary for the majority of species (RWED 2000). The status of the species are determined by the numbers of individuals, the number of areas in which they are found (i.e. the distribution), the trends of the population and the distribution (shrinking or expanding) and the extent of threats to the population and habitat. The assessment also provides an evaluation of the status of each species in the NWT, which could be different than its status on a national level. Although the Great Bear Lake watershed, or the Sahtu, are not specifically considered, searches can be conducted by ecozone. As such, the database provides a reasonable overview of the

relative numbers of plants, mammals, birds, and other organisms and the relative health of the species that could be in the watershed.

The database lists 54 animal species that are known to be in the Taiga Plains ecozone and could potentially be in the Great Bear Lake watershed (Table 2), although it is at the northern edge of the range of many species. Of these species, 37 species are considered to be secure, indicating that there is a large enough population and wide enough distribution that there is no immediate concern for the species. Six species are considered to be in the sensitive category due to small numbers or threats to the habitat (i.e. woodland caribou). The fisher is classified as “may be at risk” in the NWT because of small numbers and a restricted distribution.

4.2.2 Landbirds

Several papers have been published documenting the presence of bird species in the Great Bear Lake area from naturalists and ornithologists over the last 175 years. Swainson and Richardson (1831) reported on the results of the collections from John Franklin’s expeditions and described specimens and systematics for species of owls and thrushes. A paper by MacFarlane (1908) summarised the observations and collection of birds and eggs in the Northwest Territories between 1880 and 1894. The report described several bird species that had not been previously documented. Godfrey (1965) reported on the range extensions of several bird species further north in the Mackenzie Valley and along the Keith Arm of Great Bear Lake. Sirois (unpublished data) also provided a list of species present in the McTavish Arm over a week of surveys in August, 1994. A tentative list of species reported from areas around Great Bear Lake from various sources is shown in Table 3. These species lists and survey data provide valuable records on the presence of bird species in the Great Bear Lake area but do not provide information on the relative numbers of each species or the health of the populations.

There are apparently no surveying or monitoring programs of landbird species in the Great Bear Lake watershed, however there are several national and international programs from which general trends can be taken. Many of these programs have contributors in the Northwest Territories but there are no datasets from the Great Bear Lake watershed. Data from the Christmas Bird Counts and Breeding Bird Surveys, which include Yellowknife and Norman Wells provide some indications of the status of major bird species in the Northwest Territories.

The Audobon Society organizes an annual mid-winter count of bird species throughout North America that provides some data on the temporal trends of major species present in an area through the winter. To achieve the count, a group of individuals search and report all bird

Table 2 The status of mammals in the NWT that are found in either the Taiga Plains (ecozone 5) or Taiga Shield (ecozone 6) ecozones. Some species are at the northern edge of their range in the NWT and may not be present in the GBL watershed.

Common Name	Scientific name	Status in NWT	Ecozones ¹	Abundance ²		Trends ³		Threats ⁴	
				Pop. Size	Dist.	Pop.	Dist.	Pop.	Habitat
Barren land caribou	<i>Rangifer tarandus groenlandicus</i>	secure	1, 2, 3, 5, 6	D	B	C	C	C	C
Woodland caribou	<i>Rangifer tarandus caribou</i>	sensitive	3, 4, 5, 7, 8	D	C	B/C	B	B	B
Moose	<i>Alces alces</i>	secure	3, 4, 5, 6, 7, 8	D	3 pop.	C/D ⁵	C/D	C	C
Muskox	<i>Ovibos moschatus</i>	secure	1, 2, 3, 6	D	C	D	D	-	C
Wolverine	<i>Gulo gulo</i>	secure	1, 2, 3, 4, 5, 6, 7, 8	C	-	C	C	B/C	C
Lynx	<i>Lynx canadensis</i>	secure	3, 4, 5, 6, 7, 8	C/D	-	C	C	C	C
Marten	<i>Martes americana</i>	secure	3, 4, 5, 6, 7, 8	D	-	C	C	C	C
Ermine (stoat)	<i>Mustela erminea</i>	secure	1, 2, 3, 4, 5, 6, 7, 8	D	D	C	C	C	C
Mink	<i>Mustela vison</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	C	C	C
Grizzly bear	<i>Ursus arctos</i>	sensitive	2, 3, 4, 5, 6, 7, 8	C	D	C	C	B	B
Black bear	<i>Ursus americanus</i>	secure	4, 5, 6, 7, 8	C	D	-	C	C	C
Red fox	<i>Vulpes vulpes</i>	secure	1, 2, 3, 4, 5, 6, 7, 8	D	D	C	C	C	D
Arctic Fox	<i>Alopex lagopus</i>	secure	1, 2, 3, 5, 6	D	D	C	C	C	D
Gray wolf	<i>Canis lupus occidentalis</i>	secure	1, 2, 3, 4, 5, 6, 7, 8	C	D	C	C	C	C
Coyote	<i>Canis latrans</i>	undetermined	4, 5, 6, 7, 8	-	B/C	D	D	-	C
Mountain lion	<i>Felis concolor</i>	undetermined	5, 6, 7, 8	A	A/B	-	D	C	C
Striped skunk	<i>Mephitis mephitis</i>	secure	5, 6, 7, 8	A/B	B	C	C	D	D
Least weasel	<i>Mustela nivalis</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	-	-	-
River otter	<i>Lutra canadensis</i>	sensitive	3, 4, 5, 6, 7, 8	A/B	D	-	-	C	C
Fisher	<i>Martes pennanti</i>	may be at risk	5, 6, 7, 8	A/B	A/B	-	B	-	-
Masked shrew	<i>Sorex cinereus</i>	secure	2, 3, 4, 5, 6, 7, 8	C	D	C	C	D	D
Pigmy Shrew	<i>Sorex hoyi</i>	secure	4, 5, 6, 7, 8	C	D	C	C	D	D
Little Brown Bat	<i>Myotis lucifugus</i>	sensitive	4, 5, 6, 7, 8	A/B	B	C	C	C	D
Hoary bat	<i>Lasiurus cinereus</i>	undetermined	5, 6, 8	-	A	-	-	-	-
Northern myotis	<i>Myotis septentrionalis</i>	undetermined	4, 5, 8	A	A	-	-	-	D
Arctic Shrew	<i>Sorex arcticus</i>	secure	3, 4, 5, 6, 7, 8	C	D	C	C	D	D
Dusky shrew	<i>Sorex monticolus</i>	secure	3, 4, 5, 7, 8	C	C	C	C	D	D

Table 2 (cont'd) The status of mammals in the NWT that are found in either the Taiga Plains (ecozone 5) or Taiga Shield (ecozone 6) ecozones.

Common Name	Scientific name	Status in NWT	Ecozones	Abundance		Trend		Threats	
				Pop. Size	Dist.	Pop.	Dist.	Pop.	Habitat
Water shrew	<i>Sorex palustris</i>	secure	4, 5, 6, 7, 8	C	C	C	C	D	D
Tundra shrew	<i>Sorex tundrensis</i>	undetermined	3,4,5	-	B	-	-	-	-
Snowshoe hare	<i>Lepus americanus</i>	undetermined	3, 4, 5, 6, 7, 8	D	D	C	C	D	D
Arctic hare	<i>Lepus arcticus</i>	secure	1, 2, 3, 5, 6	D	C/D	C	C	D	D
Collared pika	<i>Ochotona collaria</i>	sensitive	4, 5, 7	B/C	B/C	C	C	D	D
Beaver	<i>Castor canadensis</i>	secure	3, 4, 5, 6, 7, 8	D	D	C/D	C	D	C
Southern red-backed vole	<i>Clethrionomys gapperi</i>	secure	5, 6, 8	D	C/D	C	C	B/C	B/C
Northern red-backed vole	<i>Clethrionomys rutilus</i>	Secure	2, 3, 4, 5, 6, 7	D	D	C	C	D	D
Tundra vole	<i>Microtus oeconomus</i>	secure	3, 4, 5, 6	D	C	C	C	-	-
Chestnut-cheeked vole	<i>Microtus xanthognathus</i>	secure	3, 4, 5, 6, 8	D	C/D	C	C	B/C	B/C
(Eastern) heather vole	<i>Phenacomys intermedius</i>	secure	4, 5, 6, 7, 8	C	C	C	C	-	-
Northern bog lemming	<i>Synaptomys borealis</i>	secure	4, 5, 6, 7, 8	C	C/D	C	C	-	-
Northern flying squirrel	<i>Glaucomys sabrinus</i>	sensitive	4, 5, 6, 7, 8	B	C	C	C	C	C
Singing vole	<i>Microtus miurus</i>	undetermined	4, 5	-	B	-	-	-	-
Meadow jumping mouse	<i>Zapus hudsonius</i>	undetermined	5, 6, 7, 8	-	C	C	-	-	-
Peary land collared lemming	<i>Dicrostonyx groenlandicus</i>	undetermined	1, 2, 3, 5, 6	-	B	C	C	-	-
Richardson's lemming	<i>Dicrostonyx richardsoni</i>	undetermined	1, 2, 3, 5, 6	-	B	C	C	-	-
Victoria collared lemming	<i>Dicrostonyx kilangmiutak</i>	secure	2, 3, 5, 6	D	C	C	C	D	D
Porcupine	<i>Erethizon dorsatum</i>	secure	3, 4, 5, 6, 7, 8	C/D	D	-	C	C	C/D
Brown lemming	<i>Lemmus sibiricus</i>	secure	1, 2, 3, 4, 5, 6	D	D	C	C	D	D
Woodchuck	<i>Marmota monax</i>	secure	5, 6, 7, 8	C/D	B	C	C	D	D
Meadow vole	<i>Microtus pennsylvanicus</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	C	D	D
Muskrat	<i>Ondatra zibethicus</i>	secure	3, 4, 5, 6, 7, 8	D	D	B/C	C	C	C
Deer mouse	<i>Peromyscus maniculatus</i>	secure	4, 5, 6, 7, 8	D	D	D	C	D	D
Arctic ground squirrel	<i>Spermophilus parryi</i>	secure	2, 3, 4, 5, 6, 7	C/D	C/D	C	C	D	D
Red squirrel	<i>Tamiasciurus hudsonicus</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	C	C	C
Least chipmunk	<i>Eutamias (Tamias) minimus</i>	secure	4, 5, 6, 7, 8	C/D	B/C	C	C	D	D

