10 WILDLIFE

10.1 Introduction

10.1.1 Baseline Information

Baseline information was obtained from a review of relevant literature, local knowledge and field studies.

Wildlife is a fundamental element of northern culture and a critical subsistence resource for residents of the communities in the Mackenzie Delta and Mackenzie Valley. The priority issues in northern communities are the:

- cumulative effects of development on wildlife populations and their habitats
- ability of northern residents to continue harvesting wildlife

This section presents the information required to address these issues in Volume 5, Biophysical Impact Assessment. General information on distribution of mammals and birds including the complete list of species in the region of the project has been reviewed in Banfield (1974), Godfrey (1986) and Bellrose (1980). However, information presented in this baseline report focuses on the wildlife valued components (VCs), as determined in the VC selection process described in Volume 5, Section 10.2, Assessment Approach.

10.1.2 Baseline Study Objectives

10.1.2.1 Mammals

The objectives of the mammal baseline studies were to determine the current abundance and distribution of mammal valued components (VCs) in the study area and to identify important habitats that might be affected by project development. Mammal field study surveys employed a habitat-based approach to:

- assess habitat conditions and capability
- determine relative abundance, habitat use and distribution of selected wildlife species
- identify important wildlife habitat features, e.g., nests, dens, and critical late winter habitat, in the local study area (LSA)

Results of these surveys were used to assess potential impacts and develop mitigation plans.

10.1.2.2 Birds

The objective of the bird surveys was to:

- document the current composition, distribution and relative abundance of bird populations

- identify and document important bird areas, such as:

  - nesting colonies
  - major waterfowl moulting areas
  - migratory staging areas

Results of these surveys were used to assess potential impacts and develop mitigation plans.

10.1.2.3 Information Requirements

The authors reviewed information from field surveys, published scientific documents and traditional knowledge to identify information gaps and uncertainties in the baseline study. The use and relevance of traditional knowledge is discussed in Volume 5, Section 10.2, Assessment Approach. Knowledge of uncertainties was useful for determining prediction confidence in the impact assessment and for developing monitoring programs.

10.2 Methods

10.2.1 Study Areas

10.2.1.1 Local Study Areas

The wildlife local study areas (LSAs) encompass the anchor fields, gathering system and pipeline corridor, and a 1-km-wide buffer zone around facility sites. Figure 10-1 and Figure 10-2 show the wildlife LSAs in the production area and along the pipeline corridor.

10.2.1.2 Regional Study Areas

Production Area

The wildlife regional study area (RSA) in the production area includes the project footprint in the production area plus a 40-km-wide buffer. This area is the estimated average annual home range of female grizzly bears on Richards Island and the Tuktoyaktuk Peninsula (Nagy and Branigan 1998). To address the known annual movements of barren-ground grizzly bears and the winter range of barren-ground caribou (Nagy 2003, personal communication), the RSA boundary was expanded to include part of the Tuktoyaktuk Peninsula, a known movement corridor for grizzlies using the production area. The RSA was also expanded east, south of the Husky Lakes, to account for the winter range of the Cape Bathurst barren-ground caribou herd.

Recent telemetry data and communications from locally knowledgeable people show some grizzly bears inhabit the Mackenzie Delta, which was not evident from the telemetry work conducted in the 1970s. To the west, the RSA is limited to the edge of the Mackenzie Delta and the Mackenzie River, as caribou do not usually use the delta or cross the river. This RSA is designed to capture potential regional and cumulative effects on mammals in the production area.

Pipeline Corridor

The wildlife RSA along the pipeline corridor is a 30-km-wide corridor on either side of the pipeline centre line. It covers the typical home range of a woodland caribou (Stuart-Smith et al. 1997; Bradshaw et al. 1995) and is the extent in which regional and cumulative effects on caribou and other mammals might occur.

The following locations were identified during community consultations as areas of seasonal movement of woodland caribou and are included in the RSA:

- lower-lying areas around Wrigley and Ebbutt Hills
- summer ranges in the McConnell Range and on the Horn Plateau

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Figure 10.2 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Beaufort Marine Area

The RSA for marine mammals (see Figure 10-3) is designed to capture the potential regional and cumulative effects of the barge option, for Niglintgak, on marine mammal VCs. The RSA encompasses the footprint of the barge option, i.e., the dredging area, barge transport corridor and Niglintgak, and includes the Mackenzie estuary and delta, about half the Tuktoyaktuk Peninsula, and the normal open-water zone for the southern Beaufort Sea out to about the 50-m depth contour. The corridor within which the barge is expected to travel is about 20 km wide. The study area includes:

- beluga summer concentration areas and Beluga Management Zone 1A protected areas
- bowhead whale migratory routes
- open-water summering areas for most southern Beaufort Sea ringed seal populations
- occasional denning areas for polar bears near Niglintgak

10.2.2 Historical Information

Most scientific information on wildlife in the Mackenzie Delta and Mackenzie Valley region came from extensive studies in the 1970s and 1980s that established baseline conditions for assessments of oil and gas development and supporting pipelines and infrastructure. Although useful as background documentation, much of this information is not suitable for current-day impact assessments because:

- wildlife populations might have changed markedly in the intervening 25 to 30 years, e.g., pintail populations have declined
- some studies were highly site-specific and are not applicable to the proposed production area or pipeline corridor, e.g., moose studies in the Liard River
- there are major gaps in regional information for some species, e.g., almost no wildlife information exists for the Deh Cho Region (Popko 2003, personal communication)
- there is little or no information on some species of high concern to present-day resource managers, e.g., woodland caribou, grizzly bear, certain fur-bearers and water birds

- wildlife distributions might have been affected by human activities, including development, in the:
    - Mackenzie Delta
    - Inuvik area
    - pipeline corridor
    - road corridors south of Norman Wells
- forest fires and human activities have extensively altered habitat conditions in many areas along the proposed route
- survey methods, standards and analytical tools, e.g., habitat modelling and home range analyses, have advanced considerably. Where data is not available for re-analysis, dated analyses might be of limited use
- the understanding of how petroleum production and pipeline development affects wildlife has changed. Previously, issues such as energetic stress were a high concern. Now, cumulative effect issues, such as core security habitat analyses, not addressed in earlier assessments, are recognized as important issues in environmental assessments

Government and university researchers have done additional wildlife research and monitoring along the Mackenzie Valley that is of value to the impact assessment. For example, the Canadian Wildlife Service (CWS) and the United States Fish and Wildlife Service (USFWS) conducted waterfowl surveys at selected sites in the Mackenzie Delta in recent years. The Northwest Territories' Department of Resources, Wildlife, and Economic Development (RWED) has surveyed cliff-nesting raptors along the Mackenzie Valley during the summer every five years since 1980. The Government of the Northwest Territories (GNWT) has conducted satellite telemetry studies of barren-ground caribou in the Tuktoyaktuk region for several years and is proposing similar studies of woodland caribou along the Mackenzie Valley and of grizzly bears in the Mackenzie Delta and Tuktoyaktuk region (Nagy 2003, personal communication).

Traditional and local knowledge will provide additional information on wildlife population trends, habitat use, seasonal distributions, movements and animal health. Supplementary traditional knowledge studies, to be conducted as part of the baseline studies, will augment existing traditional knowledge databases and provide information specific to this project. Additional information on wildlife, e.g., hunter kills and locations, is available from the Inuvialuit, Gwich'in and Sahtu harvest studies and from the GNWT's resident and nonresident alien harvest databases. This information has been incorporated in the mortality and harvest baseline information in this report.

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10.2.3 Survey Design

10.2.3.1 Terrestrial Mammal Surveys

A survey designed to determine public and professional opinion on wildlife research methods considered various means acceptable for gathering data to evaluate habitat use. Survey respondents included:

- Fort Good Hope Renewable Resources Council (RRC)
- Déline RRC
- Colville Lake RRC
- Tulita RRC
- Norman Wells RRC
- Ross River, Department of Renewable Resources
- Department of Resources, Wildlife and Economic Development
- Alberta Boreal Caribou Research Program
- Nahanni National Park Reserve of Canada
- Mackenzie Mountain Outfitters' Association

In a workshop in the Sahtu Settlement Area, 90% of respondents found pellet and track counts acceptable methods for conducting research on boreal caribou (Olsen et al. 2001). This compares to 70% of respondents who found aerial surveys acceptable.

Four types of wildlife surveys were conducted during 2002 and 2003:

- winter track survey (March to April)
- aerial ungulate survey (April and June)
- pellet group survey (June and July)
- aerial and ground grizzly bear den survey in the production area (June and July 2003)

The biologists used systematic techniques to control the survey effort, e.g., duration, distance, geographic area and target species. Biologists also recorded incidental observations of other species to supplement data from systematic surveys. Survey types and intensity varied among mammal groups and differed between areas along the pipeline corridor. Surveys specifically targeting semi-aquatic furbearers were not conducted.

The following describes the surveys that were conducted. Note that caribou of the different herds or subspecies, i.e., reindeer, barren-ground, and woodland caribou, were not distinguished in either the track or pellet group surveys. Therefore, results from these surveys are presented based on the likelihood of each subspecies in a given area.

Winter Track Surveys

Winter track surveys collected information on relative abundance, distribution and habitat use of terrestrial mammals. These surveys focused on marten, snowshoe hare and lynx. Although wolverine is considered a large carnivore in this report, it is also an important furbearer and was targeted during winter track surveys. Information on ungulates, e.g., moose and caribou, was also recorded. Surveys were conducted along a series of 500 m transects in representative vegetation and habitat types throughout the LSA and 624 transects were surveyed. See the following figures:

- Figure 10-4: Wildlife Ground Survey – Tundra Ecological Zone
- Figure 10-5: Wildlife Ground Survey – Transition Forest Ecological Zone
- Figure 10-6: Wildlife Ground Survey – North Taiga Plains Ecological Zone
- Figure 10-7: Wildlife Ground Survey – South Taiga Plains Ecological Zone

Ungulate Aerial Surveys

Ungulate aerial surveys collected information on the relative abundance and distribution of ungulates. Winter aerial surveys, conducted in the LSA focused on moose, barren-ground caribou and woodland caribou because they are important subsistence foods for people in northern communities. See the following figures:

- Figure 10-8: Ungulate Aerial Survey and Caribou Sightings – Tundra Ecological Zone
- Figure 10-9: Ungulate Aerial Survey – Transition Forest Ecological Zone
- Figure 10-10: Ungulate Aerial Survey – North Taiga Plains Ecological Zone
- Figure 10-11: Ungulate Aerial Survey – South Taiga Plains Ecological Zone

Other large mammals, e.g., large carnivores and furbearers, observed during the surveys were also recorded. A total of about 4,500 km^2 were surveyed.
In 2002, the entire pipeline route, i.e., production area and pipeline corridor, was surveyed parallel to the pipeline, with the survey flight path occurring 200 m on either side of the pipeline route centre line.

In 2003, aerial survey blocks were conducted in proximity to the pipeline route. Within the blocks, transects were conducted at 2 km intervals in the production area and at 800 m intervals along the pipeline corridor.

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Figure 10.11 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Pellet Group Surveys

Biologists conducted pellet group surveys, which provide cumulative records of habitat use in winter, to gather information on the relative abundance and distribution of mammals. They focused on moose, woodland caribou, barren-ground caribou and snowshoe hares. Pellet group counts were done along a series of 500 m long transects of 1 m width. At 25 m intervals, 10 m^2 plots were also recorded. Transects were in representative vegetation and habitat types throughout the LSA. The survey was done before green-up to ensure new growth did not conceal the previous winter's accumulation of pellets. A total of 461 transects were surveyed.

Grizzly Bear Aerial and Ground Den Surveys

Aerial surveys were flown over the production area with a focus on finding grizzly bear dens and denning habitat (see Figure 10-12). Surveys were conducted by helicopter along transects spaced at 1-km intervals or at 2-km intervals.

Aircrews found dens by searching for holes and den excavation spoil piles on southerly aspects. Biologists then visited a sample of dens on the ground to record relevant den characteristics and habitat features, including:

- aspect
- slope
- position on slope
- substrate texture
- vegetation type at the den site
- presence or absence of bedding material
- estimated age of the den
- GPS coordinates

10.2.3.2 Bird Surveys

Bird distribution surveys were designed to document when and where potential impacts to bird populations might be important. The greatest numbers and diversity of birds in the Mackenzie Valley and Mackenzie Delta regions occur during spring migration from early May to early June, in the summer nesting period from June to August, and during fall migration in late August to September. Most birds are absent in winter. Bird surveys were conducted from mid May to mid September.

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Aerial and ground-based surveys were used to determine bird distribution. Most effort was devoted to aerial surveys, which are usually the most efficient means of surveying extensive areas for populations of large birds. Aerial surveys were used to gather information on the species, numbers and distribution of loons and grebes, waterfowl, i.e., geese, swans and ducks, hawks, eagles, falcons, jaegers, gulls, terns, owls, sandhill cranes and common ravens. Populations of nesting shorebirds and small passerines could not be surveyed well from the aircraft, although some individuals were sighted during the aerial surveys. It is difficult to detect all individuals of even large species from a fast-moving aircraft. Detectability varies with species, age, gender, time of year and habitat.

Ground-based surveys are more costly in terms of staffing and are much less efficient at sampling large areas. However, they have several advantages over aerial surveys and are a useful supplement. Ground-based surveys can provide more precise, site-specific information on numbers, species, gender and age composition, nesting status, and habitat associations. This applies to large, readily detectable species and to small birds such as shorebirds and passerines. Ground-based surveys were done primarily to supplement the aerial survey results and to provide data on nesting shorebird and passerine populations.

Two types of aerial surveys and three types of ground-based surveys were used to document bird distribution in the production area and pipeline corridor. These survey methodologies are described as follows.

Spring Aerial Surveys

The objective of the spring aerial surveys was to identify and document concentrations of spring-migrating waterfowl and other waterbirds. These surveys were conducted by helicopter during spring breakup when many waterbodies were still largely or entirely ice-covered and unsuitable for use by waterbirds. Counts were made of all waterbirds on selected waterbodies, rather than of all birds within a pre-defined transect, because most of the transect would have been covered in snow and ice and unsuitable for waterbirds. The selected waterbodies had open water.

Aerial Transect Surveys

Aerial transect surveys were flown throughout the LSA to determine bird densities (see Figure 10-13). Most were conducted during the open-water season when waterbodies were ice-free and available to waterbirds. The surveys were strip-based, meaning all birds within a pre-defined transect width were recorded and densities of birds were calculated. The width of each transect, within which sightings were considered on-transect for determination of densities, was 400 m, i.e., 200 m on either side of the aircraft. Virtually all aerial transect surveys were conducted from a small fixed-wing aircraft, e.g., a Cessna 206 on floats.

Ground-truthing Surveys – Waterfowl

Ground-truthing surveys were conducted to supplement the aerial survey data on waterbirds. They provided the opportunity to more accurately identify birds to the species level, e.g., unidentified scaup to greater scaup or lesser scaup, by age and gender, and to more accurately count species that either are difficult to detect from the air, or occur in large flocks. The surveys can also provide more detailed information about group types, which can be related to stages of the nesting cycle.

Survey locations were chosen near aerial survey transect lines. Access was by floatplane. Therefore, ground-truthing surveys had to be conducted near lakes large and deep enough to accommodate a floatplane. The lakes chosen to land the floatplane on and lakes within short walking distance were surveyed. Observers scanned each lake and recorded:

- species
- number of individuals
- age and gender, when possible
- information about the composition of bird groups

Point Count Surveys – Land Birds

Point count surveys of land birds were conducted in conjunction with the ground-truthing surveys. Based on the procedure described in Ralph et al. (1995), point counts involved identifying and counting all birds seen or heard within about 100 m during a 10-minute period while standing at one place. Point count locations were at least 300 m apart and in various habitats.

Plot Surveys – Shorebirds

Ground plots were established on the outer Mackenzie Delta and at Parsons Lake for surveys of nesting bird populations. Because the breeding bird plot surveys were to document nesting shorebird populations, there was a bias toward choosing plots with suitable shorebird habitat. Areas with large proportions of open water were avoided.

Plot dimensions were 400 m by 400 m (Johnston et al. 2000). Each plot was visited once. Applying the procedure detailed in Bart and Earnst (2002), two observers did a rapid survey of the plot by quickly mapping approximate observed bird and nest locations while walking 25 m apart along a series of parallel lines back and forth across the plot. The assumption was that an observer at this distance would flush most birds from nests.

Figure 10.13 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Production Area

Surveys in the production area were conducted from late July to mid-September in 2001 and from late May to mid-July in 2002. Table 10-1 shows the types of surveys conducted in the production area. Figure 10-13, shown previously, shows the locations of aerial surveys in the outer Mackenzie Delta.

Table 10-1: Types of Bird Surveys – Production Area

Location	Aerial Surveys		Ground-based Surveys	
	Spring	Transect	Ground-truthing	Plots
Outer Mackenzie Delta	●	●	●	●
Parsons Lake	●	●	●	●
Gathering pipelines	●	●	●	–

NOTES:
● = survey conducted
– = no survey conducted

Spring aerial surveys were conducted along the gathering pipeline route from Inuvik to the outer delta, over an area of the outer Mackenzie Delta that incorporates Niglintgak, Taglu and Parsons Lake and surrounding areas. They usually followed the transects used for the aerial transect surveys. Spring aerial surveys of the outer Mackenzie Delta were conducted May 31 and June 3, 2002. There was one spring aerial survey of Parsons Lake on June 3, 2002. Spring aerial surveys of the gathering pipelines were conducted on May 31 and June 3, 2002.

Ten aerial transect surveys were conducted of the outer Mackenzie Delta, one every 10 to 14 days, from July 26 to September 16, 2001 and from June 18 to July 8, 2002. Ten transect surveys of Parsons Lake were also conducted every 10 to 14 days, from July 27 to September 15, 2001 and from June 19 to July 10, 2002. Aerial transect surveys of the gathering pipelines were conducted from June 18 to July 10, 2002 and from July 25 to September 16, 2001.

Ground-based surveys were conducted at two ground-truthing sites and seven breeding bird plots on the outer Mackenzie Delta. Both ground-truthing surveys were conducted on July 28, 2001. Breeding bird plot surveys were conducted from June 25 to July 6, 2002.

Ground-based surveys were conducted at two ground-truthing sites and five breeding bird plots in the area of Parsons Lake. Both ground-truthing surveys were conducted on July 29, 2001. The five breeding bird plot surveys were conducted from June 23 to July 4, 2002.

Ground-truthing surveys were conducted on July 30, 2001 at two sites along the gathering pipelines. No breeding bird plot surveys were conducted along the gathering pipeline route.

Pipeline Corridor

Surveys along the pipeline corridor were conducted during nesting from mid to late June 2001 and during spring migration from mid May to early June 2002. They were conducted along the pipeline route, along the Mackenzie River and in several nearby areas in the Sahtu Settlement Area and Gwich'in Settlement Area.

Table 10-2 summarizes the types and general locations of surveys conducted in the LSA.

Table 10-2: Types of Bird Surveys – Pipeline Corridor

	Aerial Surveys		Ground-based Surveys	
Location	Spring Aerial Surveys	Aerial Transect Surveys	Ground-truthing Surveys	Point Counts Surveys
Gwich'in Settlement Area				
Pipeline corridor	●	●	●	●
Mackenzie River	●	●	–	–
Travaillant Lake		●	●	●
Sahtu Settlement Area				
Pipeline corridor	●	●	●	●
Mackenzie River	●	●	–	–
Bear River	–	●	●	●
Brackett Lake	–	●	●	–
Loche River	–	●	–	–
MacKay Creek	–	●	●	–
Deh Cho Region				
Pipeline corridor	●	●	–	–
Mackenzie River	●	●	–	–
Northwestern Alberta				
Pipeline corridor	●	●	●	●

NOTES:
● = survey was conducted
– = no survey was conducted

Gwich'in Settlement Area

Spring aerial surveys of the pipeline corridor in the Gwich'in Settlement Area were conducted May 30 and June 2, 2001. Transect surveys of the pipeline corridor, the Mackenzie River and the Travaillant Lake area were conducted June 23 to 26, 2001. Ground-based surveys were conducted at four locations along the pipeline corridor in the Gwich'in Settlement Area from June 25 to 27, 2001. Ground-truthing of waterfowl and point counts for terrestrial birds were done at each location.

Sahtu Settlement Area

Spring aerial surveys in the Sahtu Settlement Area were conducted on seven days from May 18 to 28, 2002. Aerial transect surveys were conducted along the pipeline corridor and east shore of the Mackenzie River in the Sahtu Settlement Area from June 15 to 25, 2001 and at Bear River, Brackett Lake, Loche River and MacKay Creek near the pipeline corridor on June 16, 2001. Ground-based surveys that included point counts for passerines and ground-truthing for waterfowl were conducted at seven sites on or near the pipeline corridor in the Sahtu Settlement Area from June 16 to 24, 2001.

Deh Cho Region

Bird population surveys in the Deh Cho Region were done along the proposed route of the pipeline, along the Mackenzie River from the boundary of the Sahtu Settlement Area and the Deh Cho Region south to the Liard River and along the lower Liard River. Data was collected during spring aerial surveys and aerial transect surveys. Spring aerial surveys of the pipeline route, the Mackenzie River and the Liard River in the Deh Cho Region were conducted May 15 to 20 and May 25, 2002. Aerial transect surveys of the Deh Cho Region sections of the pipeline, the Mackenzie River and the Liard River were conducted June 12 to 16, 2001. No ground-based surveys were conducted in the Deh Cho Region.

Northwestern Alberta

Bird population surveys were conducted along the proposed NOVA Gas Transmission Ltd. (NGTL) pipeline corridor in northwestern Alberta in June 2001 and May 2002. Data was collected from a spring aerial survey, aerial transect surveys, ground-truthing surveys and point count surveys. The spring aerial survey was flown May 16, 2002. Aerial transect surveys were conducted June 12 and 13, 2001. Because the proposed route of the pipeline corridor in northwestern Alberta was revised between 2001 and 2002, the aerial survey routes were different for those years. Ground-based surveys, including ground-truthing surveys and five point count surveys, were conducted along the pipeline corridor at and around Wally Lake on June 15, 2001.

10.2.4 Data Analysis for Mammal Surveys

10.2.4.1 Delineation of Habitat Types

The vegetation team classified the landscape into vegetation types for each ecological zone using air photographs and field data (see Section 9, Vegetation). The LSA vegetation types provide a fine-scale vegetation classification of the landscape based on:

- plant species composition and abundance
- soil type
- moisture conditions

Bird habitat delineation was based on these vegetation types.

For mammal habitat analyses, the wildlife team produced a coarser classification of the landscape by grouping similar vegetation types into broader habitat types. Habitat types are focused more on wildlife needs and allow more powerful statistical analyses of wildlife field data and habitat model verification.

The wildlife team performed cluster analyses to develop mammal habitat types. The team used ground and detailed vegetation plots as cases and plant measurements as characteristics. The vegetation variables selected for input into the cluster analysis reflected important habitat characteristics for the wildlife VCs. Hierarchical clustering analyses were conducted using Systat, version 10.2 (Systat 10.2), a statistical and analytical graphics software, with Euclidean distance and average linkage options (Gauch 1982). The ground and detailed plots were clustered by ecological zone. In addition to the multivariate cluster analysis, other information was also considered to further group vegetation types into their final habitat types, e.g., moisture regime, geographic location, detailed vegetation type descriptions and summary vegetation statistics. Table 10-3 summarizes the habitat types.

10.2.4.2 Ungulate Aerial Surveys

Ungulate aerial survey data analysis involved summarizing counts of bulls, cows, calves and unclassified individuals per species per survey block. Densities were calculated from the number of animals of each species recorded in each survey block.

10.2.4.3 Winter Track Surveys

Analysts assigned each winter track survey transect a single habitat type based on the most common habitat type present within each transect. They calculated track density, i.e., tracks/km/day, for each VC included in the winter track survey.

Analysts averaged track density by habitat type and VC over the two years surveyed, with the transect being the unit of replication.

Table 10-3: Habitat Types in Project Area and Associated Vegetation Types by Ecological Zone

Habitat Type	Vegetation Types by Ecological Zone			
	Tundra	Transition Forest	North Taiga Plains	South Taiga Plains
Low shrub	1, 2	1, 2	–	–
Medium shrub	3	3	–	–
Sedge-cotton-grass	4, 8	4, 8	–	–
High and low-centred polygons	5, 6	–	–	–
Riparian shrub	7	–	–	–
Delta shrub	9	–	–	–
Delta sedge-cotton-grass	10, 12	–	–	–
Riparian black spruce and shrub	13	–	–	–
Upland shrub	–	–	a4	–
Jack pine mixed conifer	–	–	–	a1
Deciduous forest	–	–	–	d1
Mixedwood forest	–	d3, d5	d3, d4, d5	d2, d3, d4, d5
Riparian shrub	–	f4	f4, f5	f4, f5, f6
Black spruce-tamarack and shrub	–	g1, k4	g1, k4, h2	g1, k4, k5, i1
Treed bog	–	h3	–	–
Black spruce and lichen bog	–	h4, i3	i3	i3
Sedge-peat moss	–	k3	k3, i4	k3, i4
Burned	–	C	C	C
Disturbed	D	D	D	D
Bare ground	B	B	B	B
Water	W	W	W	W

NOTE:
– = habitat type not found at this ecological zone

Winter track survey data was tested for normality using the Kolmogorov-Smirnov test in Systat 10.2. Data was not normally distributed.

The nonparametric Kruskal-Wallis, one-way analysis of variance (Zar 1984) tested whether VC habitat type use varied between the habitat types by region, i.e., ecological and political. Habitat types with sample sizes less than three were removed from the analysis to prevent skewing of results.

When the obtained value of the Kruskal-Wallis test was significant, nonparametric multiple comparison tests were performed to determine which of the habitat types received notably different levels of use (Siegel and Castellan 1988).

$$\left| R_u - R_v \right| \geq Z\alpha_{\,k(k-1)} \sqrt{[\{N(N+1)\}/12\ (1/n_u + 1/n_v)]}$$

where R = mean rank

10.2.4.4 Pellet Group Surveys

Pellet group survey transects were assigned to single habitat types based on the most common habitat type in each transect. Researchers calculated pellet group density, i.e., pellet groups/ha, for each VC in each habitat type in the pellet group survey. Transects were the units of replication.

Pellet group statistical analysis for the pipeline corridor followed the same procedure as for winter track data.

10.2.4.5 Grizzly Bear Aerial and Ground Den Survey

Maps of the den locations were used to compare the model output for denning habitat with actual locations.

10.2.4.6 Pipeline Proximity Analysis

The purpose of this analysis was to determine whether rights-of-way have a significant effect on wildlife habitat use by comparing wildlife abundance in relation to a 300-m-buffer on either side of the Enbridge pipeline right-of-way.

Researchers took data from the winter track and pellet group surveys of Norman Wells south to the northwestern Alberta boundary for analysis, using ArcView GIS 3.3 and ArcMap 8.2 software.

Analysts divided winter track and pellet group transect data into experimental and control groups. They labelled the transect segment lying within 300 m of the Enbridge right-of-way as *experimental*, and the segment lying outside the 300-m-buffer as *control*.

Researchers did not include transects with zero values for wildlife VCs or transects lying either completely within or outside of the 300-m buffer. Sample size values represent the number of transects where observers recorded tracks or pellets of a particular species.

Analyses were done on five VCs:

- woodland caribou
- moose
- lynx

- marten
- snowshoe hare

Track density was calculated for each VC within the control and experimental segment of each transect. Each transect segment was then assigned a *plus* or *minus* according to which had the highest or lowest density of tracks.

Pluses for control transect segments and experimental transect segments were tallied for each VC, and a nonparametric sign, i.e., binomial test, was performed. Results were presented for the winter track and pellet group data separately and combined for each species.

10.2.5 Wildlife Habitat Modelling

A habitat analysis requires the delineation of discrete habitat types for the study area. This step divides the study area into comparatively homogeneous units, within which biophysical conditions, and hence habitat suitability, remain relatively constant. This permits habitat value to be more confidently extrapolated from sampled to unsampled areas.

Biophysical factors considered to directly influence habitat value include:

- vegetation cover type
- hydrologic regime
- slope
- aspect
- other topographic features

Because vegetation cover type is actually an expression of a variety of biophysical conditions, such as soil, aspect and relief, it can offer the most current and valid prediction of habitat value for most wildlife species. Consequently, vegetation cover typing was selected as the primary means of delineating distinct habitats for this study, although the habitat quality evaluation included additional landscape variables, such as:

- hydrologic regime
- slope
- aspect
- terrain ruggedness

In the LSA, the ecological land classification (ELC) vegetation types, as characterized by the project vegetation group, were used as the base vegetation unit. Wildlife models were then analyzed using habitat types, which group the ELC vegetation types into broader categories (see Section 10.2.4.1, Delineation of Habitat Types).

In the RSA, vegetation types were distinguished based on their spectral signatures. The acquired Landsat images were classified using a supervised classification, in which ELC types were used as a basis for defining vegetation types and subsequently habitat types. The RSA vegetation types mirror those of the LSA, except for a few vegetation types that were indistinguishable and merged in the North Taiga Plains and South Taiga Plains ecological zones.

10.2.5.1 Model Development

Terrestrial Mammals

Published literature, unpublished reports and data files were among the literature reviewed to determine terrestrial VC habitat requirements. The subject was also discussed with government biologists, regional hunters and trappers and local residents familiar with the study area. Most information obtained and literature reviewed for VCs was from studies done outside the study area but with similar biogeographic characteristics. Key factors and corresponding measurable habitat variables were selected for model development based on:

- the variable being clearly related to the capacity of an area to support the species being evaluated
- a basic understanding of the relationship of the variable to habitat value, e.g., what is the best and worst value for the variable and how does the variable interact with other variables
- the variable being practical to measure, either in the field or from remotely-sensed data sources

These conditions were not met for beaver and amphibians either because habitat variables required by these VCs were too fine grained to be represented on the regional maps, or because several habitat variables, such as stream and slope characteristics were not known for the vegetation polygons on which the modelling was based. For these VCs, the baseline description relies on existing information available in the literature and from locally knowledgeable persons.

Birds

Information on the habitat use patterns of birds was assembled and reviewed, and in all cases information was not sufficient to determine specific quantitative requirements, e.g., percent cover. As a result, habitat value was ranked by qualitatively comparing the written descriptions and plant species lists of the vegetation communities with the background information on habitat use by each bird species. Habitat ranks were adjusted for proximity to waterbodies for the waterfowl species, age of succession following previous forest fires, and sensory disturbance around existing developments, e.g., communities and roads.