Legend for Table 2¹Ecozones

1 - Arctic Cordillera; 2 – Northern Arctic; 3 – Southern Arctic; 4 – Taiga Cordillera; 5 – Taiga Plains; 6 – Taiga Shield;
7 – Boreal Cordillera; 8 – Boreal Plains

²Abundance

Population size in NWT; A = scarce (<1000 in NWT); B = less scarce; C = more common; D = common.

Distribution in the NWT: A = very few areas (<5% of NWT); B = few areas (5-15%); C = more areas; D = widely distributed.

³Trends

Abundance - A, B, C, D – increasing numbers of individuals to a maximum of D for a large number of individuals.

Distribution – A, B, C, D – increasing from declining number of areas (A) to a maximum of D for stable or increasing distribution.

⁴Threats

Population - A, B, C, D – decreasing level of threats to the population from significant threats (A) to a minimum of D.

Habitat – A, B, C, D - decreasing level of threats to the habitat from significant threats (A) to a minimum of D.

⁵ – moose population in the Sahtu appears to be increasing.

Table 3 List of bird species reported by Robinson (unpubl. data) in Déline from July 1963 to July 1966 and Sirois (unpubl. data). Species were reported by Robinson as common names, which have been updated from the American Ornithological Union (AOU) (www.aou.org). Scientific names are from the AOU and Godfrey (1986).

Common Name	Scientific Name	Common Name	Scientific Name
Common loon*	<i>Gavia immer</i>	Willow ptarmigan*	<i>Lagopus lagopus</i>
Yellow-billed loon	<i>Gavia adamsii</i>	Ruffed grouse	<i>Bonasa umbellus</i>
Arctic loon	<i>Gavia arctica</i>	Sharp-tailed grouse	<i>Tympanuchus phasianellus</i>
Red-throated loon*	<i>Gavia stellata</i>	Sandhill crane	<i>Grus canadensis</i>
Red-necked grebe	<i>Podiceps grisegena</i>	Semipalmated plover	<i>Charadrius semipalmatus</i>
Horned grebe	<i>Podiceps auritus</i>	Killdeer	<i>Charadrius vociferus</i>
Whistling swan (Tundra swan)	<i>Cygnus columbianus</i>	American golden plover	<i>Pluvialis apricaria</i>
Canada goose	<i>Branta canadensis</i>	Black-bellied plover	<i>Pluvialis squatarola</i>
Mallard	<i>Anas platyrhynchos</i>	Ruddy turnstone	<i>Arenaria interpres</i>
Pintail	<i>Anas acuta</i>	Common snipe	<i>Gallinago gallinago</i>
Green-winged teal	<i>Anas crecca</i>	Lesser yellowlegs*	<i>Tringa flavipes</i>
Shoveler	<i>Anas clypeata</i>	Least sandpiper	<i>Calidris minutilla</i>
Greater scaup	<i>Aythya marila</i>	Dowitcher	<i>Limnodromus</i> sp.
Common goldeneye	<i>Bucephala clangula</i>	Semipalmated sandpiper*	<i>Calidris pusilla</i>
Bufflehead	<i>Bucephala albeola</i>	Northern phalarope (Red-necked phalarope)	<i>Phalaropus lobatus</i>
Oldsquaw*	<i>Canard kakawi</i>	Parasitic jaeger	<i>Stercorarius parasiticus</i>
Harlequin duck*	<i>Histrionicus histrionicus</i>	Long-tailed jaeger	<i>Stercorarius longicaudus</i>
White-winged scoter*	<i>Melanitta fusca</i>	Glaucous gull	<i>Larus hyperboreus</i>
Surf scoter*	<i>Melanitta perspicillata</i>	California gull	<i>Larus californicus</i>
Common merganser	<i>Mergus merganser</i>	Mew gull*	<i>Larus canus</i>
Red-breasted merganser*	<i>Mergus serrator</i>	Bonaparte's gull	<i>Larus philadelphia</i>
Goshawk	<i>Accipiter gentilis</i>	Sabine's gull	<i>Xema sabini</i>
Sharp-shinned hawk*	<i>Accipiter striatus</i>	Common tern	<i>Sterna hirundo</i>
Rough-legged hawk	<i>Buteo lagopus</i>	Arctic tern	<i>Sterna paradisaea</i>
Marsh hawk	<i>Circus cyaneus</i>	Hawk owl	<i>Surnia ulula</i>
Osprey	<i>Pandion haliaetus</i>	Short-eared owl	<i>Asio flammeus</i>
Peregrine falcon*	<i>Falco peregrinus</i>	Common nighthawk	<i>Chordeiles minor</i>
Pigeon hawk (merlin)*	<i>Falco columbarius</i>	Yellow-shafted flicker (northern flicker)	<i>Colaptes auratus</i>
Sparrow hawk (American kestrel)*	<i>Falco sparverius</i>	Black-backed woodpecker	<i>Picoides arcticus</i>

Table 3 (cont'd) List of bird species reported by Robinson (1966) in Déline from July 1963 to July 1966 and Sirois (unpubl. data).

Common Name	Scientific Name	Common Name	Scientific Name
Eastern phoebe	<i>Sayornis phoebe</i>	American tree sparrow	<i>Spizella arborea</i>
Say's phoebe	<i>Sayornis saya</i>	Clay-coloured sparrow	<i>Spizella pallida</i>
Horned lark	<i>Eremophila alpestris</i>	Harris's sparrow	<i>Zonotrichia querula</i>
Tree swallow	<i>Tachycineta bicolor</i>	White-crowned sparrow*	<i>Zonotrichia leucophrys</i>
Barn swallow	<i>Hirundo rustica</i>	White-throated sparrow	<i>Zonotrichia albicollis</i>
Gray jay*	<i>Perisoreus canadensis</i>	Fox sparrow	<i>Passerella iliaca</i>
Common raven*	<i>Corvus corax</i>	Lincoln's sparrow	<i>Melospiza lincolnii</i>
Common crow	<i>Corvus brachyrhynchos</i>	Lapland longspur	<i>Calcarius lapponicus</i>
Black-capped chickadee	<i>Poecile atricapillus</i>	Snow bunting	<i>Plectrophenax nivalis</i>
Boreal chickadee	<i>Poecile hudsonica</i>	American widgeon	<i>Anas americana</i>
American robin*	<i>Turdus migratorius</i>	Sora ¹	<i>Porzana carolina</i>
Ruby-crowned kinglet	<i>Regulus calendula</i>	Yellow-bellied flycatcher ¹	<i>Empidonax flaviventris</i>
Water pipit (American pipit)*	<i>Anthus rubescens</i>	Red-eyed vireo ¹	<i>Vireo olivaceus</i>
Bohemian waxwing	<i>Bombycilla garrulus</i>	Warbling vireo ¹	<i>Vireo gilvus</i>
Northern shrike	<i>Lanius excubitor</i>	Black-and-white warbler ¹	<i>Mniotilta varia</i>
Tennessee warbler	<i>Vermivora peregrina</i>	Magnolia warbler ¹	<i>Dendroica magnolia</i>
Yellow warbler*	<i>Dendroica petechia</i>	Palm warbler ¹	<i>Dendroica palmarum</i>
Myrtle warbler	<i>Dendroica coronata</i>	Red-winged blackbird ¹	<i>Agelaius phoeniceus</i>
Blackpoll warbler*	<i>Dendroica striata</i>	Swamp sparrow ²	<i>Melospiza georgiana</i>
Western meadowlark	<i>Sturnella neglecta</i>	Pacific loon*	<i>Gavia pacifica</i>
Rusty blackbird	<i>Euphagus carolinus</i>	Herring gull*	<i>Larus argentatus</i>
Pine grosbeak	<i>Pinicola enucleator</i>	Spotted sandpiper*	<i>Actitis macularia</i>
Common redpoll*	<i>Carduelis flammea</i>	Bald eagle*	<i>Haliaeetus leucocephalus</i>
White-winged crossbill	<i>Loxia leucoptera</i>	Chipping sparrow*	<i>Spizella passerina</i>
Savannah sparrow*	<i>Passerculus sandwichensis</i>	Yellow-rump warbler*	<i>Dendroica coronata</i>
Slate-coloured junco (Dark-eyed junco)	<i>Junco hyemalis</i>	Orange-crowned warbler*	<i>Vermivora celata</i>

Notes

* - species reported by Jacques Sirois on the McTavish Arm of Great Bear Lake in August 1994.

¹ – presence of species in the Great Bear Lake area based on reports of the species in Tulita (Fort Norman) area by Godfrey (1965).

² – species observed on the north shore of the Keith Arm of Great Bear Lake by Godfrey.

species observed over several hours on a single day, usually around Christmas. Continuity of the people involved and the timing of the count annually allow some measure of the relative numbers of species present at that time of year. The closest chapter of the Christmas Bird Count is in Norman Wells, from which data are available for 2001 to 2003 from the Audubon Society (www.audubon.org/bird/cbc/) (Table 4).

Data are also available from the Canadian Wildlife Service's Breeding Bird Survey (www.cws-scf.ec.gc.ca/nwrc-cnrf/migb/01_1_2_e.cfm) which provides data every year on the numbers of breeding birds in specific areas, or plots. The survey uses annual observations from plots from the same area to determine long-term trends of breeding birds. Data from the Breeding Bird Survey for three landbird species found in the GBL watershed are shown in Figure 13. Of the three, the raven population appears to be increasing significantly over the last thirty years, while the ruffed grouse has declined and the number of gray jay has remained constant.

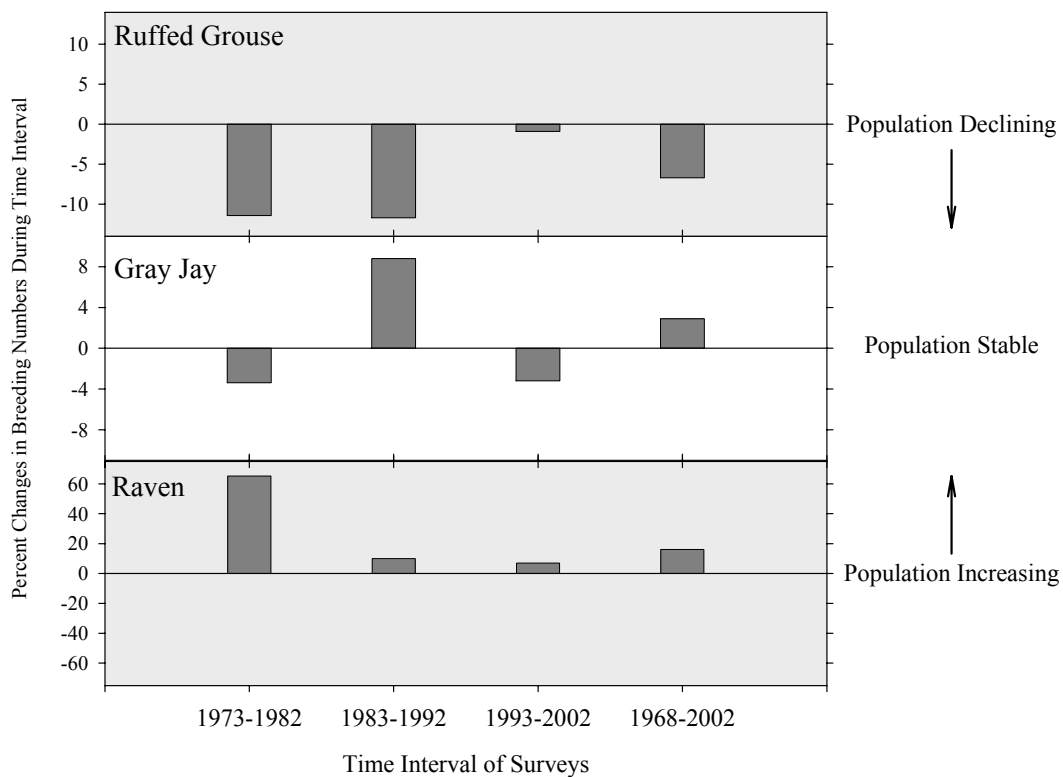


Figure 13 Population trends of three species reported in the Breeding Bird Survey. The trends are for Bird Conservation Region 6, which is equivalent to the Taiga Plains ecozone. Population within the GBL watershed may show slightly different trends.

Table 4 Bird species reported in Norman Wells during the Christmas Bird Count from 2001 to 2003. Data are from the Audobon Society, based on reports from a group of observers in Norman Wells.

Common Name	Scientific Name	Numbers Observed		
		2001	2002	2003
Mallard	<i>Anas platyrhynchos</i>	0	3	0
Red-tailed Hawk	<i>Buteo jamaicensis</i>	0	0	1
Sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	1	5	8
Willow ptarmigan	<i>Lagopus lagopus</i>	18	18	11
Northern hawk owl	<i>Surnia ulula</i>	1	1	0
Downy woodpecker	<i>Picoides pubescens</i>	0	0	1
Hairy woodpecker	<i>Picoides villosus</i>	1	2	1
Three-toed woodpecker	<i>Picoides dorsalis</i>	0	0	1
Black-backed woodpecker	<i>Picoides arcticus</i>	0	0	1
Gray jay	<i>Perisoreus canadensis</i>	8	7	9
Black-billed magpie	<i>Pica hudsonia</i>	0	1	0
Common raven	<i>Corvus corax</i>	159	170	192
Black-capped chickadee	<i>Poecile atricapillus</i>	2	2	2
Boreal chickadee	<i>Poecile hudsonica</i>	1	9	6
American dipper	<i>Cinclus mexicanus</i>	0	0	1
Slate-coloured (dark-eyed) junco	<i>Junco hyemalis</i>	0	5	2
Pine grosbeak	<i>Pinicola enucleator</i>	0	1	2
White-winged crossbill	<i>Loxia leucoptera</i>	0	4	0
Common redpoll	<i>Carduelis flammea</i>	0	34	10
Hoary redpoll	<i>Carduelis hornemanni</i>	0	23	6
Woodpecker sp.		1	0	2
Redpoll sp.		2	0	6

An analysis of the Breeding Bird Surveys and assessment of the status of bird species in the boreal forest, including the Taiga Plains and Taiga Shield ecozones, was conducted by Bird Studies Canada in 2002 (Blancher 2002). The report assessed data from several sources to evaluate the importance of the boreal forest to landbirds and to evaluate the current status of the individual species. The report includes data from the Boreal Taiga Plains, or Bird Conservation Region Number 6, which includes southwestern section of the Great Bear Lake watershed. The closest long-term site for the Breeding Bird Survey is in Norman Wells. This means that there is a large area within the Great Bear Lake watershed for which no data are available as to the status of many of the land birds. The report indicates that of the 93 landbird species identified in the breeding bird surveys in the boreal forest between 1969 and 2000, there are about 15 species that are declining and 7 species that are increasing while the rest are remaining stable.

RWED provides an assessment of bird species (Table 5) in the same manner as that outlined for mammals in Section 4.2.1.3. The data base uses information from several national programs to determine a ranking for the species found in the NWT. Some species are at the northern edge of their natural range and are expected to be scarce. Of the 190 bird species reported to be in the Taiga Plains and Taiga Shield ecozones, 101 species are considered to be secure, meaning that they are common, widely distributed and there are no immediate threats to the populations. Thirty species are considered to be sensitive, because of smaller numbers or habitat threats. Some species are also considered to be sensitive if the national population has been showing declines and the NWT population also looks vulnerable. The Eskimo curlew and the anatum form of the peregrine falcon were considered to be “at risk” while the tundra form of the peregrine falcon was listed as “may be at risk”. Fifty-three species, or 28% of the total number, were listed as undetermined because data were not available. This assessment provides a good resource for determining the number of species that may be present in the Great Bear Lake watershed and species that may require special protection if found in the watershed.

4.2.3 Waterfowl

A major source of information on the status of waterfowl species in Great Bear Lake is the Breeding Population and Habitat Survey, which is a joint activity of the Canadian Wildlife Service and the U.S. Fish and Wildlife Service. The survey uses information collected from surveys conducted during the breeding season to identify major trends for many species of waterfowl. For example the 2002 report contains data from two strata that include the Great Bear Lake watershed obtained from June 11 – 13, 2002. The data are combined with previous years to provide estimates of the numbers of breeding adults, the status of the habitat and trends of the

Table 5 The status of bird species in the NWT found in either the Taiga Plains (ecozone 5) or Taiga Shield (ecozone 6). Data are from RWED (2000).