Habitat models were not created for snow goose, peregrine falcon or Arctic tern. For these species, either modelling was unnecessary or adequate information for modelling was not available. The location of the one snow goose nesting colony in the study area near Kendall Island on the outer Mackenzie Delta is well known. These birds remain at or near the colony in summer, so there was no need to create a model to estimate their habitat availability. Similarly, there was no need to create a model for peregrine falcon nesting habitat. The RWED regularly surveys for raptor nests throughout the Northwest Territories and maintains a database of historical and current peregrine falcon nest sites in the Mackenzie Valley. The RWED made the locations of these nest sites available to the project. Islands are the preferred sites for Arctic tern nesting colonies, but the required habitat data was unavailable to map and model the habitat suitability for tern nesting colonies.

10.2.5.2 Model Validation

The purpose of model validation was to determine whether wildlife model output correlates with wildlife field survey results. For each VC, evaluators assigned a rank to habitat types in each ecological zone according to modelling criteria.

Contingency tables were created to determine whether VC track density is dependent on habitat quality using the log-likelihood ration (G test; Zar 1984). The G test was run on each VC with winter track data, i.e., woodland caribou, barren-ground caribou, moose, marten and lynx, for all ecological zones relevant to that species combined. The results of the G test were used to determine whether adjustments to model parameters were necessary.

Transects with and without winter track data for modelled VCs were sorted into effective, low and unsuitable groups based on model rank. Transects for those VCs with the six-rank system (i.e., woodland caribou, barren ground caribou and moose) were grouped as follows: effective (ranks 0-3.50), low (ranks 3.51-5.99) and unsuitable (rank 6). Transects for those VCs with the rank system (i.e., lynx and marten) were grouped as follows: effective (ranks 0-2.50), low (ranks 2.51-3.99) and unsuitable (rank 4). Analysts hypothesized that VC presence or absence is dependent on habitat.

10.3 Baseline Conditions

The list of wildlife VCs selected for the project includes large mammals, i.e., ungulates and predators, furbearers, marine mammals, waterfowl, birds of prey and other birds of ecological and socio-economic significance. See Volume 5, Section 10.2, Assessment Approach, for an outline and rationale of the selection process. Major prey species for some mammalian predators, e.g., hare for lynx and vole for marten, are also included in the field surveys.

Table 10-4 shows the final list of VCs for the production area and items that were a factor in the selection. Table 10-5 shows the final list of marine mammal VCs in the Beaufort Marine Area and Table 10-6 shows the VCs for the pipeline corridor.

Table 10-4: Wildlife Valued Components – Production Area

Valued Component	Regulatory Status	Ecological Importance	Socio-Economic Importance[1]	Resource Management Concern
Barren-ground caribou (*Rangifer tarandus groenlandicus*)	–	●	●	●
Grizzly bear (*Ursus arctos*)	●	●	●	●
Greater white-fronted goose (*Anser albifrons*)	–	●	●	●
Snow goose (*Chen caerulescens*)	–	●	●	●
Tundra swan (*Cygnus columbianus*)	–	●	–	●
Scaup (greater and lesser) (*Aythya marila*) (*Aythya affinis*)	●	●	–	●
Peregrine falcon (*Falco peregrinus*)	●	●	–	●
Whimbrel (*Numenius phaeopus*)	●	●	–	●
Arctic tern (*Sterna paradisaea*)	–	●	–	–

NOTES:
● indicates item was a factor in selecting VC
– indicates item was not a factor in selecting VC
1 The socio-economic factors in selecting VCs included subsistence harvest and outfitting and guiding interests

Table 10-5: Marine Mammal Valued Components – Beaufort Marine Area

Valued Component	Regulatory Status	Ecological Importance	Socio-economic Importance[3]	Resource Management Concern
Beluga whale *Delphinapterus leucus*	–	●	●	●
Bowhead whale *Balaena mysticetus*	●[1]	●	●	●
Polar bear *Ursus maritimus*	●[2]	●	●	●
Ringed seal *Phoca hispida*	–	●	●	●

NOTES:
● indicates item was a factor in selecting VC
– indicates item was not a factor in selecting VC
1 *Endangered* (COSEWIC), *Endangered*, to be reassessed 2004 (SARA), *Sensitive* (GNWT)
2 *Special concern* (COSEWIC), *Sensitive* (GNWT)
3 The socio-economic factors in selecting VCs included subsistence harvest and outfitting and guiding interests

SOURCES:
COSEWIC 2004, Environment Canada 2002, GNWT 2000
Community of Tuktoyaktuk et al. 2000; Community of Aklavik et al. 2000; Community of Inuvik et al. 2000

The following sections describe current knowledge of each wildlife VC in terms of its:

- status
- abundance and distribution
- population size and density
- population trends and human influences
- mortality
- seasonal occurrence
- movement patterns
- habitat use

Model results are summarized in the following text for effective habitat, which includes moderate, high and very high habitat categories. The use of the effective habitat category allows for consistency in assessing impacts on habitats that are readily used by wildlife VCs.

Table 10-6: Wildlife Valued Components – Pipeline Corridor

Valued Component	Regulatory Status	Ecological Importance	Socio-economic Importance[1]	Resource Management Concern
Barren-ground caribou (*Rangifer tarandus groenlandicus*)	–	●	●	●
Woodland caribou (*Rangifer tarandus caribou*)	●	●	●	●
Moose (*Alces alces*)	–	–	●	–
Grizzly bear (*Ursus arctos*)	●	●	●	●
Marten (*Martes americana*)	–	–	●	–
Lynx (*Lynx canadensis*)	–	–	●	–
Beaver (*Castor canadensis*)	–	–	●	–
Amphibian community (spp.)	●	●	–	–
Snow goose (*Chen caerulescens*)	–	●	●	–
Scaup (greater and lesser) (*Aythya marila*) (*Aythya affinis*)	●	–	●	–
Peregrine falcon (*Falco peregrinus*)	●	●	–	●
Lesser yellowlegs (*Tringa flavipes*)	●	–	–	–
Arctic tern (*Sterna paradisaea*)	–	●	–	–
Boreal chickadee (*Poecile hudsonicus*)	●	–	–	–

NOTES:
● indicates item was a factor in selecting VC
– indicates item was not a factor in selecting VC
1 The socio-economic factors in selecting VCs included subsistence harvest and outfitting and guiding interests

10.3.1 Regional Overview of Wildlife Valued Components

10.3.1.1 Barren-Ground Caribou

Status

Barren-ground caribou, i.e., *Rangifer tarandus groenlandicus*, are listed as *secure* in the Northwest Territories (GNWT 2004), are not listed at the national level (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2004) and are considered *accidental/vagrant* in Alberta (ASRD 2000).

Abundance and Distribution

Barren-ground caribou herds are identified by the location of their traditional calving grounds (Thomas 1969; Gunn and Miller 1986). Figure 10-14 shows the distribution of barren-ground caribou. Barren-ground caribou in the LSAs and RSAs were previously classified as the Bluenose herd because their calving grounds are near Bluenose Lake (Thomas 1969). Other calving areas for this herd are the Cape Bathurst Peninsula, Peary Peninsula and east of the Hornaday River in the Melville Hills area (Banfield and Jakimchuk 1980; Brackett et al. 1985; McLean and Heard 1991). The Bluenose herd is considered one of the major barren-ground caribou herds in the Northwest Territories (Fraser and Williams 1992) and is an important source of food for several communities in the Inuvialuit Settlement Region and Gwich'in Settlement Area (Nagy et al. 1999).

Formerly regarded as a single population, the Bluenose herd is now considered to comprise three separate herds (Nagy et al. 1999). Recent genetic and radio-telemetry studies by the GNWT distinguished three distinct barren-ground caribou herds within the range of the Bluenose herd:

- Cape Bathurst herd
- Bluenose-West herd
- Bluenose-East herd

In this document, Bluenose herd refers to the combination of the Cape Bathurst, Bluenose-West and Bluenose-East herds. The ranges of the three herds are presented in Figure 10-15.

The Cape Bathurst and Bluenose-West herds have winter ranges that extend west into the proposed development area as far as the Mackenzie River and as far south as Norman Wells, Tulita and Déline (Kelsall 1968; Nagy et al. 1999; Community of Aklavik et al. 2000). In winter, the Cape Bathurst herd extends west into the production area through the Parsons Lake lease to the Mackenzie River (Nagy et al. 1999) and is most likely to interact with the project. There are no calving grounds near the proposed development area. However, some local people recall a remnant band of caribou uses Richards Island all year, and the 1988 to 1997 Inuvialuit Harvest Study contains records of caribou shot at Niglintgak and Taglu

(Joint Secretariat 2003). However, barren-ground caribou rarely occur at Niglintgak and Taglu. The outer delta is not considered within the range of the Cape Bathurst herd. The hydrologic regime and vegetation characteristics of the lease areas limit the growth of lichens, which are the primary winter food for caribou (Kelsall 1968).

There is a herd of semi-domesticated reindeer that use mostly the south and western portion of Richards Island and surrounding area (AGRA 2000). The herd was established in 1935 and peaked at about 13,000 animals in 1980, after which time it declined to the current size of 3,000 to 5,000 animals. People in the Tuktoyaktuk community noted that reindeer eat the food of the caribou and often destroy caribou habitat and other habitat near the Husky Lakes (IEG 2002).

The production area overlaps the known winter range of the Cape Bathurst barren-ground caribou herd (see Figure 10-14). Primary factors affecting mortality of this herd are thought to be wolf predation and hunting. Information on the herd’s natural mortality rates is not available, although wolves are known to associate with high densities of wintering and migrating caribou.

Population Size

Recent population estimates are lacking for the Cape Bathurst, Bluenose-West and Bluenose-East herds. Population estimates for the late 1950s and mid-1970s to early 1990s are available for the Bluenose herd, with the most recent population estimates showing a population increase (Nagy et al. 1999; GNWT 2004). Table 10-7 shows the population estimates during this time and indicates the trends and the large variability of the population size. Separate population estimates for the Cape Bathurst, Bluenose-West and Bluenose-East herds are only available for 1992. At this time, about 88,000 to 106,000 caribou were in the Cape Bathurst and Bluenose-West herds combined and 14,000 to 19,000 were in the Bluenose-East herd (Nagy et al. 1999).

The size of the central Arctic caribou herd was inversely related to the insect population size between 1992 and 1995 and between 1995 and 2001 (National Research Council 2003).

Population Trends and Human Influences

People from Tuktoyaktuk have noticed that caribou migrate in from east of Tuktoyaktuk around Husky Lakes, particularly from the south side of the lakes, and that they use game trails (IEG 2002). As a result of over-hunting, caribou populations decreased in the 1920s, but they are now returning (IEG 2002). Tuktoyaktuk community members recall that caribou did not come to the Tuktoyaktuk area during the 1950s, but reappeared in the 1970s (IEG 2002).

Figure 10.14 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Figure 10.15 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Table 10-7: Population Estimates – Bluenose Barren-Ground Caribou Herd

Year	Population Size	Herd	Survey Method
Late 1950s	40,000	Bluenose	Visual
1974	92,000	Bluenose	Visual
1977	42,000	Bluenose	Visual
1978	27,000	Bluenose	Visual
1979	35,000	Bluenose	Visual
1980	58,000	Bluenose	Visual
1981	38,000	Bluenose	Visual
1983	65,000	Bluenose	Photo census
1986	98,000	Cape Bathurst, Bluenose-West	Photo census
1987	115,000	Cape Bathurst, Bluenose-West	Photo census
1992	122,000	Cape Bathurst, Bluenose-West, Bluenose-East	Photo census

SOURCES: Kelsall (1968); Nagy et al. (1999); GNWT (2004)

Kelsall (1968) reported the Bluenose herd comprised 35,000 to 40,000 caribou in the late 1950s. Between the late 1970s and early 1980s, the Bluenose herd population fluctuated and remained low, but then increased in the late 1980s and early 1990s to current high levels. The three herds had an estimated 122,000 animals in 1992 (see Table 10-7, shown previously), an increase from 42,000 in 1977 (Nagy et al. 1999; GNWT 2004). Information on the current status, i.e., increasing, decreasing, or stable, of the herds is unavailable (GNWT 2004).

Researchers collected spring calf-cow ratios for the Bluenose herd to provide an index of recruitment and assist in interpreting population trends (McLean and Heard 1991). Bergerud (1978) suggested caribou populations do not increase if spring calf-cow ratios, or the recruitment rate, are less than 10%. Although calf-cow ratios dropped in the early 1990s, results from 1991 indicated that survivorship was good and that the herd was increasing (McLean 1992). Recruitment rates continued to decline in 1993 and 1994, although the calf-cow ratios were still above 10%. Table 10-8 outlines the spring calf-cow ratios from 1981 to 1994.

Mortality

Barren-ground caribou mortality rates are not well understood. Information on caribou mortality in the Inuvialuit Settlement Region is only available regionally and is not specific to project areas. Natural mortality rates are unavailable for the Bluenose herd (McLean and Heard 1991).

Table 10-8: Spring Calf-Cow Ratios – Bluenose Barren-Ground Caribou Herd

Date	Calves/100 Cows (% calves)	Yearlings/100 Cows (% yearlings)	Calf Survival over Winter (%)
March 1981	– (18)	–	–
March 1983	44 (22)	18 (9)	59
March 1986	55 (26)	13 (5)	71
March 1987	46 (23)	14 (6)	75
March 1988	46 (24)	19 (9)	59
March 1989	45 (24)	11 (6)	58
March 1991	37 (19)	17 (8)	47
March 1993	– (12)	–	–
March 1994	– (14)	–	–
NOTE: – = not available			
SOURCES: McLean (1992) for 1981 to 1991 data; Nagy et al. (1999) for 1993 to 1994 data			

Several factors can cause mortality, including predation, hunting, disease, adverse weather and incidents, e.g., drowning. Wolf predation and hunting are considered the largest causes of mortality in barren-ground caribou populations (Bergerud 1974; GNWT 2004).

Barren-ground caribou are an important species for northern communities (Joint Secretariat 2003). The number of caribou harvested annually, not including wounding loss, between 1987 to 1988 and 1992 to 1993 in the Cape Bathurst and Bluenose-West herds was about 4,300, or 5% of the population (Nagy et al. 1999). In contrast, about 1,900 caribou, or 9 to 14% of the population, were harvested annually from the Bluenose-East herd during the same period. Wounding loss can vary from 0 to 25%.

Harvesting studies indicated that:

- on average 3,113 barren-ground caribou were harvested yearly in the Inuvialuit Settlement Region (Joint Secretariat 2003)
- in the Gwich'in Settlement Area, the Bluenose herd was not an important resource in 1997 as hunters only harvested 145 caribou from the Bluenose herd, compared with 1,886 from the Porcupine herd (GRRB 2004)
- in the Sahtu Settlement Area hunters harvested 2,561 barren-ground caribou in 2001 (SRRB 2003)

Seasonal Occurrence

Barren-ground caribou are highly migratory and as a result occupy different habitats during different seasons. Seasonal barren-ground caribou habitats include (Nagy et al. 1999):

- spring migration, i.e., pre-calving, ranges
- calving grounds
- late spring and early summer, i.e., post-calving, ranges
- mid-summer ranges
- late summer and early fall migration
- rutting grounds
- late fall and winter ranges

Calves remain with their mothers throughout winter and separate from the adult females during spring migration to calving grounds (McLean and Heard 1991). Group size increases as migration progresses but as caribou reach calving grounds, they break into small groups and disperse (GNWT 2004). Barren-ground caribou typically calve in the first two weeks of June (Banfield and Jakimchuk 1980). Following calving in early to mid-June, caribou from the Bluenose herd concentrate near the coast (Wright et al. 2002) where they form large post-calving aggregations in an attempt to reduce disturbance from biting insects (GNWT 2004). The large herds start moving south toward the treeline in mid to late July and begin to disperse in August (Banfield and Jakimchuk 1980). Rutting occurs for two to three weeks in October, and barren-ground caribou reach their wintering grounds in November. Winter distribution varies from year-to-year and depends on food availability and snow depth (GNWT 2004). Mature bulls typically winter farther west and south than females and young bulls, which tend to congregate in more central or eastern locations (Carruthers and Jakimchuk 1981; Carruthers et al. 1986; McLean and Heard 1991).

Calving grounds, including pre- and post-calving areas, are considered critical caribou range and are sensitive to disturbance. Nagy et al. (1999) ranked the importance of seasonal caribou habitats, as follows:

1. pre-calving, calving and post-calving ranges
2. early summer and mid-summer ranges
3. late summer and fall migration, and spring and spring migration ranges
4. rut and late fall and winter ranges

This ranking could underestimate the importance of wintering habitat. For example, caribou population levels and productivity, as measured by calf survival, might be affected more by variation in winter forage availability than summer forage availability (Cronin et al. 1994). There are no known barren-ground caribou calving grounds near the RSA in either the production area or the pipeline corridor.

Barren-ground caribou from the Bluenose herd typically begin spring migration to calving grounds in March and April (McLean and Heard 1991; GNWT 2004), although observations of northward-moving caribou have been made as early as late February. Females have left their wintering grounds near the LSA by May (Wright et al. 2002). Pregnant cows move at a rapid pace and might begin to migrate as much as a month earlier than males (Banfield and Jakimchuk 1980; McLean and Heard 1991). Despite these similarities, the Cape Bathurst, Bluenose-West and Bluenose-East herds use distinct calving, rutting and wintering ranges, as described in the following sections.

People interviewed in Inuvik revealed that caribou are found in the Caribou Hills in the winter, on the east shore of the delta and east of Inuvik toward Husky Lakes (IEG 2002). Movement patterns of the Cape Bathurst, Bluenose-West and Bluenose-East herds were monitored using radio-telemetry from 1996 to 2001 (Nagy et al. 2002). Tracking was limited to females from each herd and the results indicated: (Nagy et al. 1999, 2002):

- Cape Bathurst – n = 6
- Bluenose-West – n = 21
- Bluenose-East – n = 13

The Cape Bathurst and, on rare occasions, the Bluenose-West females arrive in the LSA by late October and leave by December. The Bluenose-East herd is almost never found in the LSA.

Nagy (2003, personal communication) noted that the year-to-year variability of caribou movements could be high. This is because regional movements of caribou throughout winter are likely affected by a number of factors, including snow depth, forage availability, predator pressure, and disturbance.

Cape Bathurst Herd

Calving occurs on the Cape Bathurst Peninsula, and rutting occurs east of Husky Lakes. The winter range stretches from the Tuktoyaktuk Peninsula to the Husky Lakes area and west to the Mackenzie River. The LSA covers part of the Cape Bathurst herd’s winter range, which is in the Tundra Ecological Zone of the Inuvialuit Settlement Region.

In winter, the Cape Bathurst herd extends west into the production area through the Parsons Lake lease to the Mackenzie River (Nagy et al. 1999). Inuvialuit harvest records from 1987 to 1998 also indicate that caribou have been harvested near Niglintgak and Taglu (Wright et al. 2002). Based on local knowledge, 150 to 200 barren-ground caribou can be sustained on Richards Island year round (Nagy 2003, personal communication). Caribou likely rarely occur on these leases because the dominant, low-lying wetland vegetation precludes the growth of abundant lichen, which is the caribou’s primary winter food (Sims 1983). The range of the Cape Bathurst herd overlaps the northern part of the Reindeer Grazing Reserve (AGRA 2000).

Bluenose-West Herd

Calving occurs west of Bluenose Lake in Tuktut Nogait National Park and locations farther west, and rutting occurs in the Anderson River area. The winter range stretches from the Tuktoyaktuk Peninsula south to the Sahtu Settlement Area and west to the Mackenzie River. The LSA covers part of the Bluenose-West herd winter range, which is in the Transition Forest Ecological Zone of the Gwich'in Settlement Area and the North Taiga Plains Ecological Zone of the Sahtu Settlement Area.

The winter ranges of the Bluenose-West and Bluenose-East herds extend west to the Mackenzie River and into the proposed pipeline corridor LSA and sometimes as far south as Norman Wells, Tulita and Déline (Kelsall 1968; Nagy et al. 1999; Community of Aklavik et al. 2000).

Bluenose-East Herd

Bluenose-East herd calving occurs in the headwaters of the Rae and Richardson rivers east of Bluenose Lake, and rutting occurs northeast of Great Bear Lake. The wintering range stretches north, east and south of Great Bear Lake. The LSA covers part of the Bluenose-East herd winter range, which is in the North Taiga Plains Ecological Zone of the Sahtu Settlement Area.

Predator–Prey Relationships

Predation is considered the single most important limiting factor of caribou population growth. Major predators of caribou include wolves, bears, lynx, only when hare populations are low, and hunters. Mortality rates of calves can be influenced to some extent by bald and golden eagles (Bergerud 2000).

Wolves are often observed in association with barren-ground caribou, especially in winter (Carruthers et al. 1986; McLean 1992; McLean and Jackson 1992). Carruthers et al. (1986) reported wolves in areas with high densities of wintering Bluenose caribou, particularly female-calf groups. The rate of wolf predation on the Bluenose herd is not known, although in other herds annual mortality rates from predation have been estimated as high as 10% (Parker 1972). Wolves are considered the primary predators of caribou, but grizzly bears have also been observed hunting caribou, especially targeting females and calves (Gunn and Miller 1986).

Movement Patterns

Movement patterns of the Cape Bathurst, Bluenose-West and Bluenose-East herds are discussed in the following sections.

Cape Bathurst

Radio-telemetry data indicates the Cape Bathurst herd leaves its wintering grounds in April and moves northeast to its calving area on Cape Bathurst Peninsula. Most females leave the wintering grounds, and the LSA, by May. The timing of male movements is not known. Females reach the calving grounds on the peninsula by early June and concentrate there until early July. Females begin to disperse in a southwest direction in mid-July and return to their wintering range by late October (Wright et al. 2002).

The timing of movements to and from wintering areas near the LSA might vary. Radio-telemetry data from 2002 to 2004 shows movement out of the LSA in December, with only a few caribou remaining in January (Nagy 2003, personal communication).

Bluenose-West and Bluenose-East

Movements were similarly timed for the Bluenose-West and Bluenose-East herds (Wright et al. 2002). The Bluenose-West herd moved northeast from its wintering grounds to calving areas in Tuktut Nogait National Park, and the Bluenose-East herd moved north from near Great Bear Lake to east of Bluenose Lake. Bluenose herd migration routes can vary between years, depending on the late-winter distribution of caribou (Banfield and Jakimchuk 1980).

Habitat Use

Little recent information is available on seasonal habitat use by the Cape Bathurst and Bluenose caribou herds. Therefore, information has been summarized from historical studies on the Bluenose herd (Kelsall 1968; Carruthers et al. 1986) and from other Arctic herds. In north-central Canada, barren-ground caribou occur in the northern tundra in the summer and the southern tundra and taiga in winter (Kelsall 1968; Miller et al. 1982). The northern landscape comprises tundra and barrens, and the southern treed landscape is primarily open-to-sparse black spruce with mosses and lichens (Fraser and Williams 1992).

Calving Grounds

Kelsall (1968) reported that caribou calving near Bluenose Lake favoured areas with high vegetation diversity and high moisture regime, i.e., poor drainage. These areas were classified as wet tundra and included pond margins, late snowbank areas, swamps and marshes.

Post-calving

During the post-calving period, caribou movements and habitat selection are greatly influenced by insect harassment, e.g., mosquitoes and oestrid flies (Kelsall 1968; Pollard et al. 1996). During summer, insects affect energy balance considerably by lessening food intake and by increasing energy expenditure (National Research Council 2003). As a result, caribou often move to the coast, where cooler, windier weather reduces mosquito numbers, or to promontories, pingos, river deltas, gravel bars, sand dunes, mud flats or snow banks, where insect concentrations are lower (Pollard et al. 1996). These areas typically support little forage, so caribou return to preferred forage areas when insect harassment diminishes in mid- to late-summer (Pollard et al. 1996).

Winter

In winter, barren-ground caribou movements and habitat selection are greatly influenced by food, i.e., lichen, availability (Banfield and Jakimchuk 1980) and predation (Carruthers et al. 1986). The primary winter food for caribou is lichen, particularly from the genera *Cladina*, e.g., *Cladina stellaris*, *C. rangifera*, *C. arbuscula*, and *C. mitis*, and *Cetraria*, *Stereocaulon*, *Peltigera*, *Alectoria* and *Cladonia* (Kelsall 1968). Other plants are also consumed, e.g., *Vaccinium* spp., *Carex* spp., and *Salix* spp., but at much lower quantities than lichen (Sims 1983). However, collectively, these other foods can exceed 50% of the total winter diet (Kelsall 1968).

Availability of thermoregulatory cover does not appear to be important in winter because caribou hair is extremely well insulating. Calves have shown no evidence of shivering at temperatures as low as -55°C (Kelsall 1968).

Food availability is affected by snow depth, density, hardness and icing (Kelsall 1968; Banfield and Jakimchuk 1980). Consequently, caribou might seek foraging areas with shallower and softer snow. In late winter, caribou in the Taiga Ecological Zone might also forage on arboreal lichens (Banfield and Jakimchuk 1980). During winter, caribou in tundra regions reportedly select xeric habitat types on windswept upland areas. These areas have little snow and provide easy access to forage, i.e., lichens. Low-lying areas with deep snow cover are avoided, although these areas might be used in winters with little snow because they have more forage. Carruthers et al. (1986) examined habitat use by the Bluenose caribou herd in the Taiga Ecological Zone during mid-winter. Availability and use of six vegetation and habitat types were assessed:

- lake and river
- open conifer
- herbaceous
- closed conifer
- burned forest
- shrub habitat types

Open habitats, e.g., lakes and rivers, were used more often than available, open coniferous forests were used in proportion to their occurrence, and all other habitats were used less often. Burned areas were one of the least preferred habitat types.

Male and female caribou in the Bluenose herd have been found to segregate in winter (Carruthers et al. 1986). Group composition, i.e., sex and age, differs a great deal between vegetation types. Male groups used open conifer forest more than female-calf groups, and female-calf groups used open habitats, e.g., lakes, fens and bogs, much more often than male groups. Caribou, especially female groups, selected landscapes with high densities of small lakes rather than areas with few large lakes (Carruthers et al. 1986). Caribou groups were also found at mean elevations of 250 m, with high densities in areas where snow depth averaged 62 cm (Carruthers et al. 1986), which is also the mean snow depth for forests less than 300 m in elevation. Snow depths in forests above 300 m in elevation averaged 68.4 cm. Females and calves were typically in habitats with higher snow depths, and males were found in forests with lower snow depths. Females using open habitats with deep snow might be a strategy to reduce wolf predation. Search time for wolves could increase in landscapes with a high density of small lakes and deep snow (Carruthers et al. 1986).

Modelling Results

Modelling results indicate that 29% of the Tundra Ecological Zone RSA is effective foraging habitat for barren-ground caribou, whereas 13% of the Transition Forest Ecological Zone is moderate-quality winter habitat with no high quality habitat (see Table 10-9).

10.3.1.2 Woodland Caribou

Status

Woodland caribou (*Rangifer tarandus caribou*) are listed as *sensitive* in the Northwest Territories (GNWT 2004) and as *at risk* in Alberta, where they are classified under the Wildlife Act (ASRD 2000). Regional differences in conservation status are an important consideration for this species. COSEWIC (2004) lists the boreal population in Alberta and the Northwest Territories as *threatened*, whereas the northern mountain population in the Northwest Territories is listed as *not at risk*. The recent upgrade of status from *vulnerable* to *threatened*, the increase in oil and gas exploration activity, and the limited information available on woodland caribou in the Northwest Territories prompted the GNWT and co-management boards to increase the importance of research on this VC (Olsen et al. 2001).

Table 10-9: Barren-Ground Caribou Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone			
	Tundra		Transition Forest	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	226,806	9	3	0
High	120,867	5	17	0
Moderate	382,828	15	113,731	13
Low	278,658	11	251,395	30
Very low	90,264	4	84,767	10
None	1,434,903	57	400,155	47
No data	23,253	1	9	0

Abundance and Distribution

Woodland caribou occur in the South Taiga Plains, North Taiga Plains and Transition Forest ecological zones, and occasionally in the Tundra Ecological Zone (see Figure 10-16) (Nagy 2003, personal communication). Two woodland caribou ecotypes are recognized in the Northwest Territories. Woodland caribou along the pipeline corridor are thought to represent the boreal ecotype. It is believed that the mountain ecotype caribou, including the 10,000 or more caribou in the Mackenzie Mountains (Bergerud 1980; Chetkiewicz and Marshal 1998a), do not migrate across the Mackenzie River and are not likely to interact with the project.

Population Size

Low woodland caribou densities are found along both sides of the Mackenzie River north to Travaillant Lake on the east and Tsiigehtchic on the west (Polar Gas Project 1986). However, no population estimates are available for the Gwich'in Settlement Area (Chetkiewicz and Marshal 1998a).

There is little data on past and current caribou population sizes in Alberta, but a recent assessment estimates 3,600 to 6,700 caribou inhabit about 113,000 km² of northern and west-central Alberta (ASRD 2000).

Population Density

Woodland caribou in northwestern Alberta are found at low densities in small isolated bands (Dzus 2001). Rough estimates of density suggest 1 to 3 woodland caribou/100 km^2 in the Northwest Territories (Olsen et al. 2001).

Figure 10.16 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Population Trends and Human Influences

Preliminary information based on local knowledge indicates that the population in the boreal ecotype is increasing in the Sahtu Settlement Area (GNWT 2004). Although woodland caribou mountain ecotype populations in the Deh Cho Region and Sahtu Settlement Area of the Northwest Territories are not considered threatened, surveys indicate that calf and cow ratios are below the threshold required for a stable population (Olsen 2000; Veitch et al. 2000; Shaw and Benn 2001).

Woodland caribou populations in northwestern Alberta are considered to be stable to declining, with an estimated population size of 3,600 to 6,700 (ASRD 2000). Based on habitat suitability and caribou distribution, the northwestern corner of Alberta is a designated caribou management zone where specific land-use guidelines for resource extraction activities apply (Dzus 2001).

Mortality

The primary limiting factors affecting woodland caribou populations are reported to be (Bergerud and Ballard 1988; Edmonds 1988; Cumming 1992; Rettie 1998):

- loss of habitat to development
- predation by wolves
- increased hunting pressure related to increased access in development areas

Because of reduced forage availability, late winter, i.e., March to April, is the critical season for woodland caribou survival, especially for females in an advanced stage of pregnancy (Nagy 2003, personal communication). In some areas, range expansion of white-tailed deer has introduced a fatal parasite into woodland caribou habitat (GNWT 2004).