Common Name	Scientific name	Status in NWT	Ecozones	Abundance		Trend		Threats	
				Pop. Size	Dist.	Pop.	Dist.	Pop .	Habitat
American widgeon	<i>Anas americana</i>	secure	4, 5, 6, 7, 8	D	D	D	C	C	C
Northern shoveler	<i>Anas clypeata</i>	secure	4, 5, 6, 7, 8	D	C	D	C	C	C
Green-winged teal	<i>Anas crecca</i>	secure	3, 4, 5, 6, 7, 8	D	D	D	-	C	C
Blue-winged teal	<i>Anas discors</i>	secure	4, 5, 6, 7, 8	D	C	D	C	C	C
Mallard	<i>Anas platyrhynchos</i>	secure	3, 4, 5, 6, 7, 8	D	D	D	C	C	C
Greater White-fronted Goose	<i>Anser albifrons</i>	secure	2, 3, 5, 6	D	C	C	C	C	C
Ringed-neck duck	<i>Aythya collaris</i>	secure	4, 5, 6, 8	D	C	D	C	C	C
Canvasback	<i>Aythya valisineria</i>	secure	4, 5, 6, 7, 8	D	D	C	C	C	C
Canada goose	<i>Branta canadensis</i>	secure	2, 3, 4, 5, 6, 7, 8	D	D	D	C	C	C
Bufflehead	<i>Bucephala albeola</i>	secure	4, 5, 6, 7, 8	D	C	C	C	C	C
Common goldeneye	<i>Bucephala clangula</i>	secure	4, 5, 6, 7, 8	D	D	C	C	C	C
Barrow's goldeneye	<i>Bucephala islandica</i>	secure	4, 5, 7	B	C	C	C	C	C
Common merganser	<i>Mergus merganser</i>	secure	4, 5, 6, 7, 8	C	D	C	C	C	C
Red-breasted merganser	<i>Mergus serrator</i>	secure	1, 2, 3, 4, 5, 6, 7, 8	C	D	C	C	C	C
Ruddy duck	<i>Oxyura jamaicensis</i>	secure	5, 6, 8	C	B	-	-	C	C
Redhead	<i>Aythya americana</i>	secure	5, 8	B	A	C	C	C	C
Greater scaup	<i>Aythya marila</i>	secure	3, 4, 5, 6	D	D	C	C	C	C
Northern pintail	<i>Anas acuta</i>	sensitive	2, 3, 4, 5, 6, 7, 8	D	D	B/C	C	C	C
Lesser scaup	<i>Aythya affinis</i>	sensitive	4, 5, 6, 7, 8	D	C	B/C	C	C	C
Long-tailed duck	<i>Clangula hyemalis</i>	sensitive	1, 2, 3, 4, 5, 6	D	D	B	C	C	C
White-winged scoter	<i>Melanitta fusca</i>	sensitive	3, 4, 5, 6, 7, 8	D	D	B	C	C	C
Surf scoter	<i>Melanitta perspicillata</i>	sensitive	4, 5, 6, 7, 8	D	D	B	C	C	C
Gadwall	<i>Anas strepera</i>	undetermined	5, 6, 8	-	B/C	-	A	-	-
Common nighthawk	<i>Chordeiles minor</i>	secure	4, 5, 6, 7, 8	-	C	B/C	C	D	C
Eskimo curlew	<i>Numenius borealis</i>	at risk	3	A	A	-	-	A	-
Short-billed dowitcher	<i>Limnodromus griseus</i>	not assessed	5, 6, 8	-	C	-	-	C	C
Wilson's phalarope	<i>Phalaropus tricolor</i>	not assessed	5	-	-	-	-	-	-
Herring gull	<i>Larus argentatus</i>	secure	2, 3, 4, 5, 6, 7, 8	D	D	C	C	C	C
California gull	<i>Larus californicus</i>	secure	5, 6, 8	C	B	C	C	C	C
Mew gull	<i>Larus canus</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	C	C	C
Bonaparte's gull	<i>Larus philadelphia</i>	secure	4, 5, 6, 7, 8	C	D	C	C	C	C
Common tern	<i>Sterna hirundo</i>	secure	5, 6, 8	B	C	C	C	C	C

Table 5 (cont'd) The status of bird species in the NWT found in either the Taiga Plains (ecozone 5) or Taiga Shield (ecozone 6). Data are from RWED (2000).

Common Name	Scientific name	Status in NWT	Ecozones	Abundance		Trend		Threats	
				Pop. Size	Dist.	Pop.	Dist.	Pop.	Habitat
Arctic tern	<i>Sterna paradisaea</i>	secure	1, 2, 3, 4, 5, 6, 8	D	D	C	C	C	C
Least sandpiper	<i>Calidris minutilla</i>	sensitive	3, 4, 5, 6, 8	D	D	B/C	-	C	C
Semipalmated sandpiper	<i>Calidris pusilla</i>	sensitive	2, 3, 5, 6	D	C	B/C	C	C	C
Black tern	<i>Chlidonias niger</i>	sensitive	5, 6, 8	B	C	B/C	C	C	C
Common snipe	<i>Gallinago gallinago</i>	sensitive	3, 4, 5, 6, 7, 8	C	D	B/C	C	C	C
Red phalarope	<i>Phalaropus fulicaria</i>	sensitive	1, 2, 3, 5	D	C	B/C	C	C	C
Red-necked phalarope	<i>Phalaropus lobatus</i>	sensitive	2, 3, 4, 5, 6, 7, 8	-	D	B/C	C	C	C
American golden-plover	<i>Pluvialis dominica</i>	sensitive	1, 2, 3, 4, 5, 6	D	C	B/C	C	C	C
Caspian tern	<i>Sterna caspia</i>	sensitive	5, 6, 8	B	C	C/D	C	C	C
Lesser yellowlegs	<i>Tringa flavipes</i>	sensitive	3, 4, 5, 6, 7, 8	-	D	B/C	-	C	C
Solitary sandpiper	<i>Tringa solitaria</i>	undetermined	4, 5, 7, 8	-	C	-	-	-	-
Long-tailed jaeger	<i>Stercorarius longicaudus</i>	undetermined	1, 2, 3, 4, 5, 6	C	C	-	-	-	-
Greater yellowlegs	<i>Tringa melanoleuca</i>	undetermined	5, 6, 8	-	B	-	-	-	-
Spotted sandpiper	<i>Actitis macularia</i>	undetermined	4, 5, 6, 7, 8	-	C	-	C	-	-
Upland sandpiper	<i>Bartamia longicauda</i>	undetermined	4, 5, 7, 8	-	C	-	-	-	-
Semipalmated plover	<i>Charadrius semipalmatus</i>	undetermined	1, 2, 3, 4, 5, 6, 8	D	D	B/C	C	-	-
Killdeer	<i>Charadrius vociferus</i>	undetermined	5, 6, 7, 8	-	C	-	C	D	D
Hudsonian godwit	<i>Limosa haemastica</i>	undetermined	3, 5	-	B	-	C	C	C
American bittern	<i>Botaurus lentiginosus</i>	sensitive	5, 6, 8	A	C	B/C	C	C	C
Belted kingfisher	<i>Ceryle alcyon</i>	secure	4, 5, 6, 7, 8	-	C	C	C	D	C
Peregrine falcon (anatum)	<i>Falco peregrinus anatum</i>	at risk	4, 5, 6, 8	A	C	C	C	C	C
Tundra peregrine falcon	<i>Falco peregrinus tundrius</i>	may be at risk	1, 2, 3, 5, 6	A	C	-	C	C	C
Northern goshawk	<i>Accipiter gentilis</i>	secure	4, 5, 6, 7, 8	B/C	D	C	C	C	C
Sharp-shinned hawk	<i>Accipiter striatus</i>	secure	4, 5, 6, 7, 8	D	C	C	C	C	C
Red-tailed hawk	<i>Buteo jamaicensis</i>	secure	4, 5, 6, 7, 8	B/C	C	D	C	C	C
Rough-legged hawk	<i>Buteo lagopus</i>	secure	1, 2, 3, 5, 6	B/C	C	C	C	C	D
Northern harrier	<i>Circus cyaneus</i>	secure	3, 4, 5, 6, 7, 8	C/D	D	C	C	C	C
Merlin	<i>Falco columbarius</i>	secure	4, 5, 6, 7, 8	-	D	C	C	C	D
Gyr Falcon	<i>Falco rusticolus</i>	secure	1, 2, 3, 4, 5	C	D	B/C	C	C	C
American kestrel	<i>Falco sparverius</i>	secure	4, 5, 6, 7, 8	-	C	C	C	C	C
Bald eagle	<i>Haliaeetus leucocephalus</i>	secure	3, 4, 5, 6, 7, 8	B/C	D	-	C	C	C/D
Osprey	<i>Pandion haliaetus</i>	secure	4, 5, 6, 7, 8	-	D	C/D	C	C	D

Table 5 (cont'd) The status of bird species in the NWT found in either the Taiga Plains (ecozone 5) or Taiga Shield (ecozone 6). Data are from RWED (2000).