Harvest pressure on woodland caribou is not high in the Sahtu Settlement Area as only 56 were harvested in 2001, compared with 2,561 barren-ground caribou (SRRB 2003). No woodland caribou were reported in the harvest studies for either the Gwich'in Settlement Area or Inuvialuit Settlement Region (Joint Secretariat 2003, GRRB 2004).

Seasonal Occurrence

Although the seasonal movements and distribution of woodland caribou in the Mackenzie Valley region are not well known, several seasonally important ranges have been identified near the pipeline corridor.

Northwest Territories Calving Grounds

Woodland caribou commonly move onto traditional calving grounds, where calves are born by early June. Islands off the northwest shore of Great Slave Lake (GNWT 2004), and the mountains along the South Nahanni River and at the headwaters of the Keele and Natla Rivers (Chetkiewicz and Marshal 1998a) serve as calving grounds for woodland caribou in the Northwest Territories.

Northwest Territories Wintering Areas

Tsiigehtchic is the only known wintering area in the Gwich'in Settlement Area (Chetkiewicz and Marshal 1998a). Elsewhere, known wintering areas include:

- Keele Valley
- Little Keele River Valley
- Mountain River
- Moose Horn
- Redstone
- Dhadinni River Valley
- Carcajou River Valley
- South Nahanni River
- rolling hills in Wrigley
- Camsell Bend area
- Drum Lake area
- around Virginia Falls

East of the Mackenzie River, caribou are known to winter in the Ebbutt and Redknife hills and on the Horn Plateau (Gray and Panegyuk 1989).

Northwest Territories Summer Ranges

Summer ranges for woodland caribou in the Northwest Territories include:

- McConnell Range
- Redknife Hills
- Horn Plateau
- Cameron Hills (Chetkiewicz and Marshal 1998a)
- Nahanni and Camsell ranges (Prescott et al. 1973a)

Northwestern Alberta Ranges

In northwestern Alberta, woodland caribou occur at low densities in small isolated bands (Shackleton 1999; Dzus 2001). According to ASRD (2000), the population of woodland caribou in Alberta is stable to declining with a population estimate from 3,600 to 6,700 individuals. In northwestern Alberta forests, caribou avoid linear features such as roads and seismic lines (Dyer 1999). The Bistcho Caribou

Range occurs within the study area (Dzus 2001). Currently, a range plan does not exist for the Bistcho Caribou Range but it is expected one will be implemented during the life of the project (Bentham 2003, personal communication).

Predator–Prey Relationships

Wolf predation is one of the most important factors limiting caribou population growth (Rettie and Messier 2000; Bergerud 2000). Logging and oil and gas development can reduce the availability of old-growth coniferous forests, opening the landscape to early successional species, including moose, deer and elk. These prey species support an increased density of wolves, which could increase predation pressure on woodland caribou.

Calf survival rates tend to be higher than in southern populations, e.g., northwestern Alberta, which might reflect a low predator density in the North. Although few wolves and bears were observed during aerial surveys in the region, residents of Fort McPherson indicate that wolf populations are increasing (Nagy 2003, personal communication).

Movement Patterns

Although little is known about woodland caribou movement patterns in the Mackenzie Valley region, it is thought that caribou move seasonally between preferred summer and winter ranges. In spring, pregnant females move onto traditional calving grounds, where they give birth in late May or early June. From August through the rut into late winter and early spring, caribou remain in small groups of 10 to 20 animals (Nagy 2003, personal communication).

Woodland caribou often associate in small herds and migrate between winter and summer ranges. In mountainous areas, they move 80 km or more between winter range in forested valleys and summer range in high alpine tundra. Seasonal movement between the lower-lying areas around Wrigley and the Ebbutt Hills and the McConnell Range and the Horn Plateau is relevant to the proposed project.

Home Range

Home range sizes for woodland caribou in northeastern Alberta average 711 km^2 in winter and 614 km^2 in summer (Stuart-Smith et al. 1997; Bradshaw et al. 1995).

Preliminary average home range size for female woodland caribou is 2,000 km^2, although one solitary female without a calf had a home range of 10,000 km^2. Telemetry data showed a large variability in home range size (Nagy 2003, personal communication).

Habitat Use

Woodland caribou typically prefer old growth coniferous forests, particularly black spruce forests and peatlands, which offer high concentrations of ground and tree lichens, their preferred forage (Bradshaw et al. 1995; Stuart-Smith et al. 1997; Rettie and Messier 2000). During the winter, caribou favour uplands, bogs and south-facing slopes, where snow is not so deep. During the summer, they use forest edges, marshes and meadows with fresh green vegetative growth. Woodland caribou might avoid habitat used by moose to avoid predation by wolves (Bergerud and Ballard 1988; Seip 1992; Rettie 1998).

Modelling Results

Habitat suitability modelling results for the RSA indicate that the North Taiga Plains Ecological Zone offers more high-quality winter foraging habitat than the South Taiga Plains Ecological Zone (see Table 10-10). In the North Taiga Plains Ecological Zone, 54% of the RSA was rated as effective habitat for winter foraging habitat compared with 46% in the South Taiga Plains Ecological Zone.

Table 10-10: Woodland Caribou Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone			
	North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	885,808	29	359,688	9
High	536,392	17	255,334	6
Moderate	260,883	8	1,234,824	31
Low	51,065	2	696,979	18
Very low	368,938	12	256,106	7
None	983,987	32	1,128,913	29
No data	269	<1	3,988	<1

10.3.1.3 Moose

Status

The moose (*Alces alces*) is listed as *secure* in both the Northwest Territories and Alberta (ASRD 2000; GNWT 2004) and is not listed nationally (COSEWIC 2004). Consultations with communities and resource managers indicate that the moose is a species of interest throughout the Mackenzie Valley region. Veitch et al. (1995) noted that moose *have been vital to the nutrition, economy, and culture of residents of the Mackenzie Valley for generations* and are the most accessible big-game species for hunters in the region.

Abundance and Distribution

Moose are widely distributed south of the treeline, and in summer they range into tundra areas where suitable shrubby habitat is locally available (Banfield 1974; Treseder and Graf 1985; GNWT 2004). Information from previous surveys and 2001 to 2003 baseline field studies conducted for the project indicate that moose inhabit each major ecological zone along the proposed pipeline route (see Figure 10-17). Although periodically observed in the production area during snow-free periods, moose occurrence in tundra habitats is considered seasonal or sporadic. Therefore, moose were identified as a VC only in the pipeline corridor.

Population Density

Recent data on the size and status of moose populations is lacking for many parts of the Mackenzie Valley region. Available survey results indicate moose densities are relatively low, i.e., 0.03 to 0.17 moose/km^2, compared with other parts of North America (GNWT 2004).

Treseder and Graf (1985) summarized moose surveys conducted in the Northwest Territories before 1985, including 11 aerial surveys in various parts of the Mackenzie Valley region between 1953 and 1984. The lowest densities were recorded in the Mackenzie Delta, which had an average of 0.006 moose/km^2. Low moose densities were also recorded in the Fort Simpson area, which had an average of 0.03 moose/km^2. The lower Mackenzie Valley between Fort Norman and Fort McPherson is perhaps the best moose habitat in the Mackenzie Valley region, with densities typically ranging from 0.05 to 0.17 moose/km^2.

Gwich'in Settlement Area

Because some communities in the Gwich'in Settlement Area expressed concern that moose populations in the region were declining, the Gwich'in Renewable Resource Board (GRRB), in conjunction with the GNWT, initiated a moose research project in the late 1990s (Marshal 1999; Marshal and Nagy 1999) and is currently developing a Moose Management Plan for the Gwich'in Settlement Area.

The GNWT and the GRRB conducted a series of aerial surveys in November of 1996, 1997 and 1998 and March 1998 in the Inuvik-Tsiigehtchic area on the east side of the Mackenzie Delta. The results showed an average density of about 0.06 moose/km^2.

Marshal and Nagy (1999) reported that, despite a lot of regularly disturbed early-successional habitat that appeared suitable for moose, moose densities in the study area, at 0.02 moose/km^2, were among the lowest reported in North America (Chetkiewicz et al. 1998c). The study area encompassed a large area between Inuvik and Tsiigehtchic on the east side of the Mackenzie Delta.

Figure 10.17 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Sahtu Settlement Area

Some of the best moose habitat in the Mackenzie Valley region is in the Sahtu Settlement Area. Systematic moose surveys in the region began in 1980, when Brackett et al. (1985) surveyed the entire Class 1 wintering habitat identified in the CWS atlas of Wildlife Habitat Inventory Maps (Prescott et al. 1973b). Observed densities along the Mackenzie Valley from Birch Island to Point Separation ranged from 0.04 to 0.27 moose/km^2, with the highest densities recorded between Little Chicago and Point Separation.

Detailed monitoring of moose population trends began in 1984 when Jingfors et al. (1987) employed a stratified random block design (Gasaway et al. 1986) to estimate the moose population density in a 3,100 km^2 block on the west side of the Mackenzie River west of Norman Wells. The same general area was subsequently surveyed from 1985 to 1988 (Stenhouse et al. 1995), in 1989 (Latour 1992) and in 1995 (Veitch et al. 1995). Over this period, the population density remained relatively stable at 0.15 to 0.17 moose/km^2.

The productivity of this moose population also remained relatively high between 1984 and 1995, with the November ratio of calves per 100 cows ranging from 44 to 56 (Veitch et al. 1995). In 1986 and 1987, Stenhouse et al. (1995) recorded a pregnancy rate of 96% for adults and 40% for yearlings.

Deh Cho Region

Recent information on moose population densities and trends is lacking for the part of the Mackenzie Valley that is in the Deh Cho Region. Surveys in the 1970s and early 1980s in the Wrigley and Fort Simpson areas indicate moose densities ranged from 0.01 to 0.05 moose/km^2 (Case et al. 1986; Jingfors et al. 1987).

Northwestern Alberta

There is limited information on moose densities within the Alberta portion of the study area. Moose densities in northwestern Alberta are generally estimated at about 0.2 moose/km^2 (Stelfox 1993). In Alberta, moose prefer mixed forests and frequent the edges of lakes, bogs, streams, and other wetland habitats (Smith 1993). In northwestern Alberta, moose limit their use of habitats near roads that are associated with oil and gas development (Jalkotzy et al. 1997).

Observed Moose Densities in the Study Area

Observed moose densities were low in 2002 and 2003. The 2002 pipeline corridor surveys found densities varied from 0.01 moose/km^2 in the Inuvialuit Settlement Region and Deh Cho Region to 0.05 moose/km^2 in the Gwich'in Settlement Area and 0.10 moose/km^2 in the Sahtu Settlement Area. In 2003, the density in the two blocks surveyed in the Gwich'in Settlement Area and the seven blocks surveyed in the Deh Cho Region were each 0.06 moose/km^2.

Population Trends and Human Influences

Gwich'in Settlement Area

Marshal and Nagy (1999) cited local knowledge as an indication that moose populations in the Gwich'in Settlement Area were decreasing. A possible factor was the age of the forest in the region. Local knowledge indicated moose densities in the region were higher in the 1970s when wildfire burns were five to 10 years old.

Information provided on the GNWT's Internet site (GNWT 2004) indicates:

- moose populations in the Gwich'in Settlement Area are increasing
- fires in the past five years are expected to result in a further increase in moose populations

Sahtu Settlement Area

Aerial surveys conducted by GNWT near Norman Wells indicate moose populations were relatively stable from 1984 to 1995 (Veitch et al. 1995).

Information on the GNWT's Internet site (GNWT 2004) indicates:

- moose populations in the Sahtu Settlement Area are increasing
- fires in the past five years are expected to result in a further increase in moose populations

Deh Cho Region

Information on the GNWT's Internet site (GNWT 2004) indicates moose populations near Fort Providence are decreasing. Moose population trends in the rest of the Deh Cho Region are not clear.

Northwestern Alberta

No concerns are listed for moose populations in northwestern Alberta.

Mortality

The reasons moose densities in the Mackenzie Valley region remain low relative to the apparent carrying capacity (Marshal and Nagy 1999) are not known. Hunting pressure is thought to be high near many communities, and some authors have expressed concern that annual moose harvests might be exceeding the population recruitment rate in certain areas (Prescott et al. 1973b; Brackett et al. 1985; Treseder and Graf 1985). However, Stenhouse et al. (1995) reported the annual moose harvest in the upper- and mid-Mackenzie Valley region has remained light, i.e., 4 to 5% of total moose population, primarily because of sparse human population and lack of road access. The GNWT (2004) indicates resident and nonresident hunters in the Northwest Territories harvest 800 to 1,000 moose annually. Harvest data from 1991 to 2001 indicates the total moose harvest in the Northwest Territories is declining. Data indicates average harvesting in each region as follows:

- in the Inuvialuit Settlement Region, 28 moose were harvested yearly with an apparently declining trend (Joint Secretariat 2003)
- in the Gwich'in Settlement Area, 35 moose were harvested in 1997 (GRRB 2004)
- in the Sahtu Settlement Area, 216 moose were harvested in 2001 (SRRB 2003).

Gasaway et al. (1992) described the results of a long-term study, from 1948 to 1988, of the roles of nutrition, snow conditions, disease, hunting and predation in limiting moose densities over large areas of central and eastern Alaska. Predation by wolves and bears annually removed 31% of the post-calving moose population. They concluded that in regions where wolves and bears were near the carrying capacity and where moose was a primary prey species, moose populations might persist in a low-density dynamic equilibrium for a very long time. Gasaway et al. (1983) suggested that the effects of mortality from severe winters, predation and hunting were largely additive. In interior Alaska, moose population declines have been attributed to periodic deep snow conditions, which lower moose-to-wolf ratios and effectively increase the impact of predation, causing moose populations to decline further or to remain at low densities.

Whether predation in the Mackenzie Valley region similarly limits moose population growth is not clear. In a detailed 1985 to 1988 study of moose near Norman Wells, Stenhouse et al. (1995) found that, although predation by wolves was the primary source of mortality and accounted for almost half of the known mortality of radio-collared female moose, both the mean annual survival rate of females, at 85%, and a calf survival rate of 80% to 93% over the first eight weeks were relatively high. In contrast, Ballard and van Ballenberghe (1997) found calf survival in Alaska can be as low as 17% in the first eight weeks of life, and Gasaway et al. (1992) reported that calf mortality rates in the first five months following birth averaged 55% in an expanding moose population and 89% in a declining population.

Seasonal Occurrence

Important winter habitat areas include the islands and floodplains of the Mackenzie River, riparian habitats associated with lakes and tributary streams and, regenerating burns (Brackett et al. 1985; Jingfors et al. 1987; Latour 1992; Benn 1999). Prescott et al. (1973b) reported that river valleys and floodplains provide the best year-round habitat in the region and are particularly important in winter. The authors documented heavy use by moose of islands in the Mackenzie River region, where frequent flooding and ice scouring keep extensive stands of willow at an optimum successional stage.

Ruttan (1972) reported that major moose wintering areas in the Mackenzie River basin included the Kakisa River drainage, wooded islands between Wrigley and Fort Good Hope, and the Travaillant River drainage. He also suggested tributary stream valleys serve as travel routes for moose moving between inland summer range to winter range on the islands and floodplains of the Mackenzie River region.

Predator–Prey Relationships

The timber wolf is the principal predator of moose in the Northwest Territories. In the Yukon and Alaska, calf predation by grizzly and black bears has been shown to have a major effect on moose populations. This might also be true in the Northwest Territories, but no data is available. Wolverines also prey on moose calves occasionally (CWS 2002).

Predation and snow conditions are interrelated factors that can have a notable effect on moose numbers. When snow is deep and moose yard together, they are more accessible to wolves (GNWT 2004). Moose have relatively long legs that allow them to travel through deep snow more easily than most other ungulates. However, snow more than 90 cm deep greatly hinders movement and restricts moose foraging. Crusted snow can also be detrimental to moose because it can pierce the skin on the forelegs and crack the hooves, making the moose more vulnerable to predation (GNWT 2004).

Movement Patterns

Several authors have suggested that moose in the Northwest Territories move or shift seasonally between winter ranges on the Mackenzie River region floodplains or major tributary valleys and adjacent upland summer ranges (Ruttan 1972; Walton-Rankin 1977). The only detailed study of moose movements in the Mackenzie Valley region involved radio tracking 30 female moose over a three-year period in a 2,838-km^2 area near Norman Wells (Stenhouse et al. 1995). These researchers also reported seasonal home ranges overlapped widely, indicating the moose were nonmigratory.

Moose appear to move seasonally at the northern extent of their range. Winter and spring aerial surveys of the production area confirmed local knowledge that a few moose occupy suitable foraging habitat on the tundra and outer delta in summer, but are absent in winter (IEG 2002). In his review of moose movement patterns, Huntermark (1997) concluded that moose populations can have both migratory and nonmigratory segments, and movement to winter ranges is primarily triggered by snow accumulation and limited access to forage.

Local knowledge needs to be considered to better understand moose movement patterns. For example, at the Sahtu Settlement Area technical workshop in June 2003 at Norman Wells, Dene Elders pointed out that moose migrate around the Little Chicago area and make their way to the river.

Home Range

On the basis of a radio-telemetry study of 30 female moose near Norman Wells, Stenhouse et al. (1995) reported that home range sizes of individual female moose varied from 40 km^2 to 942 km^2, with a mean of 174 km^2. Fall home ranges were twice as large as winter and summer home ranges, although seasonal home ranges overlapped widely. No regional information is available on home range sizes of male moose. In other regions, larger home ranges have been recorded for males than for females (Ballard et al. 1991).

Habitat Use

Prescott et al. (1973b) classified and mapped moose habitat in the Mackenzie Valley region at a scale of 1:250,000. They concluded that suitable winter habitat availability was a critical factor for moose populations in the Mackenzie Valley region because the land areas used by moose in winter were so small. Suitable winter habitats were restricted to riparian areas of stream or river valleys and lake margins and to five- to 50-year-old burns on upland sites.

Riparian habitats in major river valleys supported most of the moose population in winter, with upland site use mostly limited to slopes where snow was less restrictive. Particularly important along these drainages were the alluvial floodplains that provided an abundance of preferred winter browse species and snow conditions that are less restrictive to movement and foraging.

Subsequent surveys have confirmed the importance of recent burns and riparian habitats located on Mackenzie River islands and floodplains and some of its major tributaries as moose winter range (Jingfors et al. 1987; Veitch et al. 1995).

Browse surveys conducted throughout the Mackenzie Valley in the 1970s (Walton-Rankin 1977) indicated that successional species such as willow, balsam poplar and red osier dogwood comprised about 90% of the browse consumed, with willow accounting for 52% of the winter diet. Areas of abundant forage included (Decker and Mackenzie 1980):

- sites burned in the past 10 years
- wetland complexes
- floodlands subject to periodic disturbance

There is little recent information on moose habitat characteristics in the Mackenzie Valley region. Marshal and Nagy (1999) investigated browse availability and selection in the Mackenzie Delta in relation to habitat type and snow depth. Browsing by moose was recorded in just one of the six habitat types sampled around Inuvik and Tsiigehtchic. Because the browsing intensity on willow and other suitable browse species was less than 1% of the available browse, the authors concluded that browse availability was not limiting the moose population in that region. Based on snow depth and density measurements, they also concluded that snow depths did not restrict moose movement or foraging in the habitat types sampled.

Modelling Results

Modelling results for the RSA indicate that 54% of the Transition Forest Ecological Zone, 71% of the North Taiga Plains Ecological Zone and 52% of the South Taiga Plains Ecological Zone is effective habitat for moose (see Table 10-11).

Table 10-11: Moose Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone					
	Transition Forest		North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	134,281	16	418,070	14	571,246	15
High	269,008	32	697,885	23	166,712	4
Moderate	48,310	6	1,046,898	34	1,296,107	33
Low	132,130	16	412,230	13	1,051,904	27
Very low	45,280	5	41,524	1	148,234	4
None	220,284	26	470,618	15	697,665	18
No data	783	1	117	0	3,962	<1

10.3.1.4 Grizzly Bear

Status

In Canada, the grizzly bear (*Ursus arctos*) is classified as a species of *special concern*, i.e., a species that might become threatened or endangered because of a combination of biological characteristics and identified threats (COSEWIC 2004). In the Northwest Territories, where grizzly bear populations are currently stable, the species is listed as *sensitive*, i.e., a species not at risk of extinction or extirpation, but which might require special attention or protection to prevent them from becoming at risk (GNWT 2004).

Abundance and Distribution

The highest densities of grizzly bear densities in the Northwest Territories are in the Mackenzie Mountains. Grizzly bears prefer open or semi-forested areas in all parts of their range (see Figure 10-18) (GNWT 2004). They are most common in alpine and subalpine terrain or on the tundra, but sightings in the boreal forest are not unusual (GNWT 2004).

Grizzly bears in the Northwest Territories are divided into four distinct populations based on the ecosystems they inhabit:

- Arctic coastal
- Arctic mountain
- northern interior
- barren-ground

Arctic coastal grizzly bears occupy the area between Inuvik and Coppermine and are particularly abundant on Richards Island west of the Tuktoyaktuk Peninsula. Arctic mountain grizzly bears are found mostly in the northern Yukon from the Alaska boundary to the Richardson Mountains, which overlap the northwestern part of the Northwest Territories. The northern interior grizzly bear population ranges throughout northern British Columbia, most of the Yukon and into the southern Mackenzie Delta region. The barren-ground grizzly bear occupies the northern and eastern parts of the Northwest Territories and central Nunavut.

The ranges of both the barren-ground and northern interior grizzly bears extend into the project area.

Population Size

There are 4,000 to 5,000 grizzly bears in the Northwest Territories with an estimated resident population of 1,000 bears aged two years or older in the Inuvialuit Settlement Region (Nagy and Branigan 1998).

Figure 10.18 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

It was recently estimated that 420 grizzly bears over the age of two live in the Gwich'in Settlement Area (GRRB 2000). The estimate was based partly on a population study conducted in the Richardson Mountains in 1992 to 1993. There is no quantitative information on grizzly bear populations in the Deh Cho Region or Sahtu Settlement Area.

Population Density

Studies of grizzly bear populations in the Inuvialuit Settlement Region over the past few decades have generated a range of density estimates for different periods and geographic locations. Reported densities vary from 4 to 8 bears/1,000 km^2 (Curatolo and Moore 1975; Pearson and Nagy 1976; Harding and Nagy 1978; Nagy et al. 1983). The most recent density estimate for the Inuvialuit Settlement Region is 7 to 8 bears/1,000 km^2 (Nagy 2003, personal communication).

In the Sahtu Settlement Area of the Mackenzie Valley region, grizzly bear density is estimated at 4 to 5 bears/1,000 km^2 (Veitch 2003, personal communication; Popko 2003, personal communication). Estimates of grizzly bear population densities in the Gwich'in Settlement Area or the Deh Cho Region are not available.

Population Trends and Human Influences

Grizzly bears are widely distributed in the Mackenzie Delta, where community members have recently reported that numbers appear to be increasing.

Grizzly bears reproduce at a slow rate. Females have their first cubs at six to nine years of age, with subsequent litters every three to four years. The breeding season is between the end of May and the end of July (Nagy et al. 1983) and cubs are born in the den between mid-January and mid-March. On average, two cubs are born in a litter. Cubs stay with their mothers for two or three years. Females often produce only four or five litters in their lifetime (GNWT 2004).

Grizzly bear populations are affected by both harvesting and habitat alteration. As mineral and energy exploration, outfitting camps and road developments increase in the Northwest Territories, contact increases between humans and bears. This sometimes results in bears being destroyed or displaced from important habitats.

Bears tend to avoid humans. This avoidance might cause the bears to abandon large sections of their home range. Indirect evidence indicates that noise from the following activities can cause bears to abandon their dens:

- helicopter (Quimby 1974)
- seismic vehicle
- gravel mining operations (Harding and Nagy 1980)
- nonmotorized human activity

Den abandonment can lead to cub mortality (Lindell et al. 2000).

Lindell et al. (2000) found grizzly bears selected den sites at least 1 or 2 km from human activity, e.g., roads, industrial activity. Activity closer than 1 km and especially within 200 m of a den caused various responses, including abandonment. Many factors, including habituation, age and sex class can influence response to denning disturbance. However, den abandonment following human disturbance will not always lead to deleterious effects if alternative denning areas are available within a bear's home range (Lindell et al. 2000).

Mortality

Adult female survival and low reproductive output are believed to be biological limiting factors for Northwest Territories' grizzly bears. Also, it is common for male grizzly bears to kill cubs (GNWT 2004).

Most grizzly bear deaths in the RSA are caused by hunting or other anthropogenic factors, as adult grizzly bears have no predators other than humans.

Inuvialuit Settlement Region

Grizzly bear hunting areas were established around Paulatuk and Tuktoyaktuk in 1986 and 1989 and in Inuvik and Aklavik during 1994. A harvest rate of 3% of bears aged two years and older was used to estimate the annual total allowable harvest for each community hunting area. No more than 33% of harvested bears can be female.

Grizzly bears in the Inuvialuit Settlement Region are co-managed under the Inuvialuit Final Agreement (IFA) by:

- GNWT
- Yukon Territorial Government (YTG)
- Hunters and Trappers Committee (HTC) representatives from:
  - Aklavik
  - Inuvik
  - Paulatuk
  - Tuktoyaktuk
- Inuvialuit Game Council (IGC)
- Wildlife Management Advisory Council ([WMAC], Northwest Territories)
- Wildlife Management Advisory Council for the North Slope (WMAC-[NS]) (Nagy and Branigan 1998)

The GNWT Inuvik Region maintains a harvest database dating back to 1986. Of the nine grizzly bear harvest and management areas in the Inuvialuit Settlement Region, two, the Aklavik-Inuvik Grizzly Bear Management Area (GBMA) and the Inuvik GBMA directly overlap the RSA, and a third, the Tuktoyaktuk-West GBMA, overlaps the northeastern corner of Richards Island and Taglu.

Recent grizzly bear population estimates, densities, and allowable harvests for these three areas are:

- for the Aklavik-Inuvik GBMA:
  - 11 bears over the age of two
  - three bears per 1,000 km^2
  - total allowable harvest of zero bears per year
- for the Inuvik GBMA:
  - 29 bears over the age of two
  - 4.2 bears per 1,000 km^2
  - total allowable harvest of one bear per year
- for the Tuktoyaktuk GBMA:
  - 214 bears over the age of two
  - six bears per 1,000 km^2
  - total allowable harvest of six bears per year

However, in the Inuvialuit Settlement Region, an average of 10 grizzly bears was harvested yearly (Joint Secretariat 2003).

Gwich'in Settlement Area

Grizzly bears are co-managed under the Gwich'in Comprehensive Land Claim Agreement for the Gwich'in Settlement Area. Following a large grizzly bear harvest in the Richardson Mountains in 1992, the GRRB and GNWT supported a voluntary ban on grizzly bear hunting until a grizzly bear management plan was completed. The voluntary ban ended in 1997 and a Grizzly Bear Management Agreement was put in place April 1, 1998 (GRRB 2000).

The grizzly bear harvest in the Gwich'in Settlement Area is currently managed under quota on a sustained yield basis. The quota for each habitat zone was calculated as 3% of the estimated population of bears two years of age and older. The number of harvested females must not exceed 33% of the total harvested bears (GRRB 2000).

The total allowable human kill of grizzly bears for the Gwich'in Settlement Area was estimated to be 12 bears per year, which includes the combined effects of:

- subsistence hunting
- deaths resulting from the defence of life and property
- guided hunting
- illegal kills (GRRB 2000)

However, no grizzly bears were reported in the harvest studies the Gwich'in Settlement Area between 1995 and 1997 (GRRB 2004).

Under the Grizzly Bear Management Agreement, the GRRB, GNWT and RRC review grizzly bear kill data each year, and if total kills exceed the total allowable mortality rate caused by humans for three consecutive years, allowable harvest rates might be reduced. As of 2000, grizzly bear mortality data had not been analyzed to reassess populations and mortality quotas. Consequently, mortality levels and population trends in the Gwich'in Settlement Area and corresponding ecological zones are unavailable at this time.

Sahtu Settlement Area and Deh Cho Region

The harvest study in the Sahtu Settlement Area indicates that no bears were harvested in recent years (SRRB 2003). No information is currently available on grizzly bear mortality trends and management in the Sahtu Settlement Area and Deh Cho Region.

Seasonal Occurrence

Spring

On the Tuktoyaktuk Peninsula and Richards Island, Nagy et al. (1983) reported that grizzly bears feed on herbaceous plants, grasses and sedges during April and May. Reindeer and roots of Eskimo potato (*Hedysarum* spp.) were also eaten, along with carrion where available. Along the Arctic coastal plain of Alaska, an area ecologically similar to most of the Inuvialuit Settlement Region, Shideler and Hechtel (2000) reported that *Hedysarum* roots were eaten shortly after den emergence and before green-up. *Hedysarum* is found on river terraces and bars and other well-drained sites.

Waterfowl eggs and nestlings are also an important early-season food source in some regions of the western Arctic (Hechtel 1985; Shideler and Hechtel 2000; Burgess and Ritchie 1988). Ptarmigan and Arctic fox pups (Shideler and Hechtel 2000) are other spring foods less commonly eaten. Waterfowl nesting colonies, e.g., on Richards Island at Kendall Island Bird Sanctuary and along the Arctic coast, are important food sources for grizzly bear, especially females with cubs, in late May, June and July (Nagy 2003, personal communication).

Shideler and Hechtel (2000) described grizzly bears relying on the Arctic ground squirrel as a staple food in the Alaskan oil field region where they are widely distributed, abundant and available in seasons when bears are active. They are particularly important in spring and late fall when other food sources are unavailable. On the Alaska coastal plain and foothills, ground squirrels were often found in well-drained terrain such as sand dunes, stream banks, pingos and alluvial hills. Nagy et al. (1983) also reported extensive consumption of ground squirrels during fall and indicated they could also be an important food source for grizzly bears in the Inuvialuit Settlement Region in spring. Carrion is considered an important food source in the spring, especially where it has accumulated because of winter and spring harvesting (Popko 2003, personal communication; Veitch 2003, personal communication; Nagy 2003, personal communication). Foraging on caribou remains has been noted at Parsons Lake (Nagy 2003, personal communication).

Summer

On the Tuktoyaktuk Peninsula and Richards Island, Nagy et al. (1983) reported grasses, sedge and horsetails were the predominant food, and reindeer, crowberries (*Empetrum nigrum)*, kinnikinnick (*Arctostaphylos uva-ursi)* and blueberries (*Vaccinium myrtilloides*) were also eaten.

Pearson and Nagy (1976) reported general observations in the relatively homogeneous and elevated area between Tuktoyaktuk and Inuvik, where bears moved to low-lying coastal areas in June with a definite shift to uplands as green-up occurred. Berries and ground squirrels became important food once bears moved to upland habitats. A distinct correlation exists between habitat selection and food availability, and in this regard, ground squirrels are important.

Fall

Nagy et al. (1983) reported extensive predation upon Arctic ground squirrels on the Tuktoyaktuk Peninsula and Richards Island in August and September. Arctic ground squirrels were most often found in well-drained habitats. Herbaceous plants, berries, e.g., crowberry (*Empetrum nigrum*), alpine bearberry (*Arctostaphylos rubra*), bog bilberry (*Vaccinium uliginosum*) and bog cranberry, *(Vaccinium vitis-idaea*) and roots of Eskimo potato were also eaten in late summer and fall.

In studies conducted in the Mackenzie Delta from 1974 through 1978, the CWS recorded almost exclusive consumption of Arctic ground squirrels as food from late August through September. F.F. Slaney and Company Ltd. (1974) reported high densities of ground squirrel burrows in open vegetation types, e.g., xeric gravel and dwarf shrub heath that have well-drained, sandy or gravelly soils.

On the Alaskan Arctic coastal plain and inland foothills, Shideler and Hechtel (2000) observed foraging on green vegetation with later season phenologies, but the primary food was berries. Alpine bearberry was most common on the coastal plain, and blueberry, buffaloberry (*Shepherdia canadensis*) and crowberry were increasingly used on upland sites. Berries are important in the fall for barren-ground grizzly bears (Nagy 2003, personal communication) and very important for boreal grizzly bear in the North Taiga Plains Ecological Zone and South Taiga Plains Ecological Zone (Veitch 2003, personal communication; Popko 2003, personal communication).

Predator–Prey Relationships

Ground squirrels are an important item in the grizzly bear diet, particularly in fall just before bears hibernate and again in early spring, soon after bears have emerged and before new vegetation and ground-nesting birds are available.

Caribou, the most common food of grizzly bears, was identified by fecal analysis, with high volumes appearing in spring, mid-summer and fall. Direct observation and communication with other researchers in 1995 and 1996 showed that while these bears did eat caribou carrion, they were also effective predators of live caribou (Nagy 2003, personal communication). Grizzly bears also prey and scavenge on barren-ground caribou on the Arctic coastal plain of Alaska in spring, summer and fall, often on calves in spring and early summer on calving grounds (Shideler and Hechtel 2000). Caribou were a primary food source in the West Kitikmeot region of central Northwest Territories (McLoughlin et al. 1999).

In 1995, BHP Diamonds Inc. documented grizzly bears killing 26 caribou, including adults, yearlings and calves. In 1996, grizzly bear monitoring by BHP was more intensive, documenting 61 caribou killed by bears (Banci and Moore 1997).

Two critical nutritional periods were identified. Early summer, before the return of the Bathurst caribou herd from their calving grounds, was when barren-ground grizzly bears were in their poorest condition nutritionally (Banci and Moore 1997). Usable grizzly bear fat reserves were as low as 1 to 2% but improved upon the return of mixed post-calving herds of caribou to the study area (Banci and Moore 1997).

Late summer, when grizzly bears enter a state of hyperphagia (excessive ingestion of food), is also considered critical, as bears need to accumulate large fat reserves during hyperphagia to survive winter hibernation.

In contrast, studies on grizzly bears in the Yukon and the western Northwest Territories have determined that the bears are mostly herbivorous and predation is opportunistic (Pearson 1975; Miller et al. 1982; Nagy et al. 1983; Bromley 1988; MacHutchon 1996).

Studies from 1974 to 1977 showed grizzlies ate ground squirrels almost exclusively in late August and September when they were adding fat deposits (Pearson and Associates 1980).

Movement Patterns

Few detailed studies exist on the movement patterns of grizzly bears in the project area. Pearson and Nagy (1976) reported that grizzly bears between Tuktoyaktuk and Inuvik move to low-lying coastal areas in June, and then shift toward upland habitats as green-up occurs. Grizzly bears reportedly cross East Channel and other channels in fall and spring, indicating that waterbodies are not barriers to movement (F.F. Slaney and Company Ltd. 1975).

Home Range

Grizzly bears in the Northwest Territories live mostly in open alpine or tundra habitats, but they can also be found in forested areas. They have larger home ranges than most other bear species. A male's range can extend over 2,000 km^2, whereas a female's range is about half that size (GNWT 2004). Grizzly bears on the central barrens seem to need even larger home ranges. Research has shown that grizzly bears on the tundra use a home range up to 6,700 km^2 for males and 2,100 km^2 for females (GNWT 2004). Grizzly bears require an adequate food supply, proper denning sites and protection from human disturbances.

Nagy and Branigan (1998) reported that grizzly bears in the Inuvialuit Settlement Region use annual home ranges up to 2,000 km^2.

On Richards Island and the Tuktoyaktuk Peninsula during the 1970s, Nagy et al. (1983) estimated average annual home ranges of 1,154 km^2 for adult males, where n = 7, 644 km^2 for females without cubs, where n = 18, and 695 km^2 for females with cubs, where n = 5. Male and female grizzly bear home ranges overlap, and female home ranges appear to be related to reproductive status (Nagy et al. 1983).

In Ivvavik National Park, annual home ranges were from 52 to 276 km^2 for adult females and from 69 to 940 km^2 for males (Nagy and Branigan 1998).

There have been no studies to determine grizzly bear home ranges in the Gwich'in Settlement Area, Sahtu Settlement Area and Deh Cho Region.

Habitat Use

Grizzly bears are wide-ranging, opportunistic omnivores that use a variety of habitats through the seasons. Throughout grizzly bear range in the Northwest Territories, the distribution and quality of available habitats vary markedly between ecological zones. In general, the tundra and open forests of the Inuvialuit Settlement Region and Gwich'in Settlement Area and the mountainous regions of the Sahtu and northern Deh Cho Region are relatively good grizzly habitat, whereas most of the southern part of the pipeline corridor, south of Willow Lake River, is low-quality grizzly bear habitat (Larter 2003, personal communication; Veitch 2003, personal communication). Extensive burns along the project study area could provide varied habitat quality in the future depending on the age of the burn and stage of regeneration. The Richardson and Mackenzie Mountains west of the pipeline corridor contain the Northwest Territories' primary grizzly bear habitats (Nolan et al. 1973; Watson et al. 1973).

Inuvialuit Settlement Region

Based on a 1:250,000 scale habitat inventory conducted by the CWS in 1972, the proposed pipeline corridor in the Inuvialuit Settlement Region is good- to high-quality grizzly bear habitat (Nolan et al. 1973; Watson et al. 1973). The area from the Gwich'in boundary near Inuvik north through the Caribou Hills, Richards Island and the Tuktoyaktuk Peninsula was commonly to extensively used by grizzly bears. Grizzly bears are expected to be common throughout the Caribou Hills, which have potential denning habitat along their west slopes. Farther north, the low-relief, open tundra setting of Richards Island and the Tuktoyaktuk Peninsula were classified as Class 2 habitats, with minor grizzly bear habitat limitations. The availability of denning habitat and migrating barren-ground caribou were thought to be the reasons for the large grizzly bear population in the Inuvialuit Settlement Region compared with the smaller population in the forested boreal regions of the Sahtu Settlement Area and Deh Cho Region to the south.

Denning allows grizzly bears to hibernate and maintain homeothermy through long winters in the Inuvialuit Settlement Region. Dens are also essential for females to give birth in a safe environment. Grizzly bear den throughout the Inuvialuit Settlement Region, including areas that overlap the pipeline corridor and production area (F.F. Slaney and Company Ltd. 1975; Harding and Nagy 1978; Nagy et al. 1983; Nagy and Branigan 1998). Denning habitat has been noted as a possible limiting factor (Lentfer et al. 1972; Ruttan 1974; Pearson 1975; Harding and Nagy 1978). Disturbance of den sites might have an adverse effect on grizzly bear populations (Nolan et al. 1973; Watson et al. 1973; CAGPL 1975). However, in the 1970s, several snow dens were observed, and results indicated that bears can and do survive if displaced from a soil den by disturbance (Nagy 2003, personal communication).

On the Tuktoyaktuk Peninsula and Richards Island, grizzly bears excavated dens in south- or west-facing lake or channel banks (Nagy et al. 1983; Nagy and Branigan 1998). Dens were between sea level and an elevation of 30 m. Most dens were excavated in soil, although a few were excavated in snow, and most dens collapsed during the spring melt. Denning habitat was not considered limiting in this area (Nagy and Branigan 1998).

F.F. Slaney and Company Ltd. (1975) undertook a four-year den survey of the Mackenzie Delta in the early 1970s. The landforms and soil types that characterize grizzly bear den sites are found throughout the uplands of Richards Island and Parsons Lake, although the authors did not locate many dens at Parsons Lake. All dens were on the steep banks of lakes or river channels, and most were in sandy and silty soil in morainal outwash deposits, uplifted marine sediments and Pleistocene river deposits (F.F. Slaney and Company Ltd. 1974). Affinity for den areas varied. Over the survey period, some bears moved long distances to new denning areas between years whereas others denned near previous den sites. A previous year's den was seldom reused. Of 32 dens, only three had been previously occupied (F.F. Slaney and Company Ltd. 1975).

On the Alaska North Slope and at elevations higher than 600 m, grizzly bears typically excavated dens in soil or talus, and on southeast-facing slopes they excavated dens at elevations averaging 618 m (Nagy and Branigan 1998). Grizzly bears similarly excavated dens on south-facing slopes in Ivvavik National Park.

Gwich'in Settlement Area

The proposed pipeline corridor in the Gwich'in Settlement Area leaves the Mackenzie River region near the Thunder River confluence and extends northwest toward Inuvik and the Inuvialuit Settlement Region boundary. North of Travaillant Lake, the corridor enters the Transition Forest Ecological Zone that extends north to the Inuvialuit Settlement Region boundary. The entire pipeline corridor in the Gwich'in Settlement Area is within what CWS classified as low-habitat capability for grizzly bear, because of:

- poor interspersion of habitat
- homogenous spruce forest
- low, undulating terrain with little relief

Biologists observed grizzly bear tracks in this area during aerial surveys in the early 1970s (Nolan et al. 1973; Watson et al. 1973).

Apart from the CWS habitat inventory conducted in the 1970s, researchers have done no other grizzly bear habitat studies in the eastern half of the Gwich'in Settlement Area where the project occurs (GRRB 2000).

Sahtu Settlement Area

The proposed pipeline route usually runs parallel to the Mackenzie River in the Sahtu Settlement Area. CWS habitat mapping indicates that the pipeline route on the east side of the Mackenzie River is considered poor grizzly bear habitat mainly because of low relief and homogenous stands of black spruce forest (Nolan et al. 1973; Watson et al. 1973).

Moderate- to very high-quality habitats are found in the hilly and mountainous terrain in or near the Mackenzie Mountains west of the pipeline corridor (Nolan et al. 1973; Watson et al. 1973). The highest quality grizzly bear habitat on the east side of the Mackenzie River and near the pipeline corridor was Class 3 habitat from the Tulita Lake area northwest to Little Chicago and the Sahtu Settlement Area and Gwich'in Settlement Area boundary. Grizzly tracks were observed in this area by CWS biologists during mapping in the early 1970s.

The Franklin Mountains northwest to southeast of Norman Wells are good grizzly bear habitat (Benn 2003, personal communication). The Oscar Pass to Gibson Gap region was noted during preliminary consultations with GNWT biologists as providing denning habitat (Popko 2003, personal communication). The Fort Good Hope area is also thought to have good denning habitat.

Deh Cho Region

The segment of the pipeline corridor in the Deh Cho region is in the South Taiga Plains Ecological Zone. Most of the areas on the east side of the Mackenzie River, where the pipeline corridor is located, and in low-lying forested areas on the western floodplain were mapped as having severe limitations for grizzly bears and is considered poor habitat (Nolan et al. 1973; Watson et al. 1973). However, occasional occurrences of grizzly bears are expected in these areas. Near the pipeline corridor, but not directly intersecting it, are better quality Class 2 and 3 habitats. Class 2 habitats have minor limitations for grizzly bears and possess most requirements essential to support the species. Class 2 habitats near the pipeline corridor include the Nahanni and Camsell ranges of the Mackenzie Mountains west of the study area. Class 3 habitats, with moderate to severe limitations for grizzly bears, are along most of the west side of the Mackenzie River. The McConnell Range near Wrigley is considered relatively good grizzly bear habitat and is similar to habitat in the Mackenzie Mountains (Nolan et al. 1973; Watson et al. 1973).

Modelling Results

Modelling results indicate the available effective grizzly bear habitat in the RSA of the Tundra Ecological Zone as follows:

- fall foraging habitat – 12% (see Table 10-12)
- denning habitat – 18% (see Table 10-13)
- spring foraging habitat – 37% (see Table 10-14)

Modelling results indicate the Transition Forest Ecological Zone has the following percentage of available effective habitat:

- fall foraging habitat – 6%
- denning habitat – 3%
- spring foraging habitat – 22%

Table 10-12: Barren-Ground Grizzly Fall Foraging Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone			
	Tundra		Transition Forest	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	0	0	2,767	<1
High	121,251	5	4,506	1
Moderate	185,380	7	42,816	5
Low	279,062	11	147,238	17
Very low	804,961	31	294,128	35
None	1,065,983	42	349,127	41
No data	100,942	4	9,496	1

Table 10-13: Barren-Ground Grizzly Bear Denning Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone			
	Tundra		Transition Forest	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	335,172	13	14,285	2
High	129,773	5	10,783	1
Moderate	6,077	0	0	0
Low	134,713	5	33,324	4
Very low	1,885,811	74	758,706	89
None	66,033	3	32,979	4
No data	0	0	0	0

Table 10-14: Barren-Ground Grizzly Spring Foraging Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone			
	Tundra		Transition Forest	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	11,090	0	5,212	1
High	446,886	17	28,250	3
Moderate	520,146	20	149,046	18
Low	333,895	13	423,129	50
Very low	118,672	5	8,327	1
None	1,103,637	43	236,104	28
No data	23,253	1	9	0

Modelling results indicate the North Taiga Plains Ecological Zone in the RSA has a moderate to very high percentage of available effective habitat as follows:

- fall foraging habitat – 66% (see Table 10-15)
- denning habitat – 21% (see Table 10-16)
- spring foraging habitat – 72% (see Table 10-17)

Modelling results indicate the South Taiga Plains Ecological Zone has the following available effective habitat:

- fall foraging habitat – 52%
- denning habitat – 22%
- spring foraging habitat – 87%

Table 10-15: Northern Interior Grizzly Fall Foraging Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone			
	North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	504,393	16	573,634	15
High	1,488,405	48	184,453	5
Moderate	45,670	1	1,267,254	32
Low	401,896	13	1,403,505	36
Very low	167,092	5	268,852	7
None	479,631	16	234,143	6
No data	256	<1	3,989	<1

Table 10-16: Northern Interior Grizzly Denning Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone			
	North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	172,085	13	248,608	14
High	143	<1	2,056	<1
Moderate	120,227	9	128,241	7
Low	27,552	2	142,217	8
Very low	1,050,779	77	1,225,280	70
None	1,365	<1	2,864	<1
No data	0	0	0	0

Table 10-17: Northern Interior Grizzly Spring Foraging Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone			
	North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
Very high	505,148	16	605,796	15
High	1,532,360	50	1,104,645	28
Moderate	171,307	6	1,723,215	44
Low	315,715	10	88,620	2
Very low	84,558	3	196,666	5
None	478,016	15	212,917	5
No data	238	<1	3,973	<1

10.3.1.5 Marten

Status

The marten (*Martes americana*) is not a species at risk in either the Northwest Territories or Alberta (GNWT 2004; ASRD 2000), and is not listed nationally by COSEWIC (2004).

Abundance and Distribution

Marten are distributed across northwestern Alberta and the Northwest Territories (see Figure 10-19), although they occasionally range beyond the treeline to the Arctic coast (Banfield 1974; Chetkiewicz and Marshal 1998b; Smith 1993). Winter track surveys indicate marten occur along the length of the proposed pipeline route.

Population Size

Marten in the Northwest Territories are among the largest in North America and have one of the highest reproductive capacities documented for the species (Poole 1990). A recent genetic study in the Yukon and Northwest Territories suggests that northern marten populations are connected by high levels of gene flow (Kyle et al. 2001). The Northwest Territories population size is unknown but greater than 10,000 (GNWT 2004).

Population Density

Population densities of marten in the Mackenzie Valley have not been reported. Density estimates over the entire species distribution ranges from 0.4 to 2.4 marten/km^2 (Clark et al. 1987).

Figure 10.19 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Population Trends and Human Influences

Populations of marten in the Northwest Territories exhibit delayed fluctuations according to population cycles of prey species (GNWT 2000).

Mortality

On average, marten in the wild live five to six years, although some live as long as 14 years (Strickland and Douglas 1987). Little is known about natural mortality rates or sources of natural mortality in marten populations. Predators include fisher (*Martes pennanti*), coyote (*Canis latrans*), lynx (*Felis lynx*), great-horned owl (*Bubo virginianus*) and golden eagle (*Aquila chrysaetos*) (Banfield 1974).

Trapping is likely the major cause of marten mortality in the Northwest Territories. Recent harvest data for the Northwest Territories is not available, although an estimated 25,000 to 30,000 marten were trapped annually in the 1980s (GNWT 2000). Because marten are trapped relatively easily, they are vulnerable to localized overharvesting. Harvest studies indicate:

- in the Inuvialuit Settlement Region, the marten harvest appears to be declining as it ranged from 1,023 in 1988 to 14 in 1997, with a yearly average of 299 (Joint Secretariat 2003)

- in the Gwich'in Settlement Area, 945 marten were harvested in 1997 (GRRB 2004)

- in the Sahtu Settlement Area, 1,068 marten were harvested in 2001 (SRRB 2003)

Marten populations trapped at intermediate intensities exhibit several demographic changes, including lower densities and altered age–sex structure, i.e., early-season trapping tends to selectively remove juveniles and males (Powell 1994; Buskirk and Ruggiero 1994).

Marten reproductive rates are low by mammalian standards, suggesting marten populations might be slow to recover from population-level impacts (Buskirk and Ruggiero 1994).

Seasonal Occurrence

Natal den sites are considered an important habitat requirement for marten, and unavailability of suitable sites might limit reproductive success (Buskirk and Ruggiero 1994). Marten use two types of dens:

- natal dens for giving birth
- maternal dens used by females and young

The requirements for natal dens are thought to be more specific than for maternal dens, and typically involve large woody structures, e.g., trees, snags, and logs or deadfall, in old-growth forests (Buskirk and Ruggiero 1994). During the natal period of March and April, marten might be found in older, structurally complex stands that provide suitable denning sites.

Physiology and body shape require marten to inhabit winter dens during extreme winter conditions (Buskirk and MacDonald 1989). These dens are typically in:

- ground squirrel middens (Buskirk 1984)
- rock piles (Buskirk and MacDonald 1989)
- hollow logs and stumps (Steventon and Major 1982; Buskirk and MacDonald 1989)
- uprooted trees (Buskirk and MacDonald 1989)
- snags
- tree canopies in warmer weather (Steventon and Major 1982; Buskirk 1984)

Predator–Prey Relationships

Research on marten in the Northwest Territories suggests that marten in northern taiga forests might differ from southerly populations in food habits and prey selection.

Poole and Graf (1996) investigated the marten's winter diet by examining the gastrointestinal tracks of marten carcasses obtained from trappers. They conducted the study in northern, i.e., Fort Good Hope and Déline, and southern, i.e., Fort Liard, Fort Simpson and Fort Smith, parts of the Northwest Territories over a six-year-period from 1988 to 1989 through 1993 to 1994. Researchers compared results to several indices of prey abundance, e.g., fecal pellet counts for snowshoe hares, snap-trapping surveys for small mammals and GNWT hunter surveys for grouse and ptarmigan. This study showed that prey selection by marten varied dramatically from year to year relative to changes in primary prey species population cycles.

Voles and lemmings had the largest populations of prey in both regions. However, in periods of high snowshoe hare abundance, hares comprised a greater proportion of the total prey biomass. As the snowshoe hare population declined, hares comprised less of the marten's winter diet, and the percent biomass of arvicolines increased.

Birds ranked third as prey items in terms of both numerical abundance and biomass. Red squirrels and shrews comprised less than 5% of the diet, and deer mice, which live in both study regions, were not recorded in the gastrointestinal tracts of any of the 4,256 marten carcasses examined.

Seven species of voles and lemmings were identified as prey items. Of these, the red-backed vole (*Clethrionomys* spp.) was taken most frequently, although in some years members of the genus *Microtus* appeared more frequently in the diet of marten than did *Clethrionomys*.

Poole and Graf (1996) also suggested that the productivity of marten populations in the Northwest Territories was influenced by population cycles of major prey species. They found marten productivity, as indicated by corpora lutea counts in sectioned ovaries and by the proportion of juvenile marten in the harvest, declined as snowshoe hare populations declined.

Douglas et al. (1983) described the results of an investigation of marten habitat selection and food habits in an area of predominantly mature black spruce forest on the east side of the Mackenzie River between Norman Wells and Fort Good Hope in 1973 and 1974. Prey species and other food items were identified in marten scats collected along the transects. The percentage occurrence of prey species in scats was compared with the relative abundance of the species in the study area, as determined through live trapping. These authors found that marten were selective in the prey they consumed, showing a preference for *Microtus* spp., which occurred in 76% of the scats but which comprised only 43% of the animals captured in live traps. In contrast, *Clethrionomys rutilus* occurred in just 13% of the scats, but accounted for 55% of the animals trapped live. Snowshoe hares were not recorded as a prey species during this study, which coincided with a low in the snowshoe hare population cycle (Poole and Graf 1996). Douglas et al. (1983) identified several other food items in the marten scats, including vegetation, invertebrates and a few birds, shrews and weasels.

Using similar techniques, Slough et al. (1989) investigated the food habits of marten in the south-central Yukon from 1979 to 1981. They reported that the food habits of marten in that region were diverse and included seven species of microtine rodents, snowshoe hares, sciurids, i.e., squirrels, chipmunks, marmots and woodchucks, and shrews, deer mice, birds, insects, various fruits and carrion. Microtine rodents comprised most of the diet, occurring in 82% of the scats in summer and 60% of the scats in winter. Snowshoe hares were in 10% of the summer scats but 42% of the winter scats. The northern red-backed vole (*Clethrionomys rutilus*), which was the most common rodent in the study area, occurred with the greatest frequency in the marten scats, except during January and February 1981, when snowshoe hares reached a cyclic population peak and were found in as many as 69% of marten scats.

Movement Patterns

Marten move throughout their home ranges foraging for prey. Little is known about the movements of marten beyond home ranges, including dispersal and migration (Buskirk and Ruggeiro 1994).

In south-central Yukon, Archibald and Jessup (1984) reported two periods of dispersal for marten:

- from about mid-July to mid-September, involving the year's young
- during overwintering

Late winter dispersal might be prompted by food scarcity. Transient marten can also move up to 60 km in search of a new home range.

Home Range

Marten home ranges are large in relation to the size of the animals. They vary in relation to habitat quality and prey abundance (Soutiere 1979; Thompson and Colgan 1987). Larger home ranges have been reported in areas exposed to clearcut logging (Soutiere 1979; Potvin et al. 2000). Buskirk and MacDonald (1989) reported female marten home ranges varying from 0.6 to 20.6 km^2 and those of males ranging from 0.7 to 27.5 km^2. In the Northwest Territories, home range sizes of 2.5 to 15 km^2 for males and 1.5 to 5 km^2 for females have been reported (Powell 1994; Phillips et al. 1998; GNWT 2004).

Home ranges of adult males and females overlap, but adults of the same sex are territorial. Juvenile marten are not thought to occupy true home ranges or territories (Buskirk and Ruggiero 1994).

Habitat Use

Marten are often referred to as old-growth dependent, although they also inhabit second-growth stands (Buskirk and Powell 1994; Bowman and Robitaille 1997). In general, marten inhabit vegetation types with complex structural components near the ground, which provide winter hunting opportunities and a diversity of food in spring, summer and fall (Corn and Raphael 1992; Banci 1994). In the northern boreal forest, they often inhabit late successional coniferous stands, especially those dominated by spruce and fir with complex structure, e.g., dead and downed material, near the ground (Slough 1989; Buskirk and Powell 1994). Marten habitat is found throughout forested parts of the Northwest Territories. However, marten are rarely found beyond the treeline (Chetkiewicz and Marshal 1998b).

Marten use burned areas in the Mackenzie Valley region near Norman Wells, although there must be a lot of logs and deadfall, i.e., a protective cover, for marten to effectively hunt in burned areas (Latour et al. 1992). In northwestern

Northwest Territories, it is thought that wildfires might have caused crashes in prey populations, leading to a reduction in marten productivity (Poole 1991).

As part of the Arctic Gas pipeline study in the 1970s, Wooley (1974) conducted winter track surveys to determine habitat selection by marten between Redknife Hills and Tathlina Lake, west of Hay River, an area crossed by the proposed pipeline route near the NGTL interconnect facility. Habitats in this region are more diverse than they are along northern parts of the project. Wooley (1974) found marten in this region were often nonspecific in their habitat selection, with similar winter track densities recorded in upland mixed forest, black spruce-jack pine forest, black spruce bog, and larch fens. He observed the highest marten use in riparian forests in river and stream valleys. He attributed this to the high prey abundance in riparian areas and to the fact that, in northern latitudes, river valleys support the largest trees.

Slough (1989) found that transplanted radio-tagged marten in the southwest Yukon preferred late seral or climax coniferous habitat, although they traversed alpine tundra, open forests, i.e., with less than 25% canopy cover, an extensive burn and large rivers.

Douglas et al. (1983) suggest marten in the Northwest Territories select habitat on the basis of prey availability rather than habitat structure. They found high levels of marten activity in areas of low tree dispersion with an abundance of yellow-cheeked voles and red-backed voles, which were their primary prey species in the area.

Marten in the Mackenzie Valley region likely select habitat occupied by their principal prey species. Research suggests marten rely on snowshoe hares during periods of peak hare abundance (Poole and Graf 1996). Although hares live in mature forests, they are more likely found in shrubby and regenerating habitats. When snowshoe hare cycles are in decline, marten appear to rely more heavily on voles and lemmings. These include the red-backed vole, which mostly inhabits mature and old growth forests, and members of the genus *Microtus*, e.g., meadow voles and yellow-cheeked voles, which live mostly in open, graminoid-dominated habitats. Because many marten prey species are cyclic, necessitating *prey switching* at regular intervals, good marten habitat in the Mackenzie Valley region is likely characterized by a diversity of habitat types, including stands of old-growth forest capable of providing suitable natal denning habitat. For this reason, habitat models that stress availability of mature or old growth forest as the primary determinant of habitat suitability might not accurately reflect the biology of this species in the North.

Modelling Results

Modelling results indicate that the percentage of effective habitat in the RSA rated moderate to high for marten was relatively high in both the North Taiga Plains and South Taiga Plains Ecological Zones (see Table 10-18):

- Transition Forest Ecological Zone – 57%
- North Taiga Plains Ecological Zone – 74%
- South Taiga Plains Ecological Zone – 78%

Table 10-18: Marten Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone					
	Transition Forest		North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
High	326,628	38	1,963,537	64	683,252	17
Moderate	164,068	19	302,182	10	2,409,921	61
Low	32,343	4	85,165	3	607,620	15
None	326,170	38	736,165	24	231,044	6
No data	868	<1	293	<1	3,992	<1

Habitat is often the highest quality in the North Taiga Plains Ecological Zone, where modelling results indicated that 64% of the RSA contains high-value habitat for this species.

10.3.1.6 Lynx and Snowshoe Hare

Status

Lynx (*Lynx canadensis*) are listed as *secure* in the Northwest Territories (GNWT 2004), *sensitive* in Alberta (ASRD 2000), and *not at risk* federally (COSEWIC 2004).

The snowshoe hare (*Lepus americanus*) is listed as secure in both the Northwest Territories and Alberta (GNWT 2004; ASRD 2000) and is not listed federally.

Abundance and Distribution

Lynx inhabit Canada's boreal forest region from Newfoundland to the Yukon (see Figure 10-20) (Banfield 1974; Pattie and Fisher 1999) and are found south of the treeline in the Northwest Territories (GNWT 2004). Although lynx have never been abundant in the Mackenzie Delta region (Chetkiewicz and Marshal 1998b), their range extended into this region during periods of abundance (van Zyll de Jong 1966; Boles 1975; Chetkiewicz and Marshal 1998b). Lynx are common throughout forested areas of Alberta, including the mountains and foothills (Smith 1993).

Field observations confirmed the presence of lynx in the Deh Cho Region, Sahtu Settlement Area and Gwich'in Settlement Area, and in the South Taiga Plains, North Taiga Plains, and Transition Forest ecological zones. The abundance and distribution of the lynx depends mostly on the abundance and distribution of their main source of prey, the snowshoe hare. Lynx populations exhibit an eight- to 11-year cycle of abundance, in general synchrony with snowshoe hare populations. Lynx are particularly vulnerable to overtrapping during periods of low hare densities (Brand and Keith 1979).

Population Size

Lynx population densities vary widely throughout their population cycle. The lynx population is believed to be greater than 3,000 and possibly more than 10,000 in the Northwest Territories, (GNWT 2004). In Alberta, it is estimated there are fewer than 8,000 lynx at the bottom of the cycle (ASRD 2000). In the Northwest Territories, the number of lynx pelts harvested between 1958 and 1988 peaked and declined three times, ranging from 500 to 5,000 pelts annually (Poole 1990).

The hare population in the Northwest Territories is secure (GNWT 2004). The genetic structure of hares in the Yukon and Alaska indicates that populations are very large and connected by gene flow (Burton 2001).

Population Density

Lynx population densities have not been recorded in the study area. However, research in the Mackenzie Bison Sanctuary has shown peak lynx densities of 30 individuals per 100 km^2, which declined to 3 individuals per 100 km^2 the winter after a decline in hare numbers (Chetkiewicz and Marshal 1998b). In the Yukon, densities varied from 3 lynx per 100 km^2 in lows to 45 lynx per 100 km^2 during highs (Slough and Mowat 1996).

In northern parts of their range, snowshoe hare population densities can range from 0.02 to 16.4 hares/ha depending on the cycle phase and location (Hodges 2000a). Densities and cycle amplitude could be lower in southern parts of the range (Hodges 2000b).