Common Name	Scientific name	Status in NWT	Ecozones	Abundance		Trend		Threats	
				Pop. Size	Dist.	Pop.	Dist.	Pop.	Habitat
Golden eagle	<i>Aquila chrysaetos</i>	sensitive	3, 4, 5, 6, 7, 8	B	D	C	C	C	C
Broad-winged hawk	<i>Buteo platypterus</i>	undetermined	5	-	-	-	-	-	-
Swainson's hawk	<i>Buteo swainsoni</i>	undetermined	5	-	A	-	-	-	-
Ruffed grouse	<i>Bonasa umbellus</i>	secure	4, 5, 6, 7, 8	D	C	C	C	C	C
Spruce grouse	<i>Dendragapus canadensis</i>	secure	4, 5, 6, 7, 8	D	D	-	C	C	C
Willow ptarmigan	<i>Lagopus lagopus</i>	secure	2, 3, 4, 5, 6	D	D	C	C	C	C
Sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	secure	4, 5, 6, 7, 8	D	D	-	B/C	-	C
Rock ptarmigan	<i>Lagopus mutus</i>	sensitive	1, 2, 3, 4, 5, 6	D	D	B/C	C	B/C	D
Blue grouse	<i>Dendragapus obscurus</i>	undetermined	4, 5, 7	-	B	A/B	-	-	-
White-tailed ptarmigan	<i>Lagopus leucurus</i>	undetermined	4, 5, 7	-	A	C	-	-	-
Common loon	<i>Gavia immer</i>	secure	2, 3, 4, 5, 6, 7, 8	C/D	D	C/D	C	C	C
Pacific loon	<i>Gavia pacifica</i>	secure	2, 3, 4, 5, 6, 7, 8	C/D	D	C	C	C	C
Red-throated loon	<i>Gavia stellata</i>	secure	1, 2, 3, 5, 6, 8	C/D	D	C	C	C	C
Sandhill crane	<i>Grus canadensis</i>	secure	1, 2, 3, 5, 6, 8	D	D	C	C	D	D
Cliff swallow	<i>Petrochelidon phyrhonota</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	C	D	C
Black-billed magpie	<i>Pica pica</i>	secure	5, 6, 8	B	A	-	D	D	D
Western tanager	<i>Piranga ludovicana</i>	secure	5, 6, 7, 8	-	C	C	C	-	C
Black-capped chickadee	<i>Poecile atricapillus</i>	secure	5, 6, 7, 8	-	C	D	C	D	C
Ruby-crowned kinglet	<i>Regulus calendula</i>	secure	4, 5, 6, 7, 8	-	C	B/C	C	D	C
Eastern phoebe	<i>Sayornis phoebe</i>	secure	5, 6, 8	-	C	C	C	D	C
Northern waterthrush	<i>Seiurus noveboracensis</i>	secure	4, 5, 6, 7, 8	-	C	C	C	D	C
Sora	<i>Porzana carolina</i>	secure	4, 5, 6, 7, 8	B	C	C	C	D	C
American coot	<i>Fulica americana</i>	sensitive	5, 6, 7, 8	A/B	C	B/C	C	D	C
Gray-headed chickadee	<i>Poecile cinctus</i>	may be at risk	4, 5	A/B	A	-	-	C	C
Red-winged blackbird	<i>Agelaius phoeniceus</i>	secure	4, 5, 6, 7, 8	-	C	B/C	C	D	C
Bohemian waxwing	<i>Bombycilla garrulus</i>	secure	3, 4, 5, 6, 7, 8	-	D	B/C	C	D	C
Common redpoll	<i>Carduelis flammea</i>	secure	1, 2, 3, 4, 5, 6, 8	D	D	C	C	D	C
Pine siskin	<i>Carduelis pinus</i>	secure	4, 5, 6, 7, 8	D	C	B/C	C	D	C
Hermit thrush	<i>Catharus guttatus</i>	secure	4, 5, 6, 7, 8	-	C	D	C	D	C
Gray-cheeked thrush	<i>Catharus minimus</i>	secure	3, 4, 5, 6, 7	-	D	B/C	C	D	C
Swainson's thrush	<i>Catharus ustulatus</i>	secure	4, 5, 6, 7, 8	-	C	C	C	D	C
Common raven	<i>Corvus corax</i>	secure	1, 2, 3, 4, 5, 6, 7, 8	D	D	-	C	D	D

Table 5 (cont'd) The status of bird species in the NWT found in either the Taiga Plains (ecozone 5) or Taiga Shield (ecozone 6). Data are from RWED (2000).

Common Name	Scientific name	Status in NWT	Ecozones	Abundance		Trend		Threats	
				Pop. Size	Dist.	Pop.	Dist.	Pop.	Habitat
Yellow-rumped warbler	<i>Dendroica coronata</i>	secure	4, 5, 6, 7, 8	D	C	C	C	-	C
Magnolia warbler	<i>Dendroica magnolia</i>	secure	4, 5, 6, 7, 8	-	D	C	C	D	C
Palm warbler	<i>Dendroica palmarum</i>	secure	5, 6, 7, 8	-	C	C	C	D	C
Yellow warbler	<i>Dendroica petechia</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	C	D	C
Alder flycatcher	<i>Empidonax alnorum</i>	secure	4, 5, 6, 7, 8	-	C	C	C	D	C
Yellow-bellied flycatcher	<i>Empidonax flaviventris</i>	secure	5, 6, 7, 8	-	D	C	C	D	C
Least flycatcher	<i>Empidonax minimus</i>	secure	4, 5, 6, 7, 8	-	C	C	C	D	C
Horned lark	<i>Eremophila alpestris</i>	secure	1, 2, 3, 4, 5, 6, 7	D	D	B/C	C	D	C
Dark-eyed junco	<i>Junco hyemalis</i>	secure	3, 4, 5, 6, 7, 8	-	D	C	C	D	C
Northern shrike	<i>Lanius excubitor</i>	secure	3, 4, 5, 6, 7, 8	-	D	C	C	D	C
Red crossbill	<i>Loxia curvirostra</i>	secure	4, 5, 6, 7, 8	-	C	C	C	D	C
White-winged crossbill	<i>Loxia leucoptera</i>	secure	3, 4, 5, 6, 7, 8	D	C	C	C	D	C
Swamp sparrow	<i>Melospiza georgiana</i>	secure	5, 6, 7, 8	-	C	C	C	D	C
Lincoln's sparrow	<i>Melospiza lincolnii</i>	secure	4, 5, 6, 7, 8	-	C	D	C	D	C
Black-and-white warbler	<i>Mniotilta varia</i>	secure	5, 7, 8	-	C	C	C	D	C
Savannah sparrow	<i>Passerculus sandwichensis</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	C	-	C
Gray jay	<i>Perisoreus canadensis</i>	secure	3, 4, 5, 6, 7, 8	D	D	B/C	C	D	C
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	secure	3, 4, 5, 6, 7, 8	-	D	B/C	C	D	C
American pipit	<i>Anthus rubescens</i>	sensitive	1, 2, 3, 4, 5, 6, 7	-	D	B/C	C	D	C
Olive-sided flycatcher	<i>Contopus cooperi</i>	sensitive	4, 5, 6, 7, 8	-	C	B/C	C	-	C
Blackpoll warbler	<i>Dendroica striata</i>	sensitive	3, 4, 5, 6, 7, 8	-	D	A/B	C	D	C
Rusty blackbird	<i>Euphagus carolinus</i>	sensitive	3, 4, 5, 6, 7, 8	-	C	A/B	C	D	C
Barn swallow	<i>Hirundo rustica</i>	sensitive	4, 5, 6, 7, 8	-	C	B/C	C	D	C
Boreal chickadee	<i>Poecile hudsonicus</i>	sensitive	4, 5, 6, 7, 8	-	D	A/B	C	D	C
Bank swallow	<i>Riparia riparia</i>	sensitive	3, 4, 5, 6, 7, 8	-	C/D	B/C	C	D	C
American tree sparrow	<i>Spizella arborea</i>	sensitive	3, 4, 5, 6, 7	-	D	B	C	D	C
American redstart	<i>Setophaga ruticilla</i>	secure	5, 6, 7, 8	-	C	C	C	D	C
Red-breasted nuthatch	<i>Sitta canadensis</i>	secure	4, 5, 6, 7, 8	-	C	D	C	D	C
Chipping sparrow	<i>Spizella passerina</i>	secure	4, 5, 6, 7, 8	D	D	B/C	C	D	C
Tree swallow	<i>Tachycineta bicolor</i>	secure	4, 5, 6, 7, 8	D	D	C	C	D	C
American robin	<i>Turdus migratorius</i>	secure	3, 4, 5, 6, 7, 8	-	D	C	D	D	C
Eastern kingbird	<i>Tyrannus tyrannus</i>	secure	5, 6, 7, 8	-	D	B/C	C	D	C

Table 5 (cont'd) The status of bird species in the NWT found in either the Taiga Plains (ecozone 5) or Taiga Shield (ecozone 6). Data are from RWED (2000).