Figure 10.20 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Population Trends and Human Influences

Research has documented the relationship between the lynx population cycle and snowshoe hare abundance. Hare population densities fluctuate cyclically over eight to 11 year periods in northern boreal forests (Hodges 2000a). They are extremely abundant during the peak phase of this cycle but can be very scarce during the low phase (Smith 1993). Changes in prey availability are known to influence the ovulation rate, pregnancy rate and litter size of lynx (Brand and Keith 1979; Slough and Mowat 1996).

Poole (1994) reported that kitten recruitment was absent during the first year of hare decline. Mowat et al. (1996) found that adults continue to reproduce during the first year of a hare decline, but that recruitment stops by two years into the decline and remains low or nonexistent for three to four years (Poole 1994; Mowat et al. 1996). Also, the survival rate of kittens is much reduced as starvation takes its toll (Poole 1994).

Lynx breeding season is in April and May. A female's age at first breeding depends partly on her physical condition, on the abundance of nearby food resources, and on the availability of suitable denning sites (Chetkiewicz and Marshal 1998b). The gestation period is nine weeks, and kittens remain with the mother for almost a full year, dispersing as she prepares to breed again the following spring (Chetkiewicz and Marshal 1998b; Poole 1994; Poole 1995; Mowat et al. 1996).

Changes in hare numbers are correlated with changes in many other vertebrate species in northern boreal forests, e.g., lynx, coyotes, Arctic ground squirrels, spruce grouse, great horned owls and goshawks (Boutin et al. 1995). The most recent peak densities were in 2000 to 2001. Canadian and Alaskan cycles have been largely synchronous, peaking roughly at the turn of each decade, i.e., 1960 to 1961, 1970 to 1971, 1980 to 1981, 1990 to 1991, with the lowest densities three years later, in 1963 to 1964, 1973 to 1974 and 1983 to 1984 (USDA 1999).

Although hare in northern latitudes tend to breed later than those in the south, and females from western areas produce larger but fewer litters than eastern populations, total productivity is similar across geographic areas (Murray 2000).

Mortality

Several studies have indicated that lynx mortality is a function of trapping pressure, not of natural phenomena (Bailey et al. 1986; Stephenson 1986; Staples 1995). Trapping mortality rates appear to be related to trapping pressure, which tends to be driven by fur prices. Seasonal trapping mortality in central Alberta increased two- to four-fold with a doubling of pelt prices (Brand and Keith 1979).

In the Inuvialuit Settlement Region, 77 lynx and 960 hare were harvested yearly with highly variable numbers between years (Joint Secretariat 2003). In the Gwich'in Settlement Area, 77 lynx and 995 snowshoe hare were harvested in 1997 (GRRB 2004). In the Sahtu Settlement Area, four lynx and 645 snowshoe hare were harvested in 2001 (SRRB 2003).

Predation is the most important source of snowshoe hare mortality (Hodges 2000a), and predation risk can also have indirect effects on hare reproduction and survival (Hik 1995; Boonstra et al. 1998). Recent Yukon and Northwest Territories studies reported higher natural mortalities from starvation in the first two winters of a hare decline (O'Donoghue et al. 1995; Slough and Mowat 1996; O'Donoghue et al. 1997; Poole 1994).

Predator–Prey Relationships

Although lynx feed primarily on snowshoe hares, they will also consume mice, voles, red squirrels, flying squirrels, ruffed grouse and occasionally deer, caribou fawns and moose calves (Nellis and Keith 1968; Nellis et al. 1972; Brand et al. 1976; Todd 1985; Chetkiewicz and Marshal 1998b; Koehler and Aubry 1994). The importance of snowshoe hare in the diet of lynx is reflected in fluctuations in lynx populations. Lynx populations peak just after hares reach peak densities, then crash after their hare prey base disappears (Brand and Keith 1979; Todd 1983; Bailey et al. 1986; Poole 1989; Poole 1990). Several studies of lynx food habits indicated that they feed almost exclusively on snowshoe hares (Chetkiewicz and Marshal 1998b). These studies reported that snowshoe hare comprised 79 to 97% of the prey taken by lynx (van Zyll de Jong 1966; Chetkiewicz and Marshal 1998b). In the Gwich'in Settlement Area, the percentage of hare in the stomachs of lynx decreased from 1988 to 1992, concurrently with declining numbers of hares (Chetkiewicz and Marshal 1998b). This coincided with increased consumption of other prey species, including voles, red squirrel, grouse, ptarmigan and duck.

The diet of the snowshoe hare is quite diverse. In summer, hares eat a wide variety of grasses, forbs and brush (Banfield 1974; Pattie and Fisher 1999). Preferred food includes blue grass, brome, vetches, asters, jewelweed, wild strawberry, pussy-toes, dandelions, clovers, daisies and horsetails (Banfield 1974). To a lesser extent, they also consume the leaves of aspen, birch and willow (Banfield 1974). In winter, the diet of the hare shifts from grasses and forbs to buds, twigs, bark and the evergreen leaves of woody plants (Banfield 1974; Pattie and Fisher 1999).

Movement Patterns and Home Range

Poole (1994) monitored movements of radio-collared lynx in the Mackenzie Bison Sanctuary over a four-year period beginning in 1989 and 1990. He reported mean annual home range sizes ranged from 16.6 to 44.0 km^2 for adult males and from 17.6 to 62.5 km^2 for adult females. Other reports indicated that lynx occupy overlapping home ranges varying in size from about 12 km^2 to nearly 800 km^2, although most documented ranges have been less than 100 km^2 (Brand et al. 1976).

Lynx have a social organization similar to bobcats *(Lynx rufus)* and cougars *(Felis concolor)*, consisting of social intolerance and mutual avoidance (Seidensticker et al. 1973; Bailey 1974; Hornocker and Bailey 1986). However, when hare populations are low, lynx home ranges increase in size and territories overlap within and between sexes (Ward and Krebs 1985). A study by Ward and Krebs (1985) has shown that with hare declines of 14.7 to 0.2 hares per ha, territories expanded from 1,320 to 3,920 ha, and some lynx appeared to be nomadic.

Hare home range estimates indicate that they use areas that are five to 10 ha, and often hares are located within a small subset of their total range (O'Farrell 1965; Wolff 1980; Hodges 1998). Average home ranges in central Alberta were estimated to be 200 m in diameter (Keith et al. 1984). Hares do not have territories, and overlapping home ranges are common, but they might try to avoid encountering each other (Adams 1959; Boutin 1980; Boutin 1984). Hare home ranges are not well defined (USDA 1999).

Dispersal

Studies of lynx home ranges have shown that the animals tend to maintain the same territories for several consecutive years during periods of high hare abundance. Dispersal can occur for two reasons (Poole 1997):

- innate dispersal, which is the spontaneous movement of young individuals
- environmental dispersal in response to unfavourable environmental conditions

Near the end of their first year, kittens disperse from their mothers in response to the innate desire to establish their own home ranges and can move many kilometres away (Poole 1995; Mowat et al.1996). Adults can disperse as far as 1,100 km in periods of snowshoe hare decline and early in the period of low hare population size (Ward and Krebs 1985; Slough and Mowat 1996; O'Donoghue et al. 1997; Poole 1997).

Dispersal is an important mechanism for maintaining lynx populations across their range, and some authors have suggested that southern lynx populations depend on immigration from larger northern populations (Buskirk et al. 2000; McKelvey et al. 1999; Pulliam 1998).

Habitat Use

Lynx

The presence of snowshoe hares or other prey is the most important of many factors in lynx habitat selection.

Lynx also choose areas that provide cover from predators, or travel corridors, or habitat for maternal dens (Parker 1981). Lynx inhabit a variety of forest types and stand ages (Ruggiero et al. 2000), but are most common in forests that have a dense understorey characterized by thickets and fallen trees (Todd 1983; Pattie and Fisher 1999). They typically avoid large open areas (Todd 1983) and seldom venture far onto the tundra (Chetkiewicz and Marshal 1998b), except in starvation years when the snowshoe hare population is low (Banfield 1974). In Alberta, lynx prefer coniferous and mixed forests (Pattie and Fisher 1999).

Radio-tagged lynx in the Mackenzie Bison Sanctuary used habitats disproportionately to their availability, selecting dense coniferous and deciduous stands much more than wetland–lake bed complexes and open black spruce (Chetkiewicz and Marshal 1998b).

Forest cover types with heavy deadfall are important to denning females (Chetkiewicz and Marshal 1998b). Female lynx use maternal dens for six to eight weeks, from kit birth until kits are weaned and foraging with their mothers. Dens in the Yukon were usually under deadfall and coarse woody debris in burns, but were also found in blow-down debris, subalpine fir and willow shrub thickets in burned or unburned areas (Slough 1999). They tended to be mid-slope and facing south or southwest. Dens were not reused in subsequent years, but sites were as close as 300 m (Slough 1999). The den site must be at least 1 ha in size to be useful to the female and must be near good foraging habitat (Koehler and Aubry 1994). Because females might need to move their kittens in search of better foraging sites or away from disturbance, several suitable denning areas should be connected by travel corridors of sufficient cover within the home range (Koehler and Brittell 1990). Mowat et al. (1996) suggested denning sites should be within 500 m of each other.

Snowshoe Hare

The snowshoe hare can be found in a wide variety of habitat types including mixed, coniferous and deciduous forests, swamps, shrubby areas, and river and streamside thickets (Smith 1993; Pattie and Fisher 1999).

Habitat use varies considerably from region to region, but appears to be based primarily on the need for security cover and palatable forage species (Wolff 1980; Litvaitis et al. 1985; Thompson et al. 1989; Hodges 2000a; Hodges 2000b). However, it will also change with ease of detection, i.e., deciduous cover in summer, or light intensity, i.e., sparse cover when it is dark and moonless (Wolff 1980; O'Donoghue 1983; Litvaitis et al. 1985; Gilbert and Boutin 1991). Studies in northwestern Alberta suggest hares prefer early successional areas dominated by aspen regrowth, black spruce forests, mixedwood forests and dense shrublands (Radvanyi 1987; Eccles et al. 1986).

Optimal foraging habitat is provided by stands with plentiful shrubby vegetation (Bookhout 1965; Meslow and Keith 1971; Telfer 1972; Bider 1974; Keith 1974a; Wolff 1978; Parker 1984; Radvanyi 1987; Gilbert 1990) and stands with preferred browse species, especially willow, aspen, birch, rose and white spruce (Meslow and Keith 1971; Bider 1974; Keith 1974b; Walski and Maritz 1977; Wolff 1978; Sinclair et al. 1982; Litvaitis et al. 1985; Parker 1986; Smith et al. 1988).

Hiding cover is provided by coniferous, particularly spruce-dominated, stands with suitable understory (Adams 1959; Brocke 1975; Dolbeer and Clark 1975; Wolff 1980; Lloyd-Smith and Piene 1981; Buehler and Keith 1982; Parker 1984; Litvaitis et al. 1985; Fuller and Heisey 1986; Parker 1986; Halpin and Bissonette 1988; MacCracken et al. 1988; Barta et al. 1989; Koehler 1990). Dense shrub thickets also provide hiding cover (Rogowitz 1988).

In general, sufficient protection from predators is provided by stands with at least 50 to 60% coniferous trees in the overstorey (Keith 1974a; Keith et al. 1984; Radvanyi 1987) and dense shrubby understorey less than 3 m high, or abundant downed woody debris (Meslow and Keith 1971; Wolff 1980; Wolfe et al. 1982; Litvaitis et al. 1985; Sievert and Keith 1985; Parker 1986; MacCracken et al. 1988; Koehler and Brittell 1990; Koehler 1990).

Modelling Results

Habitat modelling indicates that most of the landscape in the RSA is of moderate to high-value habitat for lynx (see Table 10-19):

- Transition Forest Ecological Zone – 66%
- North Taiga Plains Ecological Zone – 73%
- South Taiga Plains Ecological Zone – 87%

10.3.1.7 Beaver

Status

The beaver (*Castor canadensis*) is considered *secure* in the Northwest Territories and Alberta (GNWT 2004; ASRD 2000) and is not listed federally (COSEWIC 2004).

Table 10-19: Lynx Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone					
	Transition Forest		North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	**Habitat** (%)	**Habitat Area** (ha)	**Habitat** (%)	**Habitat Area** (ha)	**Habitat** (%)
High	193,284	23	1,096,459	36	792,496	20
Moderate	368,157	43	1,140,827	37	2,651,216	67
Low	4,878	1	338,394	11	261,549	7
None	282,890	33	511,370	17	226,577	6
No data	868	<1	293	<1	3,992	<1

Abundance and Distribution

The beaver is distributed throughout most of the Northwest Territories and northwestern Alberta (see Figure 10-21) (Banfield 1974; GNWT 2004). Field observations confirmed the presence of beavers in all political divisions, i.e., northwestern Alberta, Deh Cho Region, Sahtu Settlement Area, Gwich’in Settlement Area and Inuvialuit Settlement Region, of the proposed pipeline route. Although primarily in forest habitat, the beaver has extended its range into the Arctic tundra region and has been seen as far north as the mouth of the Coppermine River (Banfield 1974).

Beaver occupy small streams and lakes throughout the study area from the Mackenzie Delta south along the Mackenzie River and into northwestern Alberta. During the 1970s, beaver were reported to be most abundant in the Ramparts-Ontaratue River area and the Kakisa-Redknife River drainage (CAGPL 1975). Smaller concentrations of beaver colonies were in the old flood plain areas south of Thunder River near Little Chicago, at Hanna River south of Fort McPherson, and near Fort Simpson.

Population Size

The Northwest Territories beaver population is unknown but is estimated to be greater than 10,000 (GNWT 2004). There is limited information on the beaver population of each district of the Northwest Territories.

Population Density

Beaver densities in the RSA are summarized in Table 10-20.

Recent data on beaver densities in the Inuvialuit Settlement Region and Gwich’in Settlement Area is not available. Historical survey results indicate that beaver densities decrease toward the northern limits of their ranges.

Figure 10.21 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Table 10-20: Beaver Densities by Political Jurisdiction

Political Jurisdiction	Beaver Density	Source
Inuvialuit Settlement Region	0.03 active lodges/km^2 0.06 colonies/km^2	Popko et al. (2002) Hawley and Aleksiuk (1970)
Gwich'in Settlement Region	0.03–0.08 colonies/km^2 0.14 colonies/km^2	Boles (1975) Wooley (1974)
Sahtu Settlement Area	0.26–0.58 lodges/km^2	Poole and Croft (1990) Popko and Veitch (1998)
Deh Cho Region	0.25 colonies/km^2	Popko et al. (2002)
Northwestern Alberta	0.10–0.38 lodges/km^2	Fuller and Keith (1980)

Poole and Croft (1990) reported the average density of active beaver lodges in the western Northwest Territories was 26 lodges/100 km^2. The survey included several blocks in the Sahtu Settlement Area and Deh Cho Region that are near the proposed pipeline route. They concluded that beaver colony densities throughout most of the western Northwest Territories were moderate to high, comparable to densities reported in other northern boreal habitats.

In the Sahtu Settlement Area, observed densities between 1989 and 2001 ranged from 43 to 58 lodges/100 km^2 (Popko et al. 2002). These densities are within the range reported in areas of moderate-quality habitat in other parts of North America.

Population Trends and Human Influences

Beaver populations are thought to be increasing in the Sahtu Settlement Area, the Deh Cho region and the Mackenzie Delta. A study in the Sahtu Settlement Area reported that lodge density increased from 43 to 58 lodges/100 km^2 from 1989 to 2001.

Mortality

Natural mortality factors include climatic stress and predation. Climate is a limiting factor for beaver at the northern limits of their range. On the Mackenzie Delta, suitable waterbodies remain ice-covered for eight months of the year, placing beaver in a position of negative energy balance (Aleksiuk 1968; Hawley and Aleksiuk 1970). Flooding from winter or spring thaws and rapid spring breakup can also cause beaver mortality.

Climatic factors are particularly important to beavers and can affect entire colonies in northern areas. In the winter, low temperatures, snowfall or deep ice in the beaver pond can increase the beaver's food-energy needs (Hather and Beal 2003). In the spring, rising water levels can flood colonies and cause mass drowning, and rapid spring breakup accompanied by a violent grinding action of ice, can destroy entire colonies (Hather and Beal 2003). Other causes of mortality include trees the beavers fell, interspecific wounding and wolf predation (Caras 1967). Beavers are not commonly killed by parasites or disease (Boyce 1981).

The Northwest Territories beaver harvest declined greatly from an annual harvest of 12,000 pelts in the late 1930s and early 1940s to less than 2,000 pelts in 1988 to 1989. However, the decline appears to be a result of less trapper effort rather than decreased population size (Poole and Croft 1990). For example, Popko and Veitch (1998) concluded that the increase in average density of beaver lodges in the Sahtu Settlement Area from 1989 to 1997, i.e., 43 to 58/100 km^2, might be a result of low harvesting activity. Many Sahtu hunters believe a regulated harvest could benefit beaver populations by:

- preventing overuse of the food supply
- reducing competition for food and space
- increasing reproduction rates and the survival of young (Boyce 1981; Payne 1984)

The harvest studies by region indicate that in the Gwich'in Settlement Area, 153 beaver were harvested in 1997 (GRRB 2004), and trappers in the Sahtu Settlement Area harvested only 290 beaver in 2001 (SRRB 2003). No beaver were reported in the Inuvialuit Settlement Region harvest studies (Joint Secretariat 2003).

Predator–Prey Relationships

Wolves, coyote, bear, cougar, lynx, fox, wolverine, bobcat, hawk, eagle and owl prey on beavers primarily when foraging or migrating on land (Cahalane 1947; Caras 1967; Fuller and Keith 1980; Shepherd 1994; Col 1998). Beavers are vulnerable to predation by river otter while in their lodges (CWS 2002).

Movement Patterns

Beavers usually disperse along waterways, often extensively (Wheatley 1997). In periods of high beaver density, dispersing individuals might occupy marginal habitat such as shallow ponds that often freeze available feed and cause starvation (Payne 1984). In northern limits of its range, beaver are confined to their lodges for eight months of the year during freezeup and have unrestricted movement patterns during the other four months.

Home Range

Beaver colonies in Canada have a yearly home range of 201 ha, centred on the lodge (Aleksiuk 1968). Home ranges averaged 10.34 ha in summer, 3.07 ha in fall and in winter they were restricted to less than 0.25 ha (Wheatley 1994).

Adult male home ranges are usually larger than adult female home ranges (Johnson and Harris 2004), which are usually centred closer to the lodge.

Beaver territories, i.e., about 50 ha, are much smaller than their home ranges and are maintained by scent mounds (Aleksiuk 1968).

Habitat Use

Beavers inhabit aquatic and riparian habitats along slow-flowing rivers, streams, marshes, lakes and ponds (Banfield 1974). They require a permanent water supply with relatively stable water levels where woody vegetation and fine-grained soil for dam construction are readily available (CAGPL 1975; Slough and Sadleir 1977; Boyce 1981; Dennington and Johnson 1974). They prefer deciduous trees, such as aspen, willow, poplar, birch and alder, but have been observed feeding on coniferous trees (Banfield 1974; Jenkins and Busher 1979; Jenkins 1981; Slough 1988). Beaver play a keystone role in the development of drainage networks in boreal forest ecosystems (Naiman et al. 1986).

On the Mackenzie Delta, which is a transitional zone between boreal forest and Arctic tundra, leaves and growing tips of willow are the main food sources for beaver in July and August, whereas willow bark, poplar and alder are the main food sources for the remaining months (Aleksiuk 1968).

Beaver habitat in the Sahtu Settlement Area is in lowlands with numerous streams, ponds, lakes and bogs (Popko and Veitch 1998). The area also has early successional stages of deciduous species preferred by beaver, and frequent lightning-caused forest fires help maintain these stages (Popko and Veitch 1998).

10.3.1.8 Amphibians and Reptiles

Status

The long-toed salamander's status is undetermined in the Northwest Territories (GNWT 2004), and the Canadian toad and red-sided garter snake are listed as *may be at risk*. The wood frog is listed as secure, and the boreal chorus frog and northern leopard frog are listed as *sensitive* (GNWT 2004). COSEWIC (2004) lists the southern populations of the northern leopard frog as *vulnerable*, but has not established the status of northern populations.

Abundance and Distribution

Except for the wood frog, which lives throughout forested parts of the Northwest Territories, all amphibians in the Northwest Territories are at the northern limits of their North American range. The red-sided garter snake, the only reptile found in the Northwest Territories, is also at the northern limit of its continental range (GNWT 2003).

Historically, long-toed salamanders were found on the Petitot River although no recent studies exist to confirm their current presence. The size and distribution of Canadian toad populations are declining in Alberta, and toads have been found at only two sites in the Northwest Territories. Boreal chorus frogs have been reported at 11 locations in the Northwest Territories (see Figure 10-22), northern leopard frogs have been found at eight sites, and wood frogs have been found at 44 sites. The red-sided garter snake has been reported only twice in the Northwest Territories.

Population Trends and Human Influences

No information is available on population trends for the long-toed salamander, Canadian toad, boreal chorus frog, wood frog and red-sided garter snake in the Northwest Territories and Alberta (GNWT 2004). Northern leopard frog populations have declined considerably in distribution and abundance in Alberta.

Sensory disturbance can impair amphibian movement and, consequently, response to predators and threats. Continuous sensory disturbance impairs call detection and has been found to impair recruitment in amphibians (Gerhardt and Klump 1988; Wollerman 1998; Wollerman and Wiley 2002; Barrass 1986). Some amphibians use auditory stimuli, e.g., thunderstorms, as a cue to emerge from hibernation, but sensory disturbance can cause early emergence from burrows, a potentially deleterious impact in the absence of sufficient water (Brattstrom and Bondello 1983).

Although some amphibian and reptile declines are the result of human activities, i.e., largely habitat loss and pollution of aquatic environments, reasons for decline in other species are not well understood. Changes in weather patterns from global climate change and increases in ultraviolet radiation from ozone depletion might also have negative effects on amphibian populations. Northern leopard frogs and Canadian toads have declined in parts of southern Canada, and this fact, combined with their uncommon occurrence and restricted distribution in the Northwest Territories, justifies concern. There is currently not enough information to determine if northern populations of any species have declined or what factors might affect these populations now or in the future (GNWT 2004).

Figure 10.22 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Mortality

At the northern extent of their range, general threats to amphibian and reptile populations include drought, fluctuating winter temperatures, freezing rain and low snow cover (Fournier 1997; GNWT 2004).

Logging might have a major impact on the long-toed salamander, and disturbance or destruction of denning sites are the main threats to Canadian toads (GNWT 2004). Threats to the northern leopard frog include loss of overwintering habitat from hydroelectric development. Logging and wetland drainage and loss are the primary threats to the wood frog (GNWT 2004).

Predation on amphibian and reptile populations in the Northwest Territories is not documented.

Predator–Prey Relationships

Permanent ponds tend to have high densities of tadpole predators, e.g. fish, which can have pronounced effects on tadpole survivorship (Skelly 1996). Larvae are also taken by several species of diving beetles (Russell and Bauer 2000). No specific information is available on predator–prey relationships for amphibian and reptile populations in the study area.

Movement Patterns

Soon after the ice melts on waterbodies, breeding amphibians move from overwintering areas to breeding sites, including a variety of seasonal pools, semi-permanent and permanent wetlands, and along stream valleys and in uplands (Cottonwood Consultants Ltd. 1986). Unlike breeding individuals, nonbreeding individuals probably do not move immediately to waterbodies after emergence in the spring.

Home Range

Home range sizes are not known for most amphibian and reptile species. Kramer (1974) found that chorus frog home ranges contained breeding pools and that most frogs remained within 100 m of these pools throughout the summer.

Habitat Use

Habitat for long-toed salamander is primarily coniferous forests. Canadian toads inhabit ponds and lake edges in the summer and for breeding. In winter, they are terrestrial and burrow into sandy soil (GNWT 2004).

The boreal chorus frog inhabits grassy pools, lakes, marshes and almost any other body of water, permanent or temporary, shallow or deep (Skelly 1996; Russell and Bauer 2000). They will breed in almost any fishless pond with at least 10 cm of water, including splash pools, roadside ditches, flooded fields, beaver ponds, marshes, swamps or shallow lakes (Canadian Amphibian and Reptile Conservation Network 2003). They are typically found in shallow water margins among vegetation (Roberts and Lewin 1979) and might spend the nonbreeding season in marshy or damp wooded areas (Russell and Bauer 2000). Boreal chorus frogs overwinter in relatively dry sites by burrowing under decaying stumps or into anthills (Roberts and Lewin 1979; Russell and Bauer 2000).

The northern leopard frog habitat for spring breeding includes lakes, ponds and flooded areas of streams. The frogs inhabit meadows and grasslands in summer, and unfrozen river and lake bottoms in winter (GNWT 2004).

Breeding wood frog habitat includes ponds and marshes. In summer, wood frogs inhabit damp woodlands or pond margins, and in winter they live under debris on the forest floor (GNWT 2004).

The red-sided garter snake inhabits mostly marshy areas in summer, and in winter it hibernates in crevices and caves.

10.3.1.9 Beluga Whale

Status

The Beaufort Sea beluga whale (*Delphinapterus leucas*) is listed as *not at risk* nationally (COSEWIC 2004) and *secure* in the Northwest Territories (GNWT 2000). The Beaufort Sea Beluga Management Plan (FJMC 2001) and the Inuvialuit Inupiat Beluga Whale Agreement (2000) are guides to management of the beluga whale in the Canadian Western Arctic.

Population Estimates

A single stock of beluga whales lives in the Canadian Beaufort Sea (O’Corry-Crowe et al. 1997; Angliss and Lodge 2003). A 1992 aerial survey of the Mackenzie River estuary, eastern Beaufort Sea and Amundsen Gulf produced a stock size index of 19,629, i.e., 15,134 to 24,125, 95% CI, beluga whales (Harwood et al. 1996). This was not a total population estimate because it did not correct for animals not seen below the surface and did not consider the part of the population outside the census area (Richard et al. 2001). Duval (1993) adjusted the figure of 19,629 by multiplying by a factor of two, which is considered a conservative, but arbitrary, conversion factor. Angliss and Lodge (2003) applied further calculations (Wade and Angliss 1997) to arrive at a minimum population size, N_{min}, of 32,453. As many as 7,500 beluga whales can be in the Mackenzie River estuary during peak summer periods (Robertson and Millar 1984). The Beaufort Sea beluga whale population appears to be stable or increasing based on the continued presence of large and old individuals and the lack of change in the age and size structure of the harvest in recent years (Angliss et al. 2001; Harwood et al. 2002).

Distribution and Habitat

The Beaufort Sea stock inhabits the Mackenzie estuary offshore in the Beaufort Sea, Amundsen Gulf and the adjacent waters of the Arctic archipelago estuary in summer and fall (Richard et al. 2001; Fraker et al. 1978) (see Figure 10-23). It is one of at least four stocks that comprise the Bering-Chukchi-Beaufort Seas population of beluga whales (Brennin et al. 1997; O'Corry-Crowe and Lowry 1997; O'Corry-Crowe et al. 1997). Beluga whales from the population that summer within the Inuvialuit Settlement Region have a summer distribution across the Arctic from Alaska to the eastern Beaufort Sea and northwest into the Arctic Basin pack ice. Recent satellite telemetry studies have shown that some of the belugas that visit the Mackenzie River estuary travel far offshore into the Beaufort Sea, to Amundsen Gulf and even as far as Viscount Melville Sound, which is about 1,500 km east in the Arctic archipelago (Richard et al. 2001).

In April and May, the Beaufort Sea beluga stock migrates northeastward and eastward through the Beaufort Sea following far offshore leads to reach the eastern Beaufort Sea and Amundsen Gulf (Fraker et al. 1978; Fraker 1979). Many of these animals then travel south in June toward the mainland and west along the landfast ice edge off the Tuktoyaktuk Peninsula near the Mackenzie estuary. Once the warm outflow water from the Mackenzie River has breached the landfast ice, in about late June, belugas enter the Mackenzie estuary where they concentrate in Kugmallit Bay, around Kendall Island and in Mackenzie Bay. Local anecdotal reports suggest calving females or females with calves might arrive at different times than older males. Few beluga whales remain in the estuary past early September (Fraker et al. 1978, FJMC 2001). Fall migration out of the Canadian Beaufort Sea probably begins in August and continues into September (Richard et al. 2001; Fraker et al. 1978). Some whales move westward along the north coast of the Yukon Territory and Alaska (Fraker 2004, personal communication), but most travel farther offshore (Richard et al. 2001).

The only summer concentrations of Beaufort beluga stock are near major outflow channels of the Mackenzie River (see Figure 10-23). The concentration areas are characterized by shallow water, i.e., less than 2 m, that is warm, i.e., 10 to 18°C, fresh and highly turbid, i.e., 20 to 150 ppm (Fraker et al. 1978, 1979). These areas are shallower than most adjacent areas of the estuary and receive most of the Mackenzie River outflow, i.e., 28% at Kugmallit, 17% at Kendall and 32% in southwest Mackenzie Bay (Fraker et al. 1979). The number of animals in each concentration area varies among years, and in some years, particular bays might not be accessible to beluga whales until late summer because of ice conditions (Fraker et al. 1978; Fraker and Fraker 1982).

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Periodically, belugas enter the Mackenzie River channels and swim upstream. It is not known where the belugas enter the channels, but they have been detected as far as Aklavik, Inuvik and even Tsiigehtchic (Fraker 2004, personal communication). Use of the estuarine concentration areas by whales is clearly important as they return every year despite being hunted. The importance of the summer concentration areas is reflected in the Beluga Management Plan Zone 1A under terms of the *Inuvialuit Final Agreement*. Zone 1A waters are protected areas in which industrial activities are highly restricted (see Figure 10-24). These areas overlap with the proposed project area.

Beluga whales feed little while in the concentration areas (Fraker et al. 1978, 1979; Pokiak 2004, personal communication). However, at certain locations elsewhere in the estuary and nearby areas, e.g., the Tuktoyaktuk Peninsula and Yukon coast, presumed feeding behaviour, such as whales diving near gulls, has been observed often (Fraker et al. 1978; Fraker et al. 1979; Robertson and Millar 1984). Stomachs of the few beluga whales taken and sampled in the Mackenzie River estuary have been reported to contain burbot, boreal smelt, saffron cod and squid beaks that remain from pelagic feeding (Fraker et al. 1978). Arctic cisco and whitefish have also been reported, and it is suspected that other species, such as Pacific herring, least cisco, rainbow smelt and inconnu are also taken (DFO 2000). Satellite-tagged belugas that moved to offshore areas often dove in deep water, presumably to feed, although the prey species are not known (Richard et al. 2001). In Alaska during the open-water season, belugas feed on a variety of schooling and anadromous fish that are sequentially abundant in coastal zones (Lowry 1994). Principal species eaten include cisco, herring, capelin, smelt, Arctic and saffron cods, whitefish, salmon, flatfishes and sculpin. Octopus, squid, shrimps, crabs and clams are eaten occasionally. Most feeding is over the continental shelf and in nearshore estuaries and river mouths. In the shallow waters of Alaska, most feeding dives are believed to be 6- to 30-m deep (Lowry 1994). There is no information on the winter diet of beluga.

Harvest

The beluga harvest has a highly important subsistence and cultural value for the Inuvialuit communities. Fraker et al. (1978) reported that in the mid-1970s about 100 families were involved harvesting and processing the whales. The beluga resource is shared and traded among all Inuvialuit communities.

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Within the proposed project area, the Inuvialuit from Tuktoyaktuk, Inuvik and Aklavik traditionally harvest beluga whales over a four- to six-week period each year between June 15 and August 15 (Community of Aklavik et al. 2000; Community of Tuktoyaktuk et al. 2000) in the concentration areas identified in the Beluga Management Plan as Zone 1A (see Figure 10-24, shown previously). Archaeological records indicate that beluga whales have been harvested at East Channel of the Mackenzie River for at least 500 years (McGhee 1988). In recent times, beluga whales have been harvested in southwestern Mackenzie Bay, in Beluga Bay near Garry, Pelly and Kendall islands, and in Kugmallit Bay, mainly south of Hendrickson Island (Fraker et al. 1978; Harwood et al. 2002). Primary whaling camps and whale processing areas include Indian Camp, Kittigazuit Camp, Whitefish Station, Ikinaluk Camp and Hendrickson Island.

Formal, long-term harvest studies were initiated as part of local co-management to provide a detailed record of beluga whale subsistence harvest in the estuary (Harwood et al. 2002). The number of whales harvested and the efficiency of the hunt are key information items collected annually. From 1988 to 1997, an average of 120 belugas were killed and recovered annually by hunters from Inuvik, Tuktoyaktuk and Aklavik (see Table 10-21).

Table 10-21: Average Annual Marine Mammal Harvest, 1988 to 1997

Marine Mammal	Tuktoyaktuk		Inuvik		Aklavik		All Mackenzie Delta Communities	
	Number/ Year	Total	Number/ Year	Total	Number/ Year	Total	Number/ Year	Total
Beluga whale	47	469	54	540	19	188	120	1,197
Bowhead whale	0	0	0	0	0	2	0	2
Ringed seal	19	194	0	4	1	10	21	208
Polar bear	10	102	0	3	2	18	12	123
SOURCE: Inuvialuit Harvest Study (Joint Secretariat 2003)								

The Alaskan Inupiat harvest of Belugas from the Beaufort Sea stock is also important. Angliss and Lodge (2003) show a mean annual number of 68 belugas removed from the stock between 1993 and 2000. In 2000, 66 were landed and another 51 were struck-and-lost, for a total of 117.

The average number of belugas harvested has decreased over the past three decades (Harwood et al. 2002), although the differences are not statistically significant. The number of whales landed each year by hunters from Mackenzie Delta communities and Paulatuk averaged 133.7 from 1970 to 1979, 124.0 from 1980 to1989, and 111.0 from 1990 to 1999. Wounding losses, i.e., animals reported struck-but-lost as a percentage of the number struck, were estimated to be 11% for the 1990s and have declined from previous decades. Fraker and Fraker

(1981) estimated that about one-third of whales shot were not recovered. Harwood et al. (2002) estimated the total annual removals from the Beaufort stock to be 189, including the Alaskan take and those that were struck-and-lost. Using the minimum number of 32,453 calculated by Angliss and Lodge (2003), annual removals amount to about 0.6 % of the stock.

10.3.1.10 Bowhead Whale

Status

The western Arctic population of bowhead whales (*Balaena mysticetus*) is classified as *endangered* nationally and under Schedule 2 of the Canadian *Species At Risk Act* (COSEWIC 2004; SARA 2002), and *sensitive* in the Northwest Territories (GNWT 2000). The United States lists the bowhead whale as *endangered* under the *Endangered Species Act* and *depleted* under the *Marine Mammal Protection Act* (NOAA 2002). The World Conservation Union rates the world bowhead whale population as *lower risk* and *conservation dependent* (Cetacean Specialist Group 1996).

Population Estimates

The global population has been estimated to be 10,000 (IWC 1996 based on Zeh et al. 1995). The global population before commercial whaling was estimated to be 50,000 (Woodby and Botkin 1993). Of the five bowhead whale stocks, the western Arctic population is the largest, comprising about 90% of the current world population (Community of Tuktoyaktuk et al. 2000). The western Arctic population is estimated to be 9,860 and is increasing at a rate of 3% per year (George et al. 2002).

Distribution and Habitat

The bowhead whale has an approximate circumpolar distribution between 55° N and 75° N. The western Arctic population occupies a seasonal range extending from its wintering area in the Bering Sea to its summer range in the Amundsen Gulf and Beaufort Sea (see Figure 10-25). From November to April, bowheads are widely distributed in the central and western Bering Sea and are often near the ice front and the polynyas of St. Matthew Island, St. Lawrence Island and the Gulf of Anadyr (Shelden and Rugh 1995). From April to June, as the ice breaks up and retreats, the bowheads migrate north and east into the eastern Chukchi Sea and then east into the eastern Beaufort Sea (Braham et al. 1980). From June to September, most bowheads are in the Canadian Beaufort Sea and Amundsen Gulf (Fraker et al. 1978; Moore and Reeves 1993), although a few might remain in the Chukchi Sea (Miller et al. 1986). The distribution of bowheads on the summering grounds varies from year to year in response to differences in food distribution, depending on oceanographic conditions. However, this population favours the Amundsen Gulf and the southeastern Beaufort Sea (Moore and Reeves 1993; Shelden and Rugh 1995; Environment Canada 2003).

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Many bowhead gather in August and September of some years to feed north of the Mackenzie Delta and Tuktoyaktuk Peninsula near the Yukon coast (Moore and Reeves 1993; Würsig et al. 1984; Fraker and Bockstoce 1980). Under such circumstances, many whales would be encountered along the proposed barge route from Herschel Basin to Kugmallit Bay. If bowheads use outer Kugmallit Bay, as a few do in some years, (Fraker and Bockstoce 1980), they could be as close as 30 km from any potential dredging activity in southern Kugmallit Bay.

In September and October, bowheads migrate west out of the Beaufort Sea through the Chukchi Sea to waters near Wrangel Island and the Siberian coast, which they then follow southeast to the Bering Strait and, (Moore and Reeves 1993; Shelden and Rugh 1995) later, south into the Bering Sea.

The Beaufort Sea is an important summer feeding area and fall feeding has been observed in the Chukchi Sea (Lowry 1993). There is evidence from stable isotopes deposited in the baleen that older animals might feed in the Bering Sea in early winter (Schell and Saupe 1993), although this has never been directly observed.

Harvest

A subsistence harvest of the western Arctic stock in Alaska takes about 0.1 to 0.5% of the bowhead whale population per annum, with an observed range of 14 to 75 animals per year. The hunt is managed under the International Whaling Commission (IWC) quota, and is not considered a threat to growth of the population (Shelden and Rugh 1995; Clapham et al. 1999; Angliss and Lodge 2003). The IWC has set a quota of 280 strikes, which can be taken from 2002 to 2007 (Angliss and Lodge 2003). Alaska Inupiat took 75 bowheads in 2001. Canada is no longer signatory to the International Convention for the Regulation of Whaling, under which the IWC operates. In recent years, Inuvialuit hunters killed two bowhead whales near Shingle Point, one in 1991 and the other in 1996 (Angliss and Lodge 2003). Some whales became entangled in ropes from crab pots from the Bering Sea fishery or from harpoon lines that became fixed to whales that had escaped.

10.3.1.11 Ringed Seal

The ringed seal (*Phoca hispida*) has been designated as *not at risk* nationally (COSEWIC 2004) and *secure* in the Northwest Territories (GNWT 2000). The species is not currently listed under the Canadian *Species At Risk Act* (SARA 2002).

Population Estimates

The ringed seal is the most abundant northern pinniped and is common in the Beaufort Sea area (Ronald and Gots 2003). There is a large year-to-year variation in ringed seal population estimates in the Beaufort Sea. Summer surveys conducted in this area produced estimates of 41,200 animals in 1982, 6,400 in 1986 and 14,300 animals in 1987 (Harwood and Stirling 1992).

Distribution and Habitat

Ringed seals are found throughout seasonally and permanently ice-covered waters of the northern hemisphere from the southern edge of the pack ice to at least within 2 km of the North Pole (Ronald and Gots 2003). Within the study area, ringed seals are reported primarily in bays in the Amundsen Gulf and secondarily in areas of landfast ice off the Tuktoyaktuk Peninsula and the west coast of Banks Island (see Figure 10-26). In winter, breeding adults occupy areas of landfast ice with hummocks or ridges, and subadults and nonbreeders are found near leads and thinner ice in the seasonal zone. Ringed seals maintain breathing holes in landfast ice, and as snow accumulates, they excavate resting and birthing lairs in the snow above breathing holes, typically around ice hummocks and along pressure ridges (Smith 1987). Snow lairs provide protection from the cold and from predators (Smith and Stirling 1975).

Pupping is in March and April on both landfast and pack ice (Smith and Stirling 1975), and females nurse pups in lairs for five to seven weeks. Mating is in late April and May about a month after parturition.

Many moulting seals haul out on the landfast and pack ice in late May to early June. They reduce feeding during the spring moult and spend more time basking on the ice. Preferred moulting areas have a high proportion of ice cover and moderate water depths of 50 to 75 m (Stirling et al. 1981). Before breakup of landfast ice, ringed seals are widely distributed at holes in the landfast ice away from the unstable ice edge. During breakup, many seals are found near the ice edge, particularly along cracks. Within the Beaufort Sea, relatively high densities of hauled-out moulting seals have been reported in several areas in the southeastern Beaufort Sea and Amundsen Gulf (see Figure 10-26) (Stirling et al. 1981).

The broad-scale distribution of ringed seals in winter and spring is determined by their dispersion during fall freezeup (Smith and Stirling 1975). The availability of prey in the fall is likely a key factor influencing how seals are spaced. Feeding is particularly important in the fall because seals need to build up their fat deposits to survive the winter, and pregnant females require nutrition for their developing fetuses. Hyperiid amphipods are an important food source for ringed seals in the central Beaufort Sea in late summer and early fall (Lowry et al. 1980). In late fall and winter, their diet is mainly Arctic cod (Lowry et al. 1980), which inhabit nearshore areas and spawn from November to February (Craig et al. 1982).

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Harvest

Ringed seals are a traditional resource in the Beaufort Sea region and continue to be harvested on a subsistence basis for food and for their pelts (Community of Aklavik et al. 2000). Young seals are preferred for food. During the Inuvialuit harvest study from 1988 to 1997, annual harvests in the Inuvialuit Settlement Region ranged from 622 to 1,581 seals (Joint Secretariat 2003). An average of 14 hunters was responsible for the seal harvest during this period. Tuktoyaktuk residents harvested 194 ringed seals, averaging 19 annually. Hunters from Inuvik harvested four and hunters from Aklavik harvested 10 over the same period (see Table 10-21, shown previously).

Ringed seals are harvested along the Beaufort Sea coastline from Herschel Island to Shingle Point, and in Kugmallit Bay from near Hendrickson Island and along the Tuktoyaktuk Peninsula to near Atkinson Point (Fabijan et al. 1993). Ringed seals appear near the coast in August, and hunters pursue them in open boats.

Before the ban on importation of seal products by the European Economic Community, the estimated annual income for the Inuit from the sale of sealskins from the Northwest Territories was $500,000 (GNWT 2003). As many as 48,000 ringed seal skins were commercially traded in Canada during the 1970s (NAMMCO 2003). More recent trade figures have been in the low $1,000s (NAMMCO 2003), and by 1985 and 1986, the annual income from sealskin sales was less than $30,000 (GNWT 2003). Efforts have recently been made to revitalize the sealing industry in the Northwest Territories. Federal *Seal Protection Regulations* include laws governing the use of seals within Canada's 320-km offshore limit.

10.3.1.12 Polar Bear

Status

The polar bear (*Ursus maritimus*) is listed as *sensitive* in the Northwest Territories (GNWT 2000), and a species of *special concern* in Canada (COSEWIC 2004). Under Schedule 3 of the *Species at Risk Act* (2002), the polar bear is listed as of *special concern*, although it is one of 64 species currently proposed for inclusion in Schedule 1 of SARA. A decision is to be made regarding this proposal in late May 2004 (CWS 2004). If the polar bear becomes listed as of *special concern* on Schedule 1, a species management plan must be prepared within five years, and projects requiring environmental assessment under an Act of Parliament must identify mitigation measures and monitoring plans to address the species and its habitat.

Existing pressures on the regional population include increasing levels of human activity, overharvesting, disposal of problem bears, changes to prey populations and effects of climate change (Stirling and Taylor 1999).

Population Estimates

The most recent population estimate for the Beaufort Sea polar bear population is 1,800 animals (Derocher et al. 1998). This population, which is shared by Canada and Alaska, extends from Point Hope in the Alaskan Chukchi Sea to Cape Bathurst in the southeastern Beaufort Sea. Data obtained from various tagging programs and anecdotal observations suggests the Beaufort Sea polar bear population has increased since the 1960s and early 1970s, probably because of reduced hunting mortality (Amstrup et al. 1986; Amstrup 2000).

Three subpopulations, an estimated 3,000 bears, can be found along the Arctic coasts of the Northwest Territories (GNWT 2004). The two largest of these populations are stable. The third, a small population shared with Nunavut, is increasing in size (GNWT 2004). Because there is little contact between polar bear subpopulations it is considered important that each be carefully monitored (GNWT 2004).

There is concern for the viability of the mainland subpopulation of polar bears because of recent warming in the North and the subsequent early recession of the pack ice with its attendant seal populations. In addition, increased human activity could have detrimental effects on polar bear denning activity, which might affect population numbers.

Extensive research on polar bears has been conducted in the past two decades (GNWT 2004). In a study of the northeastern Alaska coast, it was shown that bears have substantial tolerance for human activities such as capture and handling and aircraft over-flights (Amstrup 1993). However, increasing human activity associated with oil and gas exploration and development could adversely affect denning (Lentfer and Hensel 1980). Amstrup (1993) suggested that denning polar bears might show tolerance to industrial activity based on observations of the closely related grizzly bear (Amstrup 1993). However, more recently, Lindell et al. (2000) found that all three North American bear species usually select den sites at least 1 to 2 km from human activity, e.g., roads, habitation, industrial activity. Human activity closer than 1 km and especially within 200 m of a den caused variable responses, including abandonment (Lindell et al. 2000). The loss of a single den site following human disturbance will not always lead to deleterious effects if alternative denning areas are available within the home range (Lindell et al. 2000). Pregnant females or females with young could die if they are disturbed and abandon a den in mid-winter.

Distribution and Habitat

Polar bears are found throughout the circumpolar north (GNWT 2004). Three subpopulations, of the 14 in Canada, are recognized in the Northwest Territories – South Beaufort, North Beaufort, and Viscount-Melville (Stirling and Taylor

1999). Only the South Beaufort population is potentially affected by the proposed development.

Polar bears are limited to areas of the Northern Hemisphere that are ice-covered for most of the year. They are most abundant in shallow, near-shore areas and in areas where currents and upwellings result in high productivity and keep ice from being too consolidated in winter, such as in shear zones and polynyas (Amstrup 2003). Persistent pack ice in the Beaufort Sea means that polar bears are seldom found on the delta during open-water season (Chetkiewicz and Marshal 1998b). Ice conditions are important mainly because they determine the suitability of the habitat for ringed seals, the polar bears' primary prey. Bears have been observed throughout the polar basin, including areas north of 88º N (Amstrup 2003).

Polar bears migrate long distances to stay near the moving edge of the pack ice throughout the year. Amstrup (2000) found annual movements in the Beaufort Sea particularly large, with straight-line distances separating consecutive weekly locations totalling an average of 3,415 km. Based on analysis of the movements of 106 female polar bears between 1985 and 1993 using satellite telemetry, the Beaufort Sea polar bear population occupies a large area from about Cape Bathurst east of the Tuktoyaktuk Peninsula west to the Chukchi Sea south of Point Hope in northwestern Alaska (see Figure 10-27) (Amstrup 2000). This same data indicates a smaller core activity area, as defined by the contour surrounding 50% of the satellite relocations, concentrated from about the Canadian boundary west to near Barrow, Alaska. This core activity area can be expected to coincide with relatively high concentrations of primary prey species. Polar bears in the Beaufort Sea area seldom venture far onto land (Amstrup 2000). Seasonal and annual shifts in polar bear distribution are closely linked to shifts in prey distribution and associated sea ice conditions.

The primary prey for polar bear in the area is ringed seal, and secondary prey is bearded seal (Stirling and Archibald 1977). Polar bears will also scavenge carcasses of beluga and bowhead whales and are capable of capturing spring-migrating belugas and dragging them from small openings in the pack ice (Amstrup 2003). In winter and spring, polar bears prefer offshore areas with leads, although females with cubs prefer landfast ice (Stirling et al. 1993). In late spring and summer, polar bears move north with the retreating ice.

Local hunters feel the population has been increasing slowly (Stirling and Taylor 1999) and data obtained from various tagging programs and anecdotal observations suggests that the Beaufort Sea polar bear population has increased since the 1960s and early 1970s (Amstrup et al. 1986; Amstrup 2000).

Figure 10.27 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Polar bears usually remain on the sea ice all year, although some inhabit terrestrial areas for short periods (Amstrup 2000). Between 1985 and 1993, 106 adult polar bears were radiotagged in the Beaufort Sea area. Only 144 of 11,000 satellite relocations, about 1%, occurred on land, indicating they rarely ventured inland (Amstrup 2000). The largest dens are excavated by females with cubs over a year old, and can be about 1 m high, 2.5 m wide and 3 m long (GNWT 2004).

Female polar bears often show site fidelity to denning areas (Lentfer and Hensel 1980). Their birthing dens are located along the coast and on offshore islands, and on shore-fast ice and drifting sea ice. Radio telemetry of female polar bears from 1981 to 1999 revealed that more than half of all maternal dens were on the sea ice, with the remainder on nearshore coastal land (see Figure 10-28). Females that come ashore to den and give birth are quick to return to the sea ice when the cubs are able to travel (Amstrup 2003). The highest densities of maternal land dens were in the Arctic National Wildlife Refuge in northeastern Alaska and the in Yukon Territory from Herschel Island west (Amstrup 2000). Stirling and Andriashek (1992) reported that most maternal denning in the western Canadian Arctic is on Banks Island, and that little maternal denning is on the mainland from east of Herschel Island to east of Paulatuk. Furthermore, between 1981 and 1999, only one maternal den was located near Richards Island. The occasional denning that does occur in the region is usually north of the project area on offshore islands or pack ice.

The low level of maternal denning in coastal areas of the Canadian Beaufort Sea might be a result of hunting pressure from before about 1970 (Amstrup 2000; Stirling and Andriashek 1992). However, terrestrial denning might be increasing as regulations to protect females with cubs have been implemented (Amstrup 2000; Stirling 2004, personal communication). Some bears have denned in the outer Mackenzie Delta on Hooper and Pullen islands (Stirling and Andriashek 1992) and near Tent Island (Clarkson and Irish 1991).

Dens are excavated from mid-November to December and are used until late March or early April. Successful den sites are in areas that accumulate sufficient snow early in the season to create a snow cave that can be subsequently covered over (Amstrup 2003). This requirement can be met by slumping lake banks, troughs in patterned ground, active coastal banks, and similar features (Durner et al. 2001, 2003). The minimum physiographic relief for successful denning is only 1.3 m (Durner et al. 2001). Although suitable denning sites are not abundant near the project area, they do exist, and as mentioned previously, there is an apparent trend for more bears to establish terrestrial dens.

Figure 10.28 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Harvest

Polar bear populations are mainly limited by human hunting. Because of the low reproductive rate, overhunting could severely deplete any of the 14 polar bear subpopulations.

Polar bears are highly valued for Inuvialuit traditional harvest and for commercial sport harvest. Polar bear harvest locations have been reported along the Beaufort Sea coastline from near Herschel Island to the tip of the Tuktoyaktuk Peninsula and in the outer Mackenzie Delta near Pullen Island (Fabijan et al. 1993). The Inuvialuit Harvest Study (Joint Secretariat 2003) reports that Tuktoyaktuk residents harvested 102 polar bears over the study period averaging 12 each year, whereas residents from Inuvik harvested only three and Aklavik residents harvested 18 (see Table 10-21, shown previously).

Polar bear harvest is based on a scientifically derived total allowable harvest allocation and is guided by the *Management Agreement for Polar Bears in the South Beaufort Sea.* The harvest is currently 40 bears in the Canadian part of the management area. Five tags go to the Aklavik HTC, one to the Inuvik HTC, and 26 to the Tuktoyaktuk HTC. The HTCs regulate Inuvialuit harvest through bylaws. Kills of problem bears are also considered when setting of harvest quotas. Forty polar bear tags are allotted for the Inupiat in the Alaska part of the southern Beaufort Sea polar bear management area.

In the Inuvialuit Settlement Region, from 1988 to 1997, 20 to 63 polar bears were taken each year, i.e., mean = 44 (Joint Secretariat 2003). Because there is little contact between subpopulations, it is unlikely that new bears would move into an over hunted area. Therefore, it is important to carefully monitor each subpopulation (GNWT 2004).

Threats to polar bears include increasing human activity, oil spills, over harvesting, problem kills, changes to the populations of seals and other prey items, and climate change. Each of these elements could result in increased mortality, habitat avoidance and den site disturbances (Stirling and Taylor 1999; GNWT 2004). Other causes of mortality of polar bears of all ages are injuries, disease, occasional wolf predation, death from encounters with adult male walruses, and old age (Stirling and Taylor 1999; GNWT 2004). Young bears face many dangers such as starvation, human hunters, and old male bears (GNWT 2004). Bioaccumulation of toxic substances in their prey species also threatens these bears, despite their apparent remoteness from industrialized sites. DDT, dieldrin, mercury and other chemicals from urban centres are borne by wind and water to all parts of the Arctic (Stirling and Taylor 1999).

10.3.1.13 Greater White-fronted Goose

Status

The greater white-fronted goose is not designated a species of conservation concern federally (COSEWIC 2004) and is listed *secure* by the Government of the Northwest Territories (GNWT 2000).

Abundance and Distribution

The greater white-fronted goose is a common breeding bird on the outer Mackenzie Delta, but is less abundant at Parsons Lake and along the gathering pipeline route. They occur along the Mackenzie Valley during spring and fall migration.

These geese nest as solitary pairs or in small, loose colonies. Nesting pairs are usually monogamous and territorial. Both parents care for their young. Birds are reported to breed for the first time during their third year, and yearlings are known to follow and remain with their parents on the nesting grounds.

Families are gregarious during brood rearing, and are often encountered as large flocks of adults and flightless young. Adults might move their young from the nesting area to brood-rearing areas used by many families. Such groups were observed along the coast of the outer Mackenzie Delta during aerial surveys conducted for this project in 2001 and 2002 (see Figure 10-29).

Failed breeders and yearlings depart the nesting areas to moult in large flocks in favoured, traditional moulting areas. After the moult, Alaska North Slope and Yukon breeders move east to join breeders at major fall staging areas at the Mackenzie River and Anderson River deltas (Hawkings 1987).

Subadults, i.e. yearlings and two-year-olds, fly in large flocks to moult on inland lakes or coastal sites (Alexander et al. 1988; Johnson and Herter 1989) and are most abundant in the Mackenzie Delta, the Anderson River delta and Liverpool Bay.

Population Size

The mid-continent population of greater white-fronted geese is 700,000 or more. The centre of abundance in the Beaufort Sea area is between the Mackenzie River and Anderson River deltas.

Figure 10.29 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

It is estimated that about 25,000 breeding white-fronted geese are present along the Beaufort Sea coast between Herschel Island, Yukon Territory and Cape Parry, Northwest Territories each year. About 2,800 geese nest and moult on small islands south of Kendall Island (Alexander et al. 1991). Peak numbers of birds staging in the fall in the Mackenzie Delta were 25,200 in 1973, 22,200 in 1974 and 23,700 in 1975 (Koski 1977).

The CWS conducted annual aerial surveys of waterfowl populations on the outer Mackenzie Delta in June from 1989 to 1993. Table 10-22 shows, for white-fronted geese, the maximum, minimum and average numbers of individuals and pairs, densities of individuals and pairs, and numbers and densities corrected for visibility detection biases, i.e., the visibility correction factor (VCF).

Table 10-22: Greater White-Fronted Goose Numbers and Densities – Mackenzie Delta, 1989 to 1993

Value	Individuals		Pairs	
	Number	Density (No./km^2)	Number	Density (No./km^2)
Maximum	8,626	2.35	1,253	0.34
Minimum	3,695	0.61	812	0.13
Average	6,267	1.03	1,141	0.19
Average VCF adjustment	9,400	1.54	1,712	0.28
NOTE: VCF = visibility correction factor				
SOURCE: CWS 2000				

Population Density

As indicated in Table 10-22, shown previously, densities, adjusted for visibility detection bias, of greater white-fronted geese on the outer Mackenzie Delta from 1989 to 1993 averaged 1.54 individuals per km^2 and 0.28 breeding pairs per km^2.

Population Trends and Human Influences

The mid-continent population is reported to be stable or increasing.

Mortality

Predation is a major cause of mortality. Eagles, foxes and wolves are potential predators of adults and juveniles. Glaucous gulls, jaegers, Arctic foxes and occasionally grizzly bears are major predators of eggs and goslings. Hunting is also a major cause of mortality. Subsistence harvesting by local residents in the western Canadian Arctic averaged 7,300 birds per year. In the Inuvialuit Settlement Region, on average 1,761 geese were harvested yearly (Joint Secretariat 2003). In the Gwich'in Settlement Area, 68 greater white fronted geese were harvested in 1997 (GRRB 2004). In the Sahtu Settlement Area, 15 greater white fronted geese were harvested in 2001 (SRRB 2003).

Seasonal Occurrence

Greater white-fronted geese use the production area for nesting, moulting and migratory staging. They occur in the production area from about mid- to late May to mid- to late September (F.F. Slaney and Company Ltd. 1974; Johnson and Herter 1989). Greater white-fronted geese migrate through the Mackenzie Valley in the spring and fall (Bellrose 1980; Ely and Dzubin 1994).

Arrival

On the Mackenzie Delta, the first flocks arrive in mid-May and the largest numbers arrive in late May. From the Mackenzie Delta, birds disperse along the coast to the east and west. Greater white-fronted geese were the first geese to arrive on the outer Mackenzie Delta in 1972, on May 21, and in 1973, on May 18. They arrive at Richards Island in mid-May to early June, depending on the spring thaw, with nonbreeding subadults accompanying adult pairs to the nesting grounds.

Clutch Initiation

Greater white-fronted geese begin laying their eggs in early June in the following locations:

- north of Langley Island on June 8, n = 1 (Alliston 1984)
- Alaska North Slope on June 2 to 5, peaking June 8 to 10, n = 6 (Ely and Dzubin 1994)
- on the Kent Peninsula, Nunavut on June 4 to 9, peaking June 10 to 14, n = 6 (Ely and Dzubin 1994)

Hatching

Eggs hatch about 30 days after clutch initiation, usually in the last week of June or the first week of July (F.F. Slaney and Company Ltd. 1974; Koski 1975; Johnson and Herter 1989).

Fledging

The young fledge five to six weeks after hatching (Ely and Dzubin 1994). Fledging at one nest north of Langley Island on the outer Mackenzie Delta occurred on August 20.

Moulting

Nonbreeding subadults that accompany adult pairs to the nesting grounds leave their family groups by the time the eggs hatch. It is believed they fly to nearby inland lakes or the Beaufort Sea coast in late June to moult.

Breeding adults usually begin to moult their flight feathers when the young are two to three weeks old, and many move to the coast where they congregate in flocks. The adults and subadults are flightless during the moult of flight feathers.

Departure

Alaska North Slope and western Canadian Arctic breeders begin their fall migration eastward toward the Mackenzie Delta by the third or fourth week of August.

The peak departure period for greater white-fronted geese from the Mackenzie Delta is mid-September. Peak numbers were 19,690 on September 4 to 6, 1974, and 23,700 on September 8 to 10, 1975. Stragglers remained until early October in 1973.

Food and Feeding Habits

The greater white-fronted goose is an herbivore, feeding on grasses, berries, bulbils, tubers and rhizomes of grasses and sedges.

On the nesting grounds, greater white-fronted geese forage on mudflats and hummocks (*Puccinellia* spp. tillers) before major snowmelt occurs. After the melt, they forage mostly on pond margins and in ponds up to 1 m deep, feeding on rhizomes and basal stems of *Carex* spp. and *Dupontia fisheri* (Carrière et al. 1999).

Movement Patterns

Survey data collected for the project in 2001 and 2002 suggests families of greater white-fronted geese walk and swim from scattered inland nesting locations in the outer delta to the coast of the delta where they gather in large flocks. Routes and patterns of this movement are expected over a large area.

Home Range

Females exhibit a high fidelity to nesting areas. Most return near the previous year’s nest site, usually nesting within 500 m. Nest sites tend to be uniformly spaced, suggesting territories are maintained. Fidelity to the moulting sites is also apparent, but better data is needed.

Habitat Use

General

Greater white-fronted geese breed on the low-relief Arctic tundra and nest on the ground, typically near streams, small ponds, shallow lakes and tidal pools (Martell et al. 1984; Ely and Dzubin 1994). A study by Murphy and Anderson (1993) in Alaska found that greater white-fronted geese used 17 of 20 habitats. Greater white-fronted geese use a broad variety of landforms and vegetative complexes, including alluvium lowlands on stream deltas, low sedge-cotton-grass (*Eriophorum*) moss meadows, tussock lowlands, tundra ponds with *Carex aquatilis*, *Arctophila fulva* emergents, taiga forests and bogs, raised polygon edges, hummocky ground, inland tributary stream edges, dwarf and occasionally tall-shrub tundra of birch and willow, heath tundra, drier rock fields, eskers, and hill slopes with *Dryas* spp., grasses and lichens.

Nesting

Greater white-fronted geese nest on tidal flats and in higher, drier areas, usually near lakes or rivers (Koski and Tull 1981). The nest is usually in tall grass bordering tidal sloughs or in sedge marshes, and less often in grass-covered pingos or along the margins of tundra hummocks. They occasionally nest on heath tundra, sometimes up to 100 m from water. On a nesting area at the Anderson River, the water nearest to a nest was usually a small slough, margined with sedges.