Common Name	Scientific name	Status in NWT	Ecozones	Abundance		Trend		Threats	
				Pop. Size	Dist.	Pop.	Dist.	Pop.	Habitat
Orange-crowned warbler	<i>Vermivora celata</i>	secure	4, 5, 6, 7, 8	D	D	C	C	D	C
Tennessee warbler	<i>Vermivora peregrina</i>	secure	4, 5, 6, 7, 8	-	D	B/C	C	D	C
Warbling vireo	<i>Vireo gilvus</i>	secure	5, 6, 7, 8	-	C	D	C	D	C
Red-eyed vireo	<i>Vireo olivaceus</i>	secure	4, 5, 6, 7, 8	-	C	D	C	D	C
Wilson's warbler	<i>Wilsonia pusilla</i>	secure	3, 4, 5, 6, 7, 8	D	C/D	C	C	D	C
White-throated sparrow	<i>Zonotrichia albicollis</i>	sensitive	5, 6, 7, 8	-	C	B/C	C	D	C
Harris's sparrow	<i>Zonotrichia querula</i>	sensitive	3, 5, 6	-	C	B	C	D	C
Connecticut warbler	<i>Oporornis agilis</i>	undetermined	5	-	-	-	-	-	-
Le Conte's sparrow	<i>Ammodramus leconteii</i>	undetermined	5, 6, 8	-	B	D	C	C	C
Nelson's sharp-tailed sparrow	<i>Ammodramus nelsoni</i>	undetermined	5, 8	-	A	C	C	D	C
Cedar waxwing	<i>Bombycilla cedrorum</i>	undetermined	5	-	A	C/D	C	C	C
Smith's longspur	<i>Calcarius pictus</i>	undetermined	3, 4, 5, 6	-	C	C	C	D	C
Hoary redpoll	<i>Carduelis hornemanni</i>	undetermined	1, 2, 3, 5, 6	-	B	C	C	D	C
Purple finch	<i>Carpodacus purpureus</i>	undetermined	5, 7, 8	-	C	B/C	C	D	C
Evening grosbeak	<i>Coccothraustes vespertinus</i>	undetermined	5, 8	-	A	C/D	C	C	C
Western wood-pewee	<i>Contopus sordidulus</i>	undetermined	4, 5, 6, 7, 8	-	C	C	C	-	C
American crow	<i>Corvus brachyrhynchos</i>	undetermined	5, 6, 8	-	C	-	C	-	D
Bay-breasted warbler	<i>Dendroica castanea</i>	undetermined	5, 7, 8	-	C	B/C	C	D	C
Cape May warbler	<i>Dendroica tigrina</i>	undetermined	5, 6, 8	-	C	C	C	D	B
Townsend's warbler	<i>Dendroica townsendi</i>	undetermined	5, 7	-	A	-	-	-	-
Hammond's flycatcher	<i>Empidonax hammondii</i>	undetermined	5, 7	-	A	C	C	C	B
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	undetermined	5	-	A	C	C	-	A
Common yellowthroat	<i>Geothlypis trichas</i>	undetermined	4, 5, 7	-	B	C	C	-	C
Varied thrush	<i>Ixoreus naevius</i>	undetermined	3, 4, 5, 7	-	C	C	C	D	C
Song sparrow	<i>Melospiza melodia</i>	undetermined	5, 6, 8	-	C	B/C	C	D	C
Brown-headed cowbird	<i>Molothrus ater</i>	undetermined	5, 7, 8	-	C	B/C	C	D	C
Townsend's solitaire	<i>Myadestes townsendi</i>	undetermined	4, 5, 7	-	B	C	C	D	C
Northern wheatear	<i>Oenanthe oenanthe</i>	undetermined	1, 2, 4, 5	-	A	-	C	D	C
Mourning warbler	<i>Oporornis philadelphia</i>	undetermined	5, 7	-	A	B/C	C	C	C
Fox sparrow	<i>Passerella iliaca</i>	undetermined	3, 4, 5, 6, 7, 8	D	D	C	-	-	C
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>	undetermined	5, 6, 8	-	B	B/C	C	C	B
Pine grosbeak	<i>Pinicola enucleator</i>	undetermined	4, 5, 6, 7, 8	-	D	D	-	-	C

Table 5 (cont'd) The status of bird species in the NWT found in either the Taiga Plains (ecozone 5) or Taiga Shield (ecozone 6). Data are from RWED (2000).

Common Name	Scientific name	Status in NWT	Ecozones	Abundance		Trend		Threats	
				Pop. Size	Dist.	Pop.	Dist.	Pop.	Habitat
Snow bunting	<i>Plectrophenax nivalis</i>	undetermined	1, 2, 3, 4, 6	-	C	B/C	C	D	C
Vesper sparrow	<i>Poocetes gramineus</i>	undetermined	5, 8	-	A	C	C	C	C
Common grackle	<i>Quiscalus quiscula</i>	undetermined	5, 8	-	B	B/C	C	D	C
Golden-crowned kinglet	<i>Regulus satrapa</i>	undetermined	5, 7	-	A/B	C	C	C	B/C
Say's phoebe	<i>Sayornis saya</i>	undetermined	3, 4, 5, 7	-	C	C	C	D	C
Ovenbird	<i>Seiurus aurocapillus</i>	undetermined	5, 6, 8	-	B	C	C	C	C
Clay-coloured sparrow	<i>Spizella pallida</i>	undetermined	5, 6, 8	-	C	B/C	C	D	C
Violet-green swallow	<i>Tachycineta thalassina</i>	undetermined	4, 5, 7	-	A	D	C	C	C
Winter wren	<i>Troglodytes troglodytes</i>	undetermined	5, 7, 8	-	A	C	C	C	C
Philadelphia vireo	<i>Vireo philadelphicus</i>	undetermined	5, 6, 8	-	A	C	C	C	B/C
Blue-headed vireo	<i>Vireo solitarius</i>	undetermined	5, 6, 8	-	B/c	D	C	C	B/C
Canada warbler	<i>Wilsonia canadensis</i>	undetermined	5	-	A	C	C	C	C
Golden-crowned sparrow	<i>Zonotrichia atricapilla</i>	undetermined	5, 7	-	A	C	C	D	C
Pileated woodpecker	<i>Dryocous pileatus</i>	secure	5, 6, 7, 8	-	C	D	C	C	C
Black-backed woodpecker	<i>Picoides arcticus</i>	secure	4, 5, 6, 7, 8	-	C	D	C	C	C
Downy woodpecker	<i>Picoides pubescens</i>	secure	5, 6, 7, 8	-	C	D	C	C	C
Three-toed woodpecker	<i>Picoides tridactylus</i>	secure	3, 4, 5, 6, 7, 8	-	D	C	C	C	C
Hairy woodpecker	<i>Picoides villosus</i>	secure	4, 5, 6, 7, 8	-	C	D	C	C	C
Yellow-bellied sapsucker	<i>Sphyrapicus varius</i>	secure	4, 5, 6, 7, 8	-	C	C	C	C	C
Northern flicker	<i>Colaptes auratus</i>	sensitive	4, 5, 6, 7, 8	D	D	B/C	C	D	C
Horned grebe	<i>Podiceps auritus</i>	secure	3, 4, 5, 6, 7, 8	D	D	B/C	C	C	C
Red-necked grebe	<i>Podiceps grisegena</i>	secure	3, 4, 5, 6, 7, 8	D	D	C	C	C	C
Boreal owl	<i>Aegolius funereus</i>	secure	4, 5, 6, 7, 8	B/C	D	C	C	C	C
Great horned owl	<i>Bubo virginianus</i>	secure	3, 4, 5, 6, 7, 8	B/C	C	C	C	C	C
Snowy owl	<i>Nyctea scandiaca</i>	secure	1, 2, 3, 6	B/C	C	C	C	C	C
Great grey owl	<i>Strix nebulosa</i>	secure	4, 5, 6, 7, 8	B/C	D	C	C	C/D	C
Northern hawk owl	<i>Surnia ulula</i>	secure	3, 4, 5, 6, 7, 8	B/C	D	C	C	C	D
Short-eared owl	<i>Asio flammeus</i>	sensitive	3, 4, 5, 6	B/C	C	B/C	C	C	D
Long-eared owl	<i>Asio otus</i>	undetermined	5, 8	-	B/C	-	B/C	C	C
Barred owl	<i>Strix varia</i>	undetermined	5	-	A	-	-	C	-

populations. The data are used to help set hunting limits for many of the harvested species of waterfowl (U.S. Fish and Wildlife 2002, 2003).

The population trends of several duck species and the Canada goose in the Northwest Territories are shown in Figure 14. Some species, such as the pintail are much lower than their long term average, while others remain relatively stable or increase, as in the case of the Canada goose.

4.2.4 *Amphibians/Reptiles*

There are very few amphibian species in the NWT, although two species of frog and one salamander species are present in the Boreal Taiga ecozone in the north (RWED 2000). The most widely distributed amphibian species is the wood frog (*Rana sylvatica*), which is found in several ecozones in the NWT and is present in about 40% of the area of the NWT. There are 11 known occurrences of the boreal chorus frog (*Pseudacris (triseriata) maculate*) and the species is present in about 10% of the land area of the NWT, although the values would be much higher if only the southern NWT is considered. The long-toed salamander (*Ambystoma macrodactylum*) may also be present in the boreal taiga ecozone, and hence the Great Bear Lake watershed. Similarly, the northern leopard frog (*Rana pipiens*) is reported in the Boreal Shield ecozone in the NWT, although it is rare.

4.2.5 *Plants*

The RWED database includes several hundred entries for individual species and composites (Families) however data are not available for most species and their status has not been determined. The major tree species of black spruce, white spruce, tamarack, jack pine, and lodgepole pine are widely distributed and are considered to be secure, as are willow and Labrador tea. Because of the gaps in the database it does not provide the necessary detail to allow the assessment of plant species within the Great Bear Lake watershed.

4.3. Species at Risk

There are 441 plants and animals currently designated as “species at risk” in Canada which provides them protection under various pieces of legislation. Assessment for candidate species are conducted by the Committee on the Status of Endangered Species in Canada (COSEWIC) who provide recommendations on the levels of protection needed to allow the recovery of declining species. Candidate species are listed under specific classifications depending on their numbers and the health of the population.