On the Tuktoyaktuk Peninsula, this species nests solitarily on dry hummocks in lowlands or on tussock tundra beside a wetland (Sirois and Dickson 1989). During the nesting season in Alaska, they used all habitats but consistently selected only basin wetland complexes and wet meadows (Murphy and Anderson 1993). White-fronts also nest on patterned terrain in low-centre polygons and lake basins, usually within 3 m of ponds.

The results of surveys of the outer Mackenzie Delta and Parsons Lake during the 1972 to 1973 nesting season indicated that greater white-fronted geese used several habitats. Of the sightings:

- 21% were in high-centred polygon (peat mounds with water-filled perimeters) habitat
- 20% were in dwarf shrub–heath
- 17% were on floodplain lakes
- 15% were on upland lakes

- 12% were in low-centred polygon (nest-like patterns of peat with wet interiors) habitat
- 9% were in willow–sedge
- 6% were in other habitats

The vegetation of high-centred polygon and dwarf–shrub heath communities includes cotton grasses and sedges co-dominant with shrubs. Dwarf shrub–heath has moderate to good drainage, whereas the troughs of high-centred polygons are often filled with water. Floodplain lakes often have sedge-dominated margins whereas upland lakes tend to have steeper margins dominated by tall shrubs. Willow–sedge habitat consists of sedges, grasses and forbs with 40 to 60% of the ground covered by small shrubs.

Brood Rearing

In a study in Alaska, greater white-fronted geese consistently selected only basin wetland complexes for brood rearing. Newly hatched goslings relied on sedges for cover. In the western Arctic, newly flying families used several habitats for grazing: low sedge–cotton-grass meadows, tidal marshes, sheltered embayments, lagoons and beaches (Sirois and Dickson 1989; Ely and Dzubin 1994).

Moulting

Nonbreeding subadult geese gather to moult in coastal locations and inland lakes, usually by the last week of June. Low-relief deltaic islands, channels, meadows, marshy areas vegetated with sedges and grasses, and meandering streams often characterize these inland lake systems. Breeding adults tend to moult while rearing their young. Family groups will often move downstream during the moult period and congregate in coastal locations. Surveys of greater white-fronted geese on the outer Mackenzie Delta in 2001 and 2002 indicated a movement to the coast from inland nesting areas. The same moulting areas are used every year and tend to be large inland lakes, river channels and coastal flats. Flocks of moulting geese can move from lake to lake, often traversing considerable distances overland.

Moulting habitat requirements are poorly understood in the western Northwest Territories and in Yukon Territory. Greater white-fronted geese moult in floodplain and upland lakes in the Mackenzie Delta and at Parsons Lake. In Alaska, near Teshekpuk Lake on the Arctic coastal plain, moulting habitat is characterized by low-relief lowlands of deep lake basins with higher shorelines and extensive rich, meadow-like feeding grounds where the vegetation is dominated by mosses, grasses (*Carex aquatilis, Deschampsia, Dupontia* and *Arctophila*), forbs and shrubs.

Staging

The Mackenzie Delta is an important staging area for greater white-fronted geese before fall migration. Between 1973 and 1976, peak numbers of staging greater white-fronted geese ranged from 12,500 to 23,700, or 9 to 18% of the western mid-continent population. Most were around Shallow Bay. Staging occurs frequently on sedge and mudflats and willow-sedge habitat between Harry Island and Ellice Island. During spring migration in 1972 and 1973, greater white-fronted geese were most numerous in floodplain areas on the outer Mackenzie Delta, with 0.47 individuals/km² and less on upland areas, on Richards Island with 0.35 individuals/km² and at Parsons Lake with 0.12 individuals/km².

During the pre-nesting period, greater white-fronted geese in Alaska consistently selected basin wetland complexes, wet meadows and nonpatterned ground habitat, wet meadows and patterned ground habitat, and artificial or partially vegetated habitat.

Model Results

The habitat model assigned greater values to those vegetation types that included the following key features:

- tall grass bordering tidal sloughs or sedge marshes for nesting cover
- hummocky tundra for nest sites and sedge cover
- sedges for brood-rearing cover
- sedge–graminoid meadows during moulting

High-value vegetation types for nesting were (see Table 10-23):

- sedge – cotton-grass tussock
- low-centred polygons
- delta low-centred polygons

Moderate-value vegetation types for nesting were:

- high-centred polygons
- riparian sedge – cotton-grass
- delta high-centred polygons

Waterbodies were assigned very low value.

Table 10-23: Greater White-Fronted Goose Nesting Habitat Distribution – Tundra Ecological Zone

Habitat Value	Regional Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	78,775	3
Moderate	70,190	3
Low	98,317	6
Very low to none	2,270,471	90
No data	0	0
Total	2,517,753	100[a]

NOTE:
a Numbers do not total 100% because of rounding

The original habitat values, assigned on the basis of vegetation characteristics, were adjusted for proximity to waterbodies and sources of sensory disturbance. Nests of greater white-fronted geese are usually found near water, and waterbodies are critical for brood rearing. The highest values were assigned to suitable vegetation communities within 5 m of a waterbody.

The results of the habitat model predict low cover of high-value nesting habitat at 3%, and limited moderate-value habitat at 3%. These results are likely functions of the adjustments for proximity to waterbodies. The highest-value nesting habitat, namely 5-m-wide strips around waterbodies, accounts for a very small part of the total area within the Tundra Ecological Zone. All vegetation communities, regardless of their original, unadjusted value, were assigned a very low rating if they were more than 100 m from waterbodies. That accounts for the large proportion of very low to none nesting habitat in the Tundra Ecological Zone. Sensory disturbance was likely not a critical factor in reducing the original habitat ratings. There are few existing sources of disturbance.

The model for foraging habitat addresses only terrestrial foraging because no aquatic habitat data was available. This is an important limitation of the model for predicting the total area of high-value foraging habitat in the Tundra Ecological Zone.

Greater white-fronted geese are herbivores. Their diet during the summer consists mainly of sedges, grasses, berries, and the underground parts of plants. The habitat model assigned higher values to those vegetation types that included high percent cover of key plant forage species such as sedges (*Carex*, *Eriophorum*), horsetails (*Equisetum*) and *Dupontia fischeria*. Lower values were assigned where there were tall shrubs and low trees. These could hinder mobility and access by foraging geese. The model gave moderate value to waterbodies.

The results of the model (see Table 10-24) predict low cover of high-value terrestrial foraging habitat at 5%, but substantial moderate-value cover at 48%. Because close proximity to waterbodies is important during foraging and nesting, and because some waterbodies are important foraging habitat, over half of the Tundra Ecological Zone RSA is rated as having high or moderate value. Sensory disturbance was likely not a critical factor in reducing the original habitat ratings. There are few existing sources of disturbance.

Table 10-24: Greater White-fronted Goose Terrestrial Foraging Habitat Distribution – Tundra Ecological Zone

Habitat Value	Regional Study Area	
	Habitat Area (ha)	Habitat (%)
High	115,157	5
Moderate	1,217,240	48
Low	38,294	2
Very low to none	1,147,062	46
No data	0	0
Total	2,517,753	100[a]

NOTE:
a Numbers do not total 100% because of rounding

10.3.1.14 Snow Goose

Status

Snow goose populations are considered *secure* in the Northwest Territories (GNWT 2000), and this species is not listed nationally by COSEWIC (2004).

Abundance and Distribution

The snow goose nests in the tundra regions from northeastern Siberia east to Greenland, including islands in the Arctic archipelago (American Ornithologists' Union 1998).

There are key sites along the Mackenzie River where many snow geese congregate during the spring migration. These sites are identified as key habitat sites by the CWS (Alexander et al. 1991). The nesting colony in the Kendall Island Bird Sanctuary is an important area for this species within the production area. The use of the outer Mackenzie Delta as a migratory staging area in some fall seasons is also important, although the north Yukon coast is used more frequently.

Population Size

The Kendall Island nesting colony varied in size greatly between 1960 and 2001, with estimates ranging from 1,153 to 7,500 adults, including nesting and non-nesting geese. Estimated numbers of nesting geese during this period ranged from 210 to 2,506. The estimated total numbers of adults in recent years, i.e., 1996 to 2001, ranged from 1,645 to 4,255. The proportion of geese that were nesting varied from 13 to 59%. In 1972, a late thaw and greater than normal flooding were thought to be reasons snow geese did not nest at the usual Kendall Island location and might have been displaced to an area near Kumak Channel.

The total number of snow geese in North America in 1997 was estimated to be about 6.7 million, of which five million were breeding birds (Mowbray et al. 2000). The number of breeding birds in the western Canadian Arctic, e.g., at Banks and Kendall islands and Anderson River was estimated to be about 486,400 (Mowbray et al. 2000).

The numbers of birds staging on the Beaufort Sea coast of Alaska and the Yukon vary greatly, ranging from 163,000 to nearly 600,000 (Johnson and Herter 1989). Varying age ratios over three- to five-day periods suggest a high turnover.

A western population of the lesser snow goose subspecies, *Chen c. caerulescens* nests in the production area. This population winters in coastal areas of southern British Columbia, e.g., the Fraser River delta, Washington, Oregon, and in interior regions from Oregon to Mexico.

This population migrates through the interior of North America east of the Rocky Mountains to stage in southeastern Alberta, southwestern Saskatchewan and northern Montana, and then moves on to wintering grounds. These routes are reversed in spring (Mowbray et al. 2000; Hines et al. 1999).

Population Density

Snow geese are colonial nesters and are gregarious during the moult-migration, migration and winter seasons. The density of nests in the delta can vary from less than one to seven nests per hectare.

Population Trends and Human Influences

The North American population is growing at an annual rate of 5%. There was no apparent trend in numbers in the Kendall Island population from 1960 to 2001.

Mortality

Predation is considered a major cause of mortality. Eagles, foxes, polar bears and wolves are potential predators of adults and juveniles. The most important predators of eggs and goslings are Arctic foxes, glaucous gulls, jaegers and occasionally caribou. Grizzly or polar bears can have a devastating effect on local populations of snow geese if they come across a nesting colony. In recent years, grizzly bears were known to have eaten or destroyed most or all snow goose eggs on Howe Island, Alaska.

Hunting is also a major cause of mortality. In the Inuvialuit Settlement Region, on average, 5,871 snow geese were harvested yearly (Joint Secretariat 2003). In the Gwich'in Settlement Area, 154 snow geese were harvested in 1997 (GRRB 2004). In the Sahtu Settlement Area, 461 snow geese were harvested in 2001 (SRRB 2003).

Seasonal Occurrence

Arrival

Adult snow geese arrive at Kendall Island during the last days of May or first days of June, and yearlings arrive one or two weeks later. Some early observation dates are: Kittigazuit on May 10, 1932 and Richards Island on May 18, 1972 and May 27, 1973 (F.F. Slaney and Company Ltd. 1974). At these times most birds are concentrated near the nesting colony (see Figure 10-30).

Clutch Initiation

Clutch initiation in the Beaufort Sea area occurs late in the first week or early in the second week of June.

Hatching

Eggs hatch during the last week of June or first week of July. Movement to brood-rearing areas occurs within several days of hatching.

Fledging

Most young have fledged and can fly from the brood-rearing areas by August 15 to 20.

Moulting

Adults with young begin to moult in mid-July, the second week after the eggs hatch (Palmer 1976). Adults are flightless at this time.

Figure 10.30 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Staging

Snow geese in the western Arctic, including Mackenzie Delta birds, begin to leave brood-rearing and moulting areas by August 15 to 25, with the peak occurring between August 25 and September 5. Inclement weather can turn birds back to the Mackenzie Delta (Hawkings 1987; Alexander et al. 1988; Johnson and Herter 1989). They move to staging areas along the coastal tundra of the Beaufort Sea (Koski and Gollop 1974; Schweinsburg 1974; Johnson and Herter 1989) where they remain for one or two weeks and feed intensively.

Flock locations vary during the staging period, but birds mostly use coastal plain areas less than 300 m in elevation. Some important staging areas are the Bathurst and Tuktoyaktuk peninsulas, the outer Mackenzie Delta and the Alaska-Yukon North Slope.

The numbers of snow geese in the Mackenzie Delta increased rapidly in the third week of September 1973, coinciding with their departure from the Alaska-Yukon North Slope. In 1971, large numbers were counted on Ellice Island immediately following the departure from the north slope.

Departure

Peak departure of snow geese from northeastern Alaska and the western Arctic of Canada occurs in mid- to late September. In 1973, the last birds departed around the last week of September, but lingered on Richards Island until October 4 in 1973. The timing details for movement along the route between the Arctic and the Prairies are unknown.

Peak fall migration past Moose Channel, northwest of West Channel, in 1972 was on September 11. Large movements were noted from September 13 to 16, 1971, when the observation period was September 13 to 17. In 1975, the main arrival on the Yukon coast and Mackenzie Delta was September 3 to 7 and the major departure was September 19 to 24, with the peak being 300,000 snow geese leaving between September 11 and 15.

Food and Feeding Habits

Snow geese are herbivores. They grub for rhizomes, tubers and roots, pull up entire stems or shear them off at ground level, or graze on vegetative parts of emergent or herbaceous plants, and strip seeds and fruits of shrubs.

Movement Patterns

There is some movement of flightless adults and broods near the Kendall Island nesting colony and the outer Mackenzie Delta. In 1973, hatching was completed at Kendall Island by the first week of July, and as summer progressed, the birds moved from Kendall Island southwest along the coast into Shallow Bay.

Home Range

Snow geese breed in colonies. The colony densities vary greatly in space and time. The home range during brood rearing also varies greatly in summer and among groups of females. On Bylot Island, the densities of the breeding colonies ranged from less than one nest/ha to seven nests/ha, and the brood-rearing home range varied from 6.6 km^2 to 21.7 km^2.

Habitat Use

General

Snow geese nest, raise their young, moult and stage before fall migration in a variety of tundra habitats.

Nesting

In northern Yukon and the adjacent Northwest Territories, snow geese breed on the subarctic and Arctic coastal plain near ponds, shallow lakes, streams or braided streams. Most snow geese nest inland beside coastal salt marshes. Vegetation in nesting areas is usually dominated by dwarf willow (*Salix brachycarpa*) and sea-lyme grass (*Elymus arenarius*). Colonies are commonly in low-lying, wet meadows characterized by polygon formations and grasses and sedges.

Brood Rearing

Brood-rearing habitat includes moist inland meadows, edges of shallow, freshwater ponds and lakes and, where forage is abundant, upland tundra. Salt marshes and other intertidal areas are also preferred. Brood-rearing sites can be many tens of kilometres away from the colony.

Moulting

Snow geese apparently use the same habitat during the moult that they use for brood rearing. They prefer lakes and large ponds. Nonbreeding birds and families use the same habitat.

Staging

Western Canadian Arctic breeders disperse from the Mackenzie Delta along the Yukon North Slope into Alaska to feed on the coastal plain and in the lower foothills. On the flat coastal plain they use low-centred polygons and unpatterned wet meadows, both dominated by sedges and cotton-grass. In rolling hills they use mixed high- and low-centred polygons, wet meadows dominated by tussocks, i.e., *Eriophorum vaginatum*, and shrubs, i.e., *Salix* spp. and *Betula nana*. In hilly areas they use upland, unpatterned tundra with drainage tracks that have lush cotton-grass and water sedge.

Model Results

No habitat model was prepared for the snow goose because the two most important concentration areas are well known. These are the nesting colony in the study area near Kendall Island on the outer Mackenzie Delta, and the areas of spring-staging concentrations along the middle Mackenzie River.

10.3.1.15 Tundra Swan

Status

The tundra swan is not designated a species of concern nationally (COSEWIC 2004), and populations are considered *secure* in the Northwest Territories (GNWT 2000).

Abundance and Distribution

Tundra swans breed in Arctic Russia and across Arctic North America from Alaska to Quebec (Limpert and Earnst 1994). The population that nests on the Mackenzie Delta is part of the eastern population that winters along the Atlantic coast, mostly from New Jersey to South Carolina. The Mackenzie Delta is an important nesting area for this population.

Almost all tundra swans nesting in the Beaufort Sea region migrate through the Mackenzie Valley (Johnson and Herter 1989). On the Mackenzie Delta, swans stage around Mallik Bay, Swan Channel, outer sections of the Kendall Island Bird Sanctuary and eastern Shallow Bay (Alexander et al. 1991). They moult in the Mackenzie Delta, with concentrations at Moose Channel, near Tent Island (Hawkings 1987) and in Swan Channel.

The outer Mackenzie Delta is an important fall staging area. All but a few of the 2,000 tundra swans surveyed during fall staging on the Alaskan and Yukon slopes and outer Mackenzie Delta in 1973 were found in the Mackenzie Delta (Koski 1975). The peak fall staging numbers in 1975 were estimated at 3,400 on August 20 (Koski 1977).

Population Size

The eastern population has just over 103,000 swans (CWS 2000). The Mackenzie Delta is probably the most important breeding area in Canada for tundra swans, with about one third of the total population breeding there.

Helicopter surveys of tundra swan and geese were conducted over the outer Mackenzie Delta, and in other parts of the mainland Inuvialuit Settlement Region, by the CWS from 1989 to 1993. The mean annual number of swans on the outer delta during that period was 5,036 (see Table 10-25).

Table 10-25: Tundra Swan Numbers and Densities – Mackenzie Delta, 1989 to 1993

Value	Individuals		Pairs	
	Number	Density (no./km^2)	Number	Density (no./km^2)
Maximum	6,685	1.13	2,278	0.43
Minimum	3,120	0.57	1,560	0.27
Average	5,036	0.83	2,087	0.34

Population Density

Mean annual density of swans on the outer delta between 1989 and 1993 was 0.83/km^2, with a range of 0.57 to 1.13 swans/km^2. This data is summarized in Table 10-25, shown previously.

Field studies conducted in 2001 and 2002 found the highest tundra swan densities were in the outer Mackenzie Delta. Average monthly densities ranged from 101 to 179 individuals/100 km^2 during the June, July and August aerial surveys. Densities were much lower in September, suggesting the swans had begun to move out of the area. Large flocks of swans gathered along the coastal edges of the outer Mackenzie Delta starting in July and continuing into August (see Figure 10-31). Tundra swans were also numerous and widely distributed around Parsons Lake, with most sightings to the northwest and north of the lake (see Figure 10-32). The lowest densities were found along the gathering pipeline route, with average monthly densities ranging from 24 to 50 individuals/100 km^2 (see Figure 10-33).

Population Trends and Human Influences

The North American tundra swan population has been increasing or stable in recent years. The population size was stable from 1980 to 1989, with the eastern wintering population increasing 2% and the western wintering population decreasing 2%. The eastern population more than doubled from 1955 to 2000, based on the mid-winter waterfowl survey and has varied from 80,000 to 100,000 since the mid-1980s (Serie et al. 2002). The eastern population increased an average of 6% per year during the 1990s (CWS 2000). However, the 2000 mid-winter index for the eastern population decreased 5% from the previous year.

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Mortality

The main source of mortality for tundra swans on the breeding grounds is the loss of eggs and cygnets to nest predators. Potential predators include brown bears, Arctic foxes, red foxes, wolves, wolverines, glaucous gulls, common ravens and jaegers. Adult mortality is limited. Golden eagles might occasionally take adults or subadults. Subsistence hunting contributes little to tundra swan mortality (Ritchie and King 2000). However, in the Gwich'in Settlement Area, 106 tundra swans were harvested in 1997 (GRRB 2004). One tundra swan was harvested in the Sahtu Settlement Area in 2001 (SRRB 2003). On average, 127 swans were harvested yearly in the Inuvialuit Settlement Region (Joint Secretariat 2003).

Seasonal Occurrence

Arrival

The phenology of tundra swan activities in the Arctic depends on the timing of snowmelt. Spring arrival along the coast of the Canadian Beaufort Sea is in mid-May to mid-June (Alexander et al. 1988). Tundra swans arrive in the Mackenzie Delta earlier than in areas to the west or east. Nesting territories in the North Slope of Alaska are occupied in early June.

Spring migration is primarily through the Mackenzie Valley. For example, concentrations of tundra swans were observed in the Sahtu Settlement Area during spring surveys in May 2002 (see Figure 10-34).

Clutch Initiation

Tundra swans initiate egg laying in late May to early June. Two initiation dates were: June 14, near Reindeer Station, where n = 3, and June 6, south of Inuvik, where n = 1 (Alliston 1984).

Hatching

The incubation period is 31 to 32 days with the hatch date on the North Slope of Alaska averaging from July 8 to July 10. The peak hatching period is between late June and mid-July (Godfrey 1986; Johnson and Herter 1989; Alexander et al. 1988). Example hatch dates for the delta region are: July 23, near Reindeer Station, where n = 3, and July 15, south of Inuvik, where n = 1. In 1972, the earliest observation of young in the Mackenzie Delta was on July 5.

Fledging

The young can fly at nine to 10 weeks of age, and they complete fledging by mid-September. Examples of fledging dates for the Mackenzie Delta region are September 28, near Reindeer Station, where n = 3, and September 20, south of Inuvik, where n = 1.

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Moulting

Adults begin moulting in late July after the eggs hatch and are flightless for 33 to 34 days. Females moult before males, and families and nonbreeders leave the moulting areas in late September to early October to begin their southward migration (Alexander et al. 1988; F.F. Slaney and Company Ltd. 1974; Johnson and Herter 1989).

Staging

No premigratory concentrations were noted in the outer Mackenzie Delta in 1972 and 1973, although tundra swans were observed there in family groups and small groups of nonbreeders in late August and September. The highest concentrations were observed in the third week of August with numbers dropping off after September 9. Koski (1977) noted a similar pattern of abundance and departure timing.

Departure

Families leave in late September on the North Slope of Alaska and in late September to early October on the Canadian Beaufort Sea coast. In 1973, the last family group was observed on the outer Mackenzie Delta on October 4 and in Inuvik on October 12. Nonbreeders in the coastal Canadian Beaufort Sea area depart in late September to early October.

Food and Feeding Habits

Tundra swans are herbivorous. While on the breeding grounds, tundra swans feed almost entirely on aquatic plants. They obtain food by head dipping and tipping-up on the water (Carboneras 1992), and they prefer to feed in shallow water so they can reach desired food items (Bellrose 1980). Their long necks permit feeding in water up to 1 m deep. Primary foods are the seeds, stems, roots and tubers of submerged and emergent aquatic vegetation. Secondary foods include upland plants and their berries, e.g., *Vaccinium uliginosum* and *Empetrum nigram*. During the brood-rearing period and adult moult, a favourite food of swans is sago pondweed (*Potamogeton pectinatus*). Swans in northeastern Alaska also eat *Puccinella phryganodes, Carex aquatilis, C. subspathacea* and *Oxytropis nigrescens*.

Movement Patterns

Family groups can move more than 1 km between lakes and from nest sites to brood-rearing lakes.

Home Range

Home ranges have been determined for radio-tagged tundra swans on the western Alaska breeding grounds. Pairs with young had an average home range of 139 ha, nonbreeding pairs averaged 362 ha and flocked nonbreeders averaged 1,331 ha.

Habitat Use

General

Tundra swan breeding habitat mainly comprises tundra lakes, ponds and pools in coastal deltas. Swans occur less frequently in the treeline area inland, rarely breed in forests of the Mackenzie Delta (Martell et al. 1984), and build their nests near large waterbodies. Swan density is positively correlated with wetland availability, particularly the number of lakes per square kilometre and the linear kilometres of lake shoreline per square kilometre. Tundra swans prefer lakes that support *Potamogeton* spp., i.e., pondweed. The primary emergent vegetation associated with tundra swan habitat is *Carex aquatilis* and *Arctophila fulva*, and the primary vegetation in moist tundra is *Carex* spp., *Puccinellia phryganodes, Dupontia fischeri* and *Stellaria humifusa*.

Nesting

Breeding territories usually include a large lake for foraging and escape, and numerous other wetlands. Previous ground surveys during the nesting season found densities of 2.8 swans/km^2 in wet sedge habitat, 2.4 swans/km^2 in wet sedge-patterned ground habitat and 5.5 swans/km^2 on tidal flats.

Nests can be more than 200 m from the nearest waterbody, although the mean distance was 100 m on the Colville River delta and 60 m on the Miluveach River delta.

Nest sites are usually elevated mounds that provide good visibility, with numerous lakes nearby, and that are also near suitable brood-rearing habitat. In the Kuparuk oilfield, nests were mostly found in moist tussock tundra, deep open lakes with islands, basin wetland complexes and wet meadows. Nest sites in the northwestern Mackenzie Delta were usually in damp sedge meadows, patches of low open willows often mixed with sedges, or on islets. The nest was usually within 45 m of the shoreline, 8.4 m away, on average (Campbell 1973).

The results of surveys of the outer Mackenzie Delta and at Parsons Lake in 1972 to 1973 indicated that the predominant habitat used by tundra swans during the nesting season was sedge-herb habitat, in 46% of the swan sightings. Sedges dominate this habitat type, with grasses, forbs and small shrubs occurring as well. This habitat is poorly drained and usually has standing surface water. Upland lakes, willow-sedge habitat, floodplain lakes, high-centred polygon habitat and low-centred polygon habitat were used in the nesting season to a lesser extent.

Surveys of the nesting swans on the Colville River delta on the North Slope of Alaska indicated that 77% of nests were in six habitat types:

- young basin wetland complexes
- old basin wetland complexes
- moist tussock tundra
- nonpatterned wet meadows
- deep open water with islands or polygonalized margins
- moist sedge-shrub meadows (Ritchie and King 2000)

During the nesting season in all years, nonbreeding swans on the Alaskan North Slope strongly selected ponds or lakes with aquatic grass but without islands (Murphy and Anderson 1993).

Brood Rearing

Broods are regularly seen in lakes with littoral areas dominated by emergents such as *Arctophila fulva*. During brood rearing, swans will use a wide array of habitats but are known to consistently select deep open lakes.

Of five broods recorded on lakes on the Yukon coastal plain:

- one was on a lake less than 0.26 km^2, where n = 18
- three were on lakes between 0.26 km^2 to 1.3 km^2, where n = 28
- one was on a lake between 1.3 km^2 to 1.9 km^2, where n = 6
- no broods were recorded on lakes larger 1.9 km^2, where n = 8

In 1975, the mean brood size on the Yukon-Alaska North Slope was 2.57 to 2.44, which is similar to the Mackenzie Delta where the mean size was 2.22 to 2.54.

The highest densities of juvenile tundra swans, i.e., 13.6 swans per 100 km^2, recorded by Campbell and Weber (1973) were in the northern treeless part of the Mackenzie Delta where woody vegetation is limited to scattered patches of shrubby willows and where water covers a large percentage of the area. High densities, i.e., 8.9 swans per 100 km^2, were also recorded in the drier upland areas north of the treeline and outside the delta where the vegetation mainly comprises low grasses, sedges, forbs, ericaceous plants and willows. Lower densities of 4.6 swans per 100 km^2 were recorded in the southern Mackenzie Delta, treed area including black spruce, willow, alder and balsam poplar. Lower densities of 3.2 swans per 100 km^2 were also recorded in the boreal forest outside the delta, where black spruce is the dominant plant community. No broods were recorded in mountain tundra or coastal habitat.

In surveys of nesting swans on the North Slope of Alaska from 1992 to 1996, Ritchie and King (2000) observed 62% of broods in six habitat types, as follows:

- wet-sedge willow meadows
- lakes with low-water connections
- lakes with high-water connections
- brackish water
- salt-killed tundra
- deep open water without islands

Most broods in the Miluveach River area were found in three habitat types:

- deep open water without islands
- deep open water with islands
- moist sedge-shrub meadows

Moulting

The islands in the Mackenzie Delta south of Kendall Island are an important area for moulting tundra swans. Surveys of the outer Mackenzie Delta and Parsons Lake in 1972 to 1973 found the predominant habitats used by tundra swans during the moulting period were upland lakes, in 39% of sightings, and floodplain lakes, in 33% of sightings. Low-centred polygons, in 7% of sightings, and channels, in 6% of sightings, were also used as moulting habitat.

Staging

F.F. Slaney and Company Ltd. (1974) found no evidence of staging concentrations before departure in the fall of 1972 or 1973, and no shift in habitat use was noted. Murphy and Anderson (1993) noted no consistent selection of any habitat during fall staging.

Model Results

The habitat model gave greater nesting habitat value to:

- vegetation types with wet sedge habitats, polygons or patterned ground and moist tussock tundra used for nesting cover

- littoral areas with emergents especially Arctic pendant grass (*Arctophila fulva*), wet sedge-willow, moist sedge-shrub and sago pondweed (*Potamogeton pectinatus*) used for brood rearing

Lower values were assigned to vegetation types with high percent cover of tall shrubs or trees, to drier vegetation types, and to waterbodies.

High-value vegetation types for nesting were:

- sedge – cotton-grass tussock
- low-centred polygons
- delta sedge – cotton-grass
- delta low-centred polygons

Moderate-value vegetation types were:

- high-centred polygons
- riparian sedge – cotton-grass
- delta high-centred polygons
- water

The original habitat values, assigned on the basis of vegetation characteristics, were adjusted for proximity to waterbodies, and for proximity to sources of sensory disturbance. Nests of tundra swans are usually found near waterbodies that are critical for brood rearing. The highest values were assigned to suitable vegetation communities within 45 m of a waterbody.

As shown in Table 10-26, the results of the habitat model predict a low quantity of cover of high-value nesting habitat for tundra swans in the Tundra Ecological Zone at 7%. Moderate-value habitat is also predicted to be relatively limited at 5%. These results are likely functions of the adjustments for proximity to waterbodies. The highest value, 45-m-wide strips around waterbodies, account for a small part of the total area within the Tundra Ecological Zone. All vegetation communities, regardless of their original unadjusted value, were assigned a very low rating if they were greater than 200 m from waterbodies. That accounts for the large proportion of very low to none nesting habitat in the Tundra Ecological Zone. Sensory disturbance was probably not a critical factor in reducing the original habitat ratings, as there are few existing sources of disturbance.

Table 10-26: Tundra Swan Nesting Habitat Distribution – Tundra Ecological Zone

Habitat Value	Regional Study Area	
	Habitat Area (ha)	Habitat (%)
High	180,033	7
Moderate	133,165	5
Low	231,162	9
Very low to none	1,973,393	78
No data	0	0
Total	2,517,753	100[a]

NOTE:
a Numbers do not total 100% because of rounding

No aquatic habitat data was available, so the model for foraging habitat addresses aquatic foraging by assigning a high value to waterbodies. This is an important limitation of the model for predicting the total area of high-value foraging habitat in the Tundra Ecological Zone (see Table 10-27).