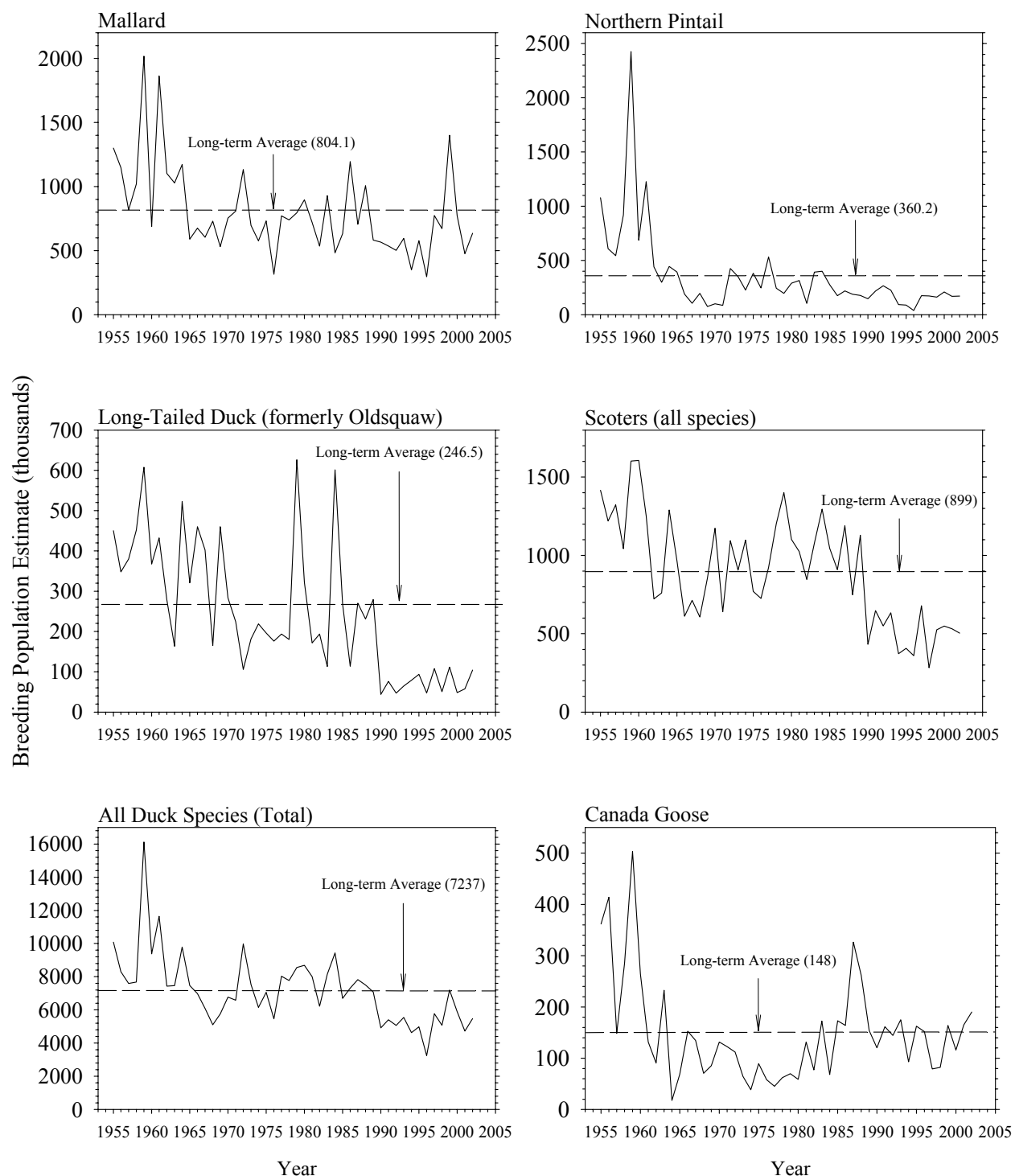


Figure 14 Status of waterfowl populations in the Mackenzie Valley region, based on surveys of breeding area during nesting time. Data are from the U.S. Fish and Wildlife Service (2002).

The COSEWIC classifications are:

Extinct:	a species no longer exists.
Extirpated:	a species no longer exists in the wild in Canada, but occurs elsewhere.
Endangered:	a species faces imminent extirpation or extinction.
Threatened:	a species likely to become endangered if limiting factors are not reversed.
Special Concern:	a species that may be particularly sensitive to human activities or natural events.

There are currently 21 species of birds and mammals from the Northwest Territories currently listed as species at risk, seven of which may be present in the Great Bear Lake watershed (Table 6). Three additional candidate bird species are currently being considered because of declining numbers. Of these, the rusty blackbird is considered of higher priority because of rapidly declining numbers throughout its range (Blancher 2002). The arctic grey wolf (*Canis lupus arctos*) is listed under the data deficient category.

A committee of federal and territorial agencies and co-management boards, including the Sahtu Renewable Resources Board, reviewed the status of species in the Northwest Territories (RWED 2000) and recommended that the fisher should be considered under a category “May Be At Risk” within the NWT. Both the Canadian toad and the red-sided garter snake are considered to be at risk in the NWT (RWED 2000), but it is unlikely that their range extends as far north as the GBL watershed.

No plants from the NWT are currently designated under COSEWIC in any category and are not listed as candidate species. RWED (2000) however listed three plant species, the parsley fern, Loesel’s twayblade and bog adder’s mouth under the category “May Be At Risk” although their distribution within the NWT is not clear or whether they are present in the GBL watershed. This designation by the NWT will probably be considered by the COSEWIC process during their normal assessment schedule.

Habitat degradation and loss represent one of the greatest threats to many species in southern Canada and is an increasing concern in the north as development increases and the climate changes. Other threats include genetic and reproductive isolation, which occurs when the natural range of a species becomes fragmented and the populations within each fragment are too small to remain viable, and the suppression of natural events, such as forest fires and floods that maintain

Table 6 List of species with special status under Species at Risk legislation and may be present within the GBL watershed. Data are taken from the Species at Risk site of Environment Canada (www.speciesatrisk.gc.ca/default_e.cfm) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Species	Status	Status under Species at Risk Act	Comments
Eskimo Curlew	Endangered	Schedule 1	Once very numerous, with breeding habitat within the Mackenzie District of the NWT; used to number in hundreds of thousands, now in the dozens; breeds in tundra and forest transition zones.
Peregrine Falcon anatum subspecies	Threatened	Schedule 1	The anatum subspecies breeds in area including the GBL watershed but overwinters in Mexico to South America. Decline linked to high body burdens of eggshell- thinning contaminants, particularly DDT. Current levels of DDT are significantly lower than during the 1970's.
Grizzly Bear (Northwest population)	Special Concern	Schedule 3	Currently on Schedule 3 but upgrade to Schedule 1 is pending after public consultation
Peregrine Falcon anatum subspecies	Special Concern	Schedule 3	Tundra subspecies that nests on tundra (southern Arctic ecozone) which forms northeastern border of the GBL watershed. Decline caused by contaminants, same as anatum subspecies.
Short-eared owl	Special Concern	Schedule 3	Breeds in tundra of Southern Arctic ecozone but declines were primarily due to habitat loss in southern populations
Wolverine	Special Concern	Schedule 3	Currently on Schedule 3 but upgrade to Schedule 1 is pending after public consultation. Distributed across western and northern Canada but loss appears to be linked to changes in ungulate herds, a major food source.
Woodland Caribou (northern population)	Special Concern	Schedule 1 designation pending	Southern boreal populations are designated as "Threatened" but northern herds in NWT and Yukon may be subject to overhunting. Habitat destruction, intense hunting, disturbance and predation all contribute to the decline of this species.
Rusty Blackbird	Group 1 Candidate (Highest Priority)		This species has shown a decline of nearly 93 % over its North American range in the 30-year period from 1966-1996. Populations in Canada have experienced similar declines in the past 30 years, showing an annual rate of decrease of 10%.
Common Nighthawk	Group 3 Candidate		No information
Blackpoll Warbler	Group 3 Candidate		No information
Fisher	May Be At Risk		May not be present in great Bear Lake watershed

suitable habitat. Environmental contamination that causes the loss of reproductive fitness, over harvesting, climate change, disease and the presence of invasive species are also known stresses to all natural populations. Habitat loss and species fragmentation are probably to be less of a threat currently in the GBL watershed because the region remains largely undeveloped, however climate change and overharvesting of threatened species, disease and contamination by pesticides remain significant concerns. The Eskimo curlew provides an excellent example of a northern species which was reduced by overhunting and is now threatened. Both the wolverine and grizzly bear populations in the Great Bear Lake watershed could also be affected by continued hunting.

5.0 Status of Known Stresses on the Watershed

5.1. Climate Change

The impact of climate change is one of the major issues facing communities in the north because of its potential impact on the land, surface waters and the ecology of the region. The accumulation of gases in the atmosphere from the burning of fossil fuels for energy results in a general warming of temperatures and an increase in the number and severity of severe weather events. There is a potential for the north to undergo huge changes as air temperatures increase, permafrost melts and the region becomes drier.

Agriculture and Agri-Food Canada and Natural Resources Canada have provided results for estimates of climatic conditions throughout Canada using the values recorded at weather stations between 1961 and 1990 (see Section 3.4) and projecting into the future until the year 2069. The data have been generated using the Canadian General Circulation Model with predictions of rates of increase of greenhouse gases for grids across Canada. Data are available from the Canadian Climate Impacts Scenarios Website (www.cics.uvic.ca/scenarios/index.cgi). The data for the Great Bear Lake watershed (65 to 66 °N latitude and 120-125 °W longitude) have been extracted from the Canadian grid and summarised for several parameters in Figure 15.

Monthly average, minimum and maximum temperatures are predicted to increase significantly from the values recorded between 1961 and 1990 by 5-6 °C in both the summer and winter by 2040. The data predict longer growing season (Figure 15, lower) and greater precipitation, however the warmer temperatures could lead to greater deficits in the water balance for the watershed. These warmer, drier conditions could have significant impacts on many species, but particularly nesting waterfowl. Eroding permafrost could also become a significant issue.

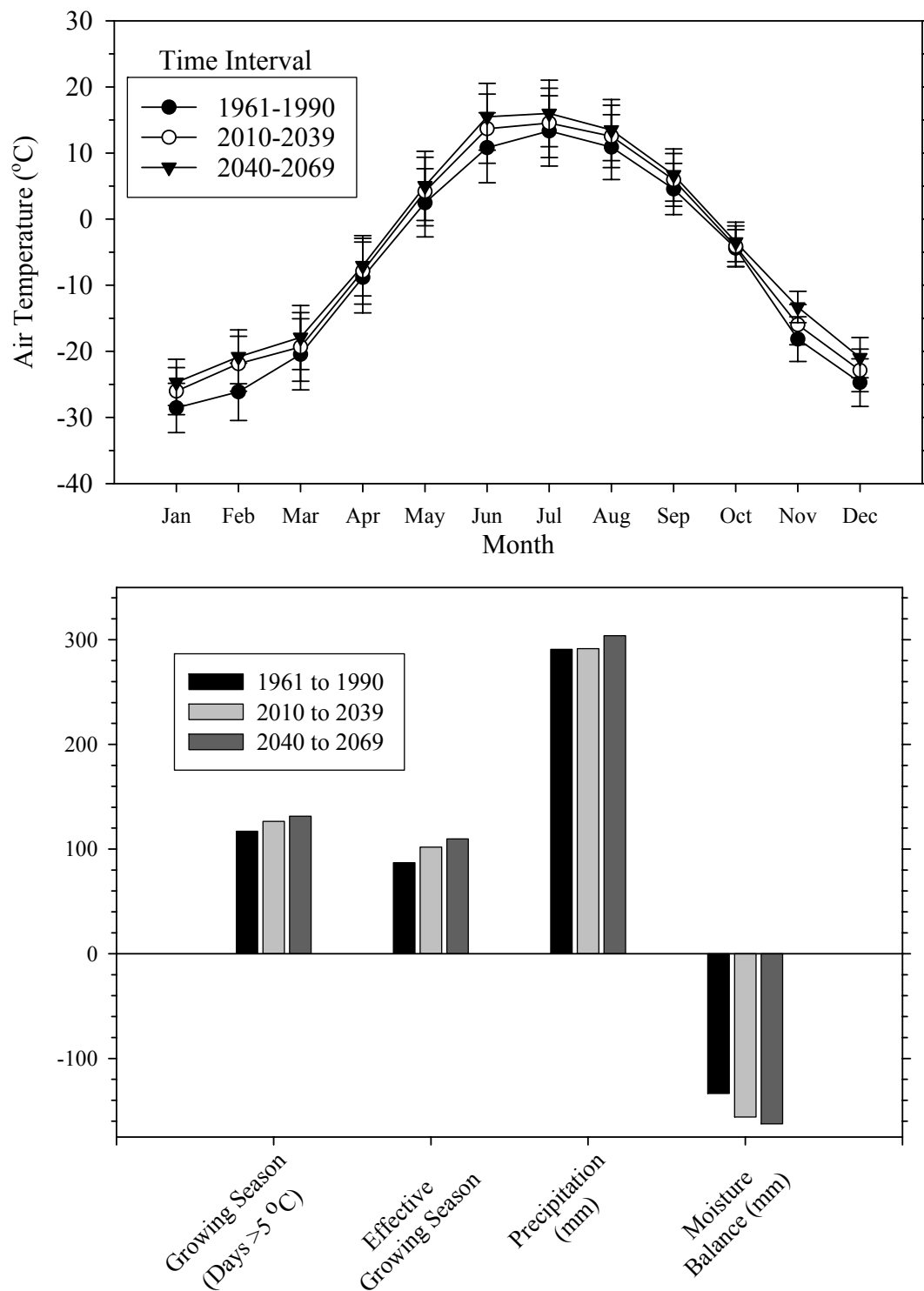


Figure 15 Predicted effects of climate change on the climate of the Great Bear Lake watershed. Data are from Agriculture and Agri-Foods Canada and Natural Resources Canada

An analysis of the potential effects of climate change on the Bathurst caribou herd indicated that increased precipitation during the winter could have significant impact on caribou feeding and movement, as deeper snow would make digging for food and migration more difficult (Brotten and Wall 1997). Warmer temperatures in spring could cause earlier insect harassment and the presence of flies and mosquitoes for a longer period of time. Longer, warmer summers could allow the animals to enter the winter with greater fat reserves. These long term impacts should be considered in the development of monitoring research plans for the watershed.

5.2. Contaminants

A number of studies have been conducted to determine the levels of potential contaminants in the terrestrial environment (Table 7). Most of the studies have been conducted to provide background data for human and ecological risk assessments for Port Radium or to determine the status of contaminants in some specific medium, such as traditional foods. A common feature of most of the studies is relatively small sample sizes, which restricts the conclusions about the concentrations reported and the use of the data for long-term trends. With the exception of samples collected at the mine site at Port Radium, all studies to date have reported the levels of metals and radionuclides in samples from the terrestrial environment similar to those reported for the same species outside the Sahtu and there is no evidence of significant concerns. Organochlorine pesticides, which are a significant issue in the aquatic environment due to food chain biomagnification, are very low in terrestrial species and are not a concern in the Great Bear Lake watershed.

5.3. Development

A map of the development in the Great Bear Lake watershed (Figure 16) indicates that there are few pressures to the ecosystem from loss of habitat or potential sources of contamination. The only community in the watershed is Déline, which is expected to have little impact on the terrestrial environment other than a landfill site. Of the abandoned mine sites in the watershed, the most assessment work has been conducted at Port Radium, where radium, uranium and silver were mined between 1930 and 1980. Site assessments conducted in 2001 and 2002 indicated that the area affected by waste rock and tailings was relatively limited. Detailed analysis of plants and soils from the site has been conducted and risk assessment is presently being conducted on the data. Currently, little assessment work has been conducted on other mine sites such as the Terra Mine and Contact Lake. Although most of the impacts are expected to be to the aquatic system, some local impacts may also occur by wind-blown dust and physical hazards. The cumulative effects of these abandoned sites must be assessed in terms of the other impacts of climate change and other stresses that may have long-term effects on the watershed.

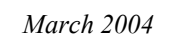


Figure 16 Map of Great Bear Lake Watershed showing the extent of development in 2003. Key concerns are the mine sites in the Coppermine River uplands and unmarked areas of field caches and landfills.

Table 7 Summary of studies reporting contaminant levels in terrestrial samples in the Great Bear watershed. With the exception of Port Radium, the studies report concentrations of major contaminants similar to the same types of samples collected elsewhere in the NWT.

Lead Agency	Objective of Study	Items Collected	Date	Elements Analysed	Conclusions
Sahtu Dene Council	<ul style="list-style-type: none"> To determine contaminants in moose and caribou in the Sahtu. 	<ul style="list-style-type: none"> 6 moose and 2 woodland caribou 	1999	21 metals; 7 gamma-emitting radionuclides; polonium-210	<ul style="list-style-type: none"> The concentrations of possible contaminants were low in all samples all other elements the same as in the same species elsewhere in the NWT.
Déline Dene Band	<ul style="list-style-type: none"> To determine contaminants in sediment, water and terrestrial samples at Port Radium and reference sites. 	<ul style="list-style-type: none"> Foods, water, background radiation, sediment 	1998	Metals, radionuclides	<ul style="list-style-type: none"> Contamination of run-off water and sediments evident around Port Radium, but all other indicators low at two other sites on GBL.
Sahtu Renewable Resources Board	<ul style="list-style-type: none"> To assess the health of the Bluenose-East caribou herd, including contaminants in liver and kidney. 	<ul style="list-style-type: none"> 11 adult and 1 sub-adult females; 1 male adult and 1 sub-adult 	2002	26 metals; gamma-emitting radionuclides; polonium-210	<ul style="list-style-type: none"> The concentration of metals and radionuclides the same as in the same species elsewhere in the NWT.
SENES Consultants	<ul style="list-style-type: none"> To assess potential risks to humans and the environment at Port Radium. 	<ul style="list-style-type: none"> Background radiation 	2001, 2003	Metals and arsenic, radionuclides	<ul style="list-style-type: none"> Elevated background radiation in localized areas, elevated metals and arsenic in some vegetation samples on the site. Final report for 2003 not yet submitted.
Déline Uranium Team	<ul style="list-style-type: none"> To determine the concentration of potential contaminants in traditional foods near Déline. 	<ul style="list-style-type: none"> Food samples collected near Déline 	2002, 2003 (ongoing)	Metals	<ul style="list-style-type: none"> Metal levels the same as in the same foods measured elsewhere. Study from 2003 not finalized.
Dene Nation/RWED	<ul style="list-style-type: none"> Analysis of metals and radionuclides in large mammals from the Sahtu and other regions. 	<ul style="list-style-type: none"> Large mammals (moose, caribou, Dall sheep) 	ongoing	Metals, radionuclides	<ul style="list-style-type: none"> Final report not yet submitted.

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