The habitat model gave greater weight to vegetation types with aquatic plants, especially *Potamogeton* spp., *Carex aquatilis, Arctophila fulva, Puccinellia phryganodes, Dupontia fischeri,* and *Stellaria humifusa*. The model also gave high value to waterbodies. Lower values were assigned to vegetation types with high percent cover of tall shrubs or trees and to drier types.

Table 10-27: Tundra Swan Terrestrial Foraging Habitat Distribution – Tundra Ecological Zone

Habitat Value	Regional Study Area	
	Habitat Area (ha)	Habitat (%)
High	1,361,526	54
Moderate	131,398	5
Low	112,929	5
Very low to none	911,901	36
No data	0	0
Total	2,517,754	100

As with the nesting habitat model, the original habitat values in the foraging habitat model assigned on the basis of vegetation characteristics were adjusted for proximity to waterbodies, and for proximity to sources of sensory disturbance. Waterbodies are important for foraging. The highest values were assigned to suitable vegetation communities within 45 m of a waterbody.

The results of the modelling predict high cover of high-value foraging habitat at 54%, due in part to the high ranking assigned to waterbodies and the adjustment for proximity to water. However, the model predicts low cover of moderate-value habitat at 5%.

10.3.1.16 Greater Scaup

Both greater and lesser scaup occur in the production area and along the pipeline corridor. The two species are very similar in appearance and are difficult to distinguish during surveys, particularly aerial surveys. Consequently, much background information about these species concerns scaup as a group. Nesting scaup in the production area are likely to be greater scaup, which prefer tundra habitats like those in Niglintgak, Taglu and Parsons Lake. Lesser scaup nest primarily south of the treeline, although some nest on the tundra. For this assessment, the greater scaup is a VC in the production area.

Status

The greater scaup is designated *secure* in the Northwest Territories (GNWT 2000) and is not listed as a species of concern nationally (COSEWIC 2004).

Abundance and Distribution

The breeding range of the greater scaup is nearly circumpolar in Arctic and subarctic regions. It winters along ocean coasts and large inland lakes, south of the breeding range (Carboneras 1992). The main North American breeding grounds are in western Alaska, although the North American breeding range extends from western and northern Alaska across the north Yukon Territory to the Mackenzie Delta and Tuktoyaktuk Peninsula in northwestern Northwest Territories, along the east coast of Hudson Bay and east into north-central Quebec and Labrador. North American populations winter primarily along the Atlantic and Pacific coasts and on the Great Lakes. Most greater scaup that nest in the Mackenzie Delta region probably migrate southeast to winter along the Atlantic coast (Kessel et al. 2002; Bellrose 1980).

Greater and lesser scaup were the most abundant species group recorded during the 2001 to 2002 field surveys in the production area. In general, scaup were evenly distributed during the spring surveys and in June but became concentrated in larger groups in August and September. Greater scaup is the predominant scaup species nesting in tundra areas whereas lesser scaup predominate in the forested regions of the production area. The following figures show the distribution and abundance of scaup during the 2001 and 2002 aerial surveys:

- Figure 10-35: Scaup Aerial Survey – Outer Mackenzie Delta, June 2002
- Figure 10-36: Scaup Aerial Survey – Parsons Lake, August 2001
- Figure 10-37: Scaup Aerial Survey – Gathering Pipeline Route, June 2002
- Figure 10-38: Scaup Aerial Survey – Gwich'in Settlement Area, June 2002
- Figure 10-39: Scaup Aerial Survey – Sahtu Settlement Area, Spring 2001
- Figure 10-40: Scaup Aerial Survey – Sahtu Settlement Area, June 2001
- Figure 10-41: Scaup Aerial Survey – Deh Cho Region, May 2002

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Figure 10.41 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

During systematic waterbody censuses of the Mackenzie Delta in June to August 1982, greater scaup outnumbered lesser scaup on the outer Mackenzie Delta, with 14% of the total waterfowl identified as greater and 0.4% as lesser. Scaup were more numerous in the inner Mackenzie Delta, where 0.9% was greater scaup and 14% lesser scaup (Alliston 1984).

Both species of scaup also occur along the pipeline corridor, but the dominant nesting species there is the lesser scaup. Greater scaup occur mostly as migrants and locally as breeders.

Population Size

The population of both species of scaup in the Mackenzie Delta from 1974 to 1985 ranged from a low of 52,700 in 1974 to a peak of 183,500 in 1984 (Hawkings 1987). Breeding pair surveys of scaup in tundra and wooded parts of the Mackenzie Delta in 1982 indicated 42,000 to 52,000 pairs were present. An estimated 150,000 greater scaup occurred in the Northwest Territories (GNWT 2000).

Population Density

Alliston (1985) reported the density of scaup broods on waterbodies in the inner delta to be 0.065 broods/ha of water and in the outer delta to be 0.023 broods/ha of water. In 1983, higher densities of broods were recorded on waterbodies in the inner Mackenzie Delta, i.e., 0.087 broods/ha of water (Alliston 1985).

The regional density is unknown. A dense population of ducks, i.e., 31 birds/km^2, mostly lesser scaup, breeds in the Brackett Lake area north of Tulita in the Sahtu Settlement Area (Davis 1974).

Population Trends and Human Influences

It is difficult to identify trends for each species of scaup as most data is presented just as scaup. The two similar-looking species are difficult to distinguish in the field, especially from fast-moving survey aircraft, so continental population estimates and trends can be derived only indirectly.

The North American population of both species of scaup in 1998 was estimated at about 3.5 million, down from just over seven million in 1984 (Allen et al. 1999). Nationally, the greater scaup population appears to be declining, but it might be stable in the Northwest Territories.

Mortality

Exposure to wet, cold, windy weather can be a major cause of death for young ducklings of both scaup species. Gulls, jaegers, ravens and northern pike also take ducklings. Predators of adults include red fox, Arctic fox and mink (Austin et al.

1998; Kessel et al. 2002). Hunting is an alternate cause of scaup mortality, as 27 scaup were harvested on average per year in the Inuvialuit Settlement Region in 1997 (Joint Secretariat 2003). In the Gwich'in Settlement Area, 20 scaup were harvested in 1996 (GRRB 2004), and in the Sahtu Settlement Area, 14 scaup were harvested in 2001 (SRRB 2003).

Seasonal Occurrence

Arrival

Because spring arrival times depend on the availability of open water, they probably show at least moderate annual variation. The peak of northward scaup migration, although not identified to species, through the Mackenzie Valley is in mid- to late May. The greater scaup usually arrives in the production area in late May to early June and tends to nest later than most waterfowl. The timing of events for lesser scaup is similar to the timing for the greater scaup.

Clutch Initiation

Greater scaup begin laying eggs in the third week of June. Based on observations of seven nests of tundra scaup, i.e., presumably greater scaup, on the outer Mackenzie Delta, Alliston (1984) estimated clutch initiation was from June 21 to 26. The incubation period lasts about 23 to 27 days, and incubation is by females only.

Hatching

Greater scaup eggs hatch from mid-July to early August. On the outer Mackenzie Delta, Alliston (1984) estimated that hatching occurred at four nests from July 25 to 28, 1982.

Fledging

The young are usually able to fly by late August or early September, although estimated fledging dates in 1982 were September 10 to 11, based on four nests of greater scaup on the outer Mackenzie Delta.

Moulting

Males usually leave nesting areas for moulting areas soon after females begin incubation. In the production area, this probably occurs in late June to early July. Greater scaup from the Beaufort Sea region moult in bays and lagoons along the Beaufort Sea coast of the Northwest Territories.

Departure

Most greater scaup leave the breeding grounds in Alaska and northwestern Canada in mid-September to late October. Peak movement is probably in mid- to late September.

Food and Feeding Habits

Both species of scaup are diving ducks that forage by diving below the water's surface. The most important food for greater scaup is mussels. Other foods include insects, worms, small fish, crustaceans, seeds and vegetative parts of aquatic plants. They usually feed by diving, but also dabble on the water surface.

Movement Patterns

Broods of flightless young walk and swim between waterbodies, but on a local scale near the nest and not en masse to favoured areas where family groups gather.

Adults that are flightless during the moult also swim and walk from waterbody to waterbody. There is no information as to whether traditional routes are followed on these local movements.

Home Range

There is no information on home range sizes of greater scaup, although they are probably similar to lesser scaup. There is evidence, from some areas, of annual fidelity to certain lakes for moulting, and females are highly philopatric to breeding areas. The breeding home ranges of lesser scaup pairs tend to be small, usually confined to a few small lakes or wetlands or a particular section of shoreline of a larger lake.

Habitat Use

General

Throughout the year, greater scaup use lakes, ponds, bays and inlets to feed on submergent and emergent vegetation, floating pondweed and aquatic invertebrates. Greater scaup use coastal tundra on the outer Mackenzie Delta for nesting and brood rearing. Lesser scaup, which are the common scaup in the forested parts of the Mackenzie Delta, breed in small ponds.

Nesting

Nests are usually in tufts of grass on slight rises near the margins of small ponds or lakes. The most important feature of nest sites is a substantial cover of the previous year's growth of tall grasses or sedges on a substrate not usually subject to flooding in June and July. An isolated breeding population of greater scaup on Great Slave Lake, Northwest Territories, nested on nearly treeless islands (Fournier and Hines 2001).

Nests are occasionally made on floating mats of buckbean, i.e., *Menyanthes trifoliata*, at Minto Lake, Alaska. Nests are usually less than 1 m from the water's edge, but occasionally they are up to 200 m away. Five nests of greater scaup found in the Mackenzie Delta in the summer of 1982 were built over water in the cover of *Carex* spp.-dominated vegetation type. In Alaska, greater scaup show a strong affinity for shallow, 1 to 2 m lakes and large ponds in a complex of many smaller lakes and ponds in a largely treeless land.

Larger lakes, of more than 10 ha, with long curving shorelines and small inlets with submergent and emergent vegetation and floating pondweed, e.g. *Potamogeton* spp., are also favoured by greater scaup in Alaska. In western Alaska in the Yukon-Kuskokwim Delta, nesting populations of greater scaup reached highest densities at ponds and lakes on large flat areas of peat and tundra vegetation over permafrost. In the outer Mackenzie Delta and at Parsons Lake in 1972 to 1973, 91% of greater scaup sightings during the nesting period were on upland or flood plain lakes, and they showed a preference for upland lakes (F.F. Slaney and Company Ltd. 1974).

Brood Rearing

Emergent aquatic vegetation provides important escape cover for broods and moulting flightless adults. In mid-summer, hens and ducklings forage on submergent and emergent vegetation in the clear water of protected coves and along shorelines.

Moulting

Greater scaup use large waterbodies in a variety of habitats for moulting. Moulting males use relatively large lakes, often annually, that might be near, or far, from breeding sites. Such lakes are, characteristically, shallow and contain abundant food and suitable cover. Moulting adult males feed throughout shallow, i.e., less than 2 m, food-rich lakes. Moulting greater scaup visit the shallow bays on the Canadian coast of the Beaufort Sea, e.g. Herschel Island, Yukon and McKinley Bay and Hutchison Bay on the Tuktoyaktuk Peninsula. In surveys of the outer Mackenzie Delta and Parsons Lake during the moulting period in 1972 to 1973, all greater scaup sightings were on upland lakes.

Staging

Large lakes with large embayments, protective embankments and shallow feeding areas are used in both spring and fall. During spring migration on the outer Mackenzie Delta and at Parsons Lake in 1972 to 1973, greater scaup were most commonly observed in willow-sedge habitat, in 41% of sightings, and upland lakes, in 38% of sightings. They were also observed in floodplain lakes, in 12% of sightings, and sedge-herb habitat, in 7% of sightings. Willow-sedge habitat is dominated by sedges, grasses and herbs with 20 to 30% cover by small shrubs shorter than 60 cm. Sedge-herb habitat is dominated by sedges, with grasses, forbs and small shrubs, although not numerous, also present.

Model Results, by Ecological Zone

Greater scaup usually nest in tufts of grass on slight rises less than 1 m from the margin of a small pond or lake. The habitat model assigned greater values to vegetation types that included the following important characteristics:

- cover by the previous year's growth of tall grasses or sedges
- slight rises
- a substrate not subject to flooding
- emergent vegetation, which is important cover for broods
- waterbodies larger than 10 hectares with long curving shorelines, small inlets and depths less than 1 to 2 m

Greater scaup usually nest in tufts of grass on slight rises less than 1 m from the margin of a small pond or lake. The habitat model assigned greater values to vegetation types that included the following important characteristics:

- cover of previous year's growth tall grasses or sedges
- slight rises
- substrate not subject to flooding
- emergent vegetation, important cover for broods

High-value vegetation types for nesting were high- and low-centred polygons, and delta high- and low-centred polygons. Moderate-value vegetation types for nesting were sedge – cotton-grass tussock, riparian shrub, riparian sedge – cotton-grass, and delta sedge – cotton-grass.

The original habitat values, assigned on the basis of vegetation characteristics, were adjusted for proximity to waterbodies and sources of sensory disturbance. Nests of greater scaup are usually found near waterbodies that are critical for brood rearing. The highest values were assigned to suitable vegetation communities within 1 m of a waterbody.

Table 10-28 presents the results of the habitat model. The habitat model predicted 0% cover of high-value nesting habitat for greater scaup in the Tundra Ecological

Zone. Moderate-value habitat was predicted to be very limited at 6%. Those results are partly functions of the adjustments for proximity to waterbodies. The high value 1-m-wide strips around waterbodies were too small to be detected by the 30-m pixel resolution of the satellite imaging used for the RSA habitat. As a result, the 1-m strips identified in the LSA model were aggregated with moderate-value habitat less than 200 m from waterbodies in the RSA model. All vegetation communities, regardless of their original unadjusted value, were assigned a very low rating if they were more than 200 m from waterbodies. That accounts for the large proportion of very low to no nesting habitat in the Tundra Ecological Zone. Sensory disturbance was likely not a critical factor in reducing the original habitat ratings because there are few existing sources of disturbance.

Table 10-28: Greater Scaup Nesting Habitat Distribution – Tundra Ecological Zone

Habitat Value	Regional Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	0	0
Moderate	151,816	6
Low	205,802	8
Very low to none	2,160,135	86
No data	0	0
Total	2,517,753	100

10.3.1.17 Lesser Scaup

See Section 10.3.1.16, Greater Scaup, for a description of the assumptions made regarding scaup.

Lesser scaup in the production area, particularly while nesting, occur mostly along the southern parts of the gathering pipeline route where it approaches the treeline. Moulting and nonbreeding lesser scaup might use waterbodies on the tundra within the production area. For this assessment, the lesser scaup is a VC in the pipeline corridor.

Information Sources

The key information sources for distribution and abundance of lesser scaup in the project study area were publications from the CWS, the series of reports produced from studies conducted for the proposed Arctic Gas pipeline in the 1970s, and the book *The Birds of the Beaufort Sea* by Johnson and Herter (1989). A variety of other reports, including those from other consultant studies and from the U.S. Fish and Wildlife Service, were also consulted. Specific references are cited in the text that follows.

Most summary information on lesser scaup biology was from the *Birds of North America* (Austin et al. 1998) and Johnson and Herter (1989).

Status

The lesser scaup is not listed nationally (COSEWIC 2004), but its populations are designated *sensitive* in the Northwest Territories (GNWT 2000).

Abundance and Distribution

The breeding range of lesser scaup is confined to North America (Austin et al. 1998). The core breeding area is the boreal forest and parkland from central Alaska east to Manitoba and Hudson Bay and south to north-central United States. The Northwest Territories has one of the highest breeding densities of lesser scaup (Bellrose 1980). Unlike the greater scaup, lesser scaup are uncommon to rare in tundra areas. The lesser scaup winters along both coasts and throughout the southern half of the central United States, south through Mexico and into Central America and the Caribbean. The primary winter range is along the Gulf of Mexico coast. Most birds that breed in the Mackenzie Delta probably migrate through the Mississippi flyway in the central U.S. to the Gulf coast of Louisiana.

For additional details regarding abundance and distribution of lesser scaup, see this topic in Section 10.3.1.16, Greater Scaup.

Population Size

See this topic in Section 10.3.1.16, Greater Scaup.

Population Density

See this topic in Section 10.3.1.16, Greater Scaup.

Population Trends and Human Influences

See this topic in Section 10.3.1.16, Greater Scaup.

The lesser scaup population in North America has declined since the early 1980s, but it is not known if this is a long-term trend or a normal, natural fluctuation in the species' numbers. The population in the Northwest Territories is estimated to be 1.5 million, with population numbers appearing to be stable or increasing (GNWT 2000). Regional population trends for the pipeline corridor are not known.

Mortality

See this topic in Section 10.3.1.16, Greater Scaup.

Seasonal Occurrence

Arrival

See this topic in Section 10.3.1.16, Greater Scaup.

Clutch Initiation

The estimated average date of clutch initiation at 27 lesser scaup nests on the inner Mackenzie Delta was June 28 in 1982, with a range from June 18 to July 6. Clutch initiation in Yellowknife and Brackett Lake, Northwest Territories occurred from early June to mid July.

Hatching

Estimated hatching dates for lesser scaup on the inner Mackenzie Delta in 1982 extended from July 17 to August 5. Hatching in Yellowknife and Brackett Lake, Northwest Territories, occurred from early July to early August.

Fledging

Lesser scaup hatched on the Mackenzie Delta in summer 1982 were estimated to have fledged from September 2 to 21.

Moulting

Males typically leave nesting areas for moulting areas soon after females begin incubation. This probably occurs in late June to early July in the production area.

Departure

Lesser scaup fall migration from breeding and moulting areas begins in mid to late September, with peak movements through southern Canada from mid October to mid November.

Food and Feeding Habits

See this topic in Section 10.3.1.16, Greater Scaup.

Lesser scaup feed mostly by filtering bottom mud through their bill to catch insects, molluscs and crustaceans. They also eat seeds, roots and vegetative parts of aquatic plants (Carboneras 1992).

Movement Patterns

See this topic in Section 10.3.1.16, Greater Scaup.

Home Range

The breeding home ranges of lesser scaup pairs tend to be small, typically confined to a few small lakes or wetlands or a particular section of shoreline of a larger lake.

Habitat Use

General

Lesser scaup, which are the common scaup in the forested parts of the Mackenzie Delta, breed in small ponds.

Lesser scaup were more numerous on the inner Mackenzie Delta than the outer Mackenzie Delta during waterbody censuses in June to August 1982. Scaup made up 41% of waterfowl recorded in the inner Mackenzie Delta, with identified species being 14% lesser scaup and 0.9% greater scaup. Lesser scaup, accounting for 39% of waterfowl on the inner delta, was the dominant waterfowl species in the area. Scaup were less numerous on the outer Mackenzie Delta, and the species ratio was reversed, with 0.4% lesser scaup and 14% greater scaup.

Nesting

Detailed habitat descriptions for lesser scaup in the northern part of the range are limited. Nests in the Northwest Territories are typically concealed in dense tussocky sedge within 1 m of open water and under dense lateral and overhead cover. Nests are usually on dry or moist soil in the wet meadow zone of a wetland. Seven lesser scaup nests found in the Mackenzie Delta in the summer of 1982 were built over water under cover of *Carex* spp.-dominated vegetation. In the boreal forest, an affinity for beaver (*Castor canadensis*) runs has been recognized, and in interior Alaska, pair densities are highest on semi-permanent waterbodies that are larger than one hectare and characterized by horsetail (*Equisetum*). Wetlands with sedge (*Carex*) and cattail were of secondary importance. Near Yellowknife, lesser scaup breeding pairs were more abundant in ponds larger than 50 m^2 with a perimeter of more than 200 m.

Lesser scaup nest locations, in relation to water, varied greatly in the southern parts of the prairie provinces. Lesser scaup selected sedges over other vegetation for nest sites in Lousana, Alberta. In the Delta Marsh, Manitoba, 85% of lesser scaup nests were on floating or semi-floating mats of vegetation. In southeast Alberta, lesser scaup nests were, on average, 12 m from water, but near Brooks, Alberta, they preferred extensive *Juncus* beds for nest sites.

Brood Rearing

Broods of lesser scaup use shallow semi-permanent and permanent ponds or bays on large lakes with plenty of aquatic invertebrates, emergent vegetation, e.g. cattail and bulrush, and some emergent vegetation.

Moulting

Most concentrations of moulting lesser scaup are on boreal forest lakes. In interior Alaska, post-breeding lesser scaup use ponds that are larger than one hectare and characterized by cattail and sedge vegetation. Moulting habitat for lesser scaup in the Beaufort Sea area includes coastal lagoons and the water around islands and spits. Moulting lesser scaup in boreal forest regions use a variety of small to large lakes. Late-moulting females likely use semi-permanent and permanent wetlands near or at the brood-rearing area.

Model Results, by Ecological Zone

The results of the model are presented in Table 10-29.

Table 10-29: Lesser Scaup Nesting Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone					
	Transition Forest		North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	**Habitat** (%)	**Habitat Area** (ha)	**Habitat** (%)	**Habitat Area** (ha)	**Habitat** (%)
High	0	0	0	0	0	0
Moderate	4,002	<1	0	0	0	0
Low	22,634	3	49,665	2	21,449	1
Very low to none	823,441	97	3,037,678	98	3,914,380	99
No data	0	0	0	0	0	0
Total	850,077	100[a]	3,087,343	100	3,935,829	100

NOTE:
a Numbers do not total 100% because of rounding

Important characteristics of vegetation types that were assigned greater value in the nesting habitat model consisted of:

- cover of previous year's growth of dense tussocky sedge (*Carex* spp.) with abundant lateral and overhead cover tall grasses or sedges
- slight rises, substrate not subject to flooding
- emergent vegetation and horsetail (*Equisetum* spp.)

In the Transition Forest Ecological Zone, high-value vegetation types for nesting were willow – ground birch, black spruce – tamarack/bog bilberry/golden moss, and tamarack/sedge/brown moss. Moderate-value vegetation types for nesting in this zone were black spruce/shrub heath, and shrub fen.

In the North Taiga Plains Ecological Zone, high-value vegetation types for nesting were willow – ground birch, black spruce/ground birch/red bearberry, leatherleaf/peat moss, tamarack/sedge/brown moss, old burn willow – ground birch, recent burn black spruce/ground birch/red bearberry, and old burn tamarack/sedge/brown moss. Moderate-value vegetation types for nesting in this zone were black spruce – tamarack/bog bilberry/golden moss, shrub fen and old burn black spruce – tamarack/bog bilberry/golden moss.

In the South Taiga Plains Ecological Zone, high-value vegetation types for nesting were willow – ground birch, tamarack/sedge/brown moss, forested fen, tamarack/sedge/brown moss, and tamarack/sedge/brown moss. Moderate-value vegetation types for nesting in this zone were black spruce – tamarack/bog bilberry/golden moss, black spruce/shrub heath, shrub fen, and old burn black spruce – tamarack/bog bilberry/golden moss.

The original habitat values, assigned on the basis of vegetation characteristics, were adjusted for proximity to waterbodies and sources of sensory disturbance and for history of forest fire. Nests of lesser scaup are usually found near waterbodies that are critical for brood rearing. As a result, the highest values were assigned to suitable vegetation communities within 10 m of a waterbody. If a habitat had been burned between 2001 and 2003, all ratings were adjusted to very low to none.

The results of the habitat model predicted 0% cover of high-value nesting habitat for lesser scaup in either the Transition Forest, North Taiga Plains or South Taiga Plains ecological zones. Those results were partly functions of the adjustments for proximity to waterbodies. As was the case with the greater scaup, the high value 10-m-wide strips around waterbodies were too small to be detected by the 30-m pixel resolution of the satellite imaging used for the RSA habitat. Consequently, the 10-m strips were aggregated with moderate-value habitat less than 200 m from waterbodies in the RSA model. Moderate-value habitat was predicted to cover less than 1% in the Transition Forest Ecological Zone and to be absent in the North Taiga Plains and South Taiga Plains Ecological Zones. All vegetation communities, regardless of their original unadjusted value, were assigned a very low rating if they were more than 200 m from waterbodies. This is partly responsible for the prediction that large proportions of the areas of these ecological zones have low or very low value for lesser scaup nesting. Sensory disturbance was likely not a critical factor in reducing the original habitat ratings. There are few existing sources of disturbance.

10.3.1.18 Peregrine Falcon

Status

The subspecies *anatum* is considered *threatened* federally (COSEWIC 2004) and *at risk* by the Northwest Territories (GNWT 2000). The *tundrius* subspecies is listed as *special concern* federally and *may be at risk* in the Northwest Territories.

Abundance and Distribution

The peregrine falcon's global breeding range is nearly cosmopolitan and includes most of North America. Two subspecies occur regularly in the production area and the pipeline corridor:

- American or continental peregrine (*Falco p. anatum*)
- Arctic or tundra peregrine (*F. p. tundrius*)

Peregrine falcons nest throughout the Mackenzie Delta region, Mackenzie Valley, southern Northwest Territories and northwestern Alberta in suitable cliff-nesting habitat (Corrigan 2002; Martell et al. 1984; White et al. 2002).

The tundra subspecies breeds along and north of the treeline and is the predominant subspecies breeding near the production area. It is also found south of its breeding range during migration, including in areas near the pipeline corridor. The continental subspecies breeds south of the treeline in areas near the pipeline corridor and might also occur north of its breeding range near the production area.

The peregrine, uncommon to rare in the Beaufort Sea area, is found mainly along river valleys from Point Barrow, Alaska east to Victoria Island, including the North Slope of Alaska, coastal parts of the Yukon Territory and Northwest Territories, and parts of Banks Island and Victoria Island.

Both tundra and continental subspecies are migratory and are absent from nesting areas in winter. They winter from the southern United States into South America. A peregrine falcon banded at the mouth of the Mackenzie River was recovered 12,000 km to the south, in Chile (Schmutz et al. 1991).

Population Size

Surveys for peregrine falcon nest sites have been conducted regularly in the Mackenzie Valley since the mid 1960s. About 80 occupied nest sites were recorded during the 2000 survey, which covered 700 km of the Mackenzie Valley between the Saline River, about 75 km upriver from Tulita, and Inuvik (Carrière et al. 2003). This number has not increased since 1990, and the species has possibly reached maximum occupancy in the area (Carrière et al. 2003). No population figures are available for the Inuvialuit Settlement Region or the Mackenzie Delta. It is likely that few peregrine falcons, if any, nest in the production area because of the lack of suitable cliff habitat, although peregrine falcons have been sighted during the nesting season at the riverside bluffs along the east bank of the Mackenzie River at the Caribou Hills, which has potentially suitable nesting habitat. There are no figures available for the southern Northwest Territories.

Population Density

No figures are available.

Population Trends and Human Influences

The number of occupied nest sites in the Mackenzie Valley increased until the 1990s and has been stable since then. The status of the population nesting in the southern Northwest Territories is not known. The northwestern Alberta population has increased over the last five to 10 years. Productivity was very low in 2000, although this is not necessarily an indication of a major population trend.

Mortality

No regional data is available. Adults are usually only vulnerable to large avian predators such as eagles, gyrfalcons or great horned owls. Nestlings can be killed by other raptors or by mammalian predators. Nestling mortality is caused mainly by bad weather in the first two weeks after hatching. No peregrine falcons were harvested in the Inuvialuit Settlement Region, Gwich'in or Sahtu Settlement Areas (Joint Secretariat 2003; SRRB 2003; GRRB 2004).

Seasonal Occurrence

Arrival

Spring arrival dates for the production area and pipeline corridor are not known. At the Colville River on the North Slope of Alaska, peregrine falcons arrive in late April through early May (Kessel and Cade 1958).

Clutch Initiation

The timing of egg laying is variable. At Campbell Lake just south of Inuvik, the incubation period was from late May to late June (Windsor 1977). Typically, three or four eggs are laid (Ehrlich et al. 1988), and the incubation period is 33 to 35 days per egg.

Fledging

The young fledge 35 to 42 days after hatching and depend on their parents for up to two months after fledging (Kemp 1994).

Departure

There is no detailed information on departure dates, but they do not winter in the area. Peregrines probably leave in August through early October.

Food and Food Habits

Peregrine falcons prey mostly on birds, with the main prey species depending on the location. Important bird prey in the Northern Hemisphere include shorebirds, i.e., mainly Scolopacidae, and waterfowl Anseriformes (White et al. 1994). Mammals and insects are also occasionally eaten.

Movement Patterns

Peregrine falcons make regular foraging trips from their nesting cliffs, usually within a few kilometres, and in the Beaufort Sea area there is a northward movement of immature peregrines in mid to late August.

Home Range

No regional data is available. Birds defend a nesting territory of about 1 km around the nest and have a much larger home range for feeding during the nesting season. The size of the home range varies greatly and reflects prey density.

Habitat Use

The peregrine nest is typically in a scrape or depression on a cliff ledge. Post-breeding adults and fledged young stay together for a period after leaving the nest and during this time might use nearby coastal and other wetland habitats with abundant prey, i.e., shorebirds and waterfowl. Peregrine falcons can be found in almost any habitat during migration, but are most frequent at mudflats, shorelines and open fields where prey is most abundant.

Because RWED has for many years conducted regular surveys for peregrine falcon nest sites and maintains a database of historical and active nest sites, habitat modelling for nesting habitat was not done. The numbers of historical and active nest sites near the pipeline corridor and along the Mackenzie River in each ecological zone are shown in the following discussion, based on the RWED database of nest sites (RWED 2004).

Tundra Ecological Zone

There are no records of nest sites in the Tundra Ecological Zone.

Transition Forest Ecological Zone

There are 22 historical and active nest sites near Campbell Lake, 14 along the banks of the Mackenzie River and two inland.

North Taiga Plains Ecological Zone

In the RWED nest site database, 49 nest sites are listed in the North Taiga Plains Ecological Zone, of which 31 are along the Mackenzie River and 18 are inland to the east of the river.

South Taiga Plains Ecological Zone

Seven previously recorded peregrine falcon nest sites are near the pipeline corridor, all at the northern edge of the South Taiga Plains Ecological Zone.

10.3.1.19 Whimbrel

Status

The whimbrel is not considered a species of concern nationally (COSEWIC 2004), but is designated *sensitive* in the Northwest Territories (GNWT 2000).

Abundance and Distribution

The western North American population of whimbrel breeds from coastal Alaska across the northern Yukon into the northwestern Northwest Territories from the Mackenzie Delta to the Tuktut Nogait National Park area (Skeel and Mallory 1996). The population migrates along the Pacific flyway and winters on the west coasts of North America and South America (Morrison et al. 2001).

Whimbrels were recorded in all surveyed parts of the production area in 2001 and 2002. They were found nesting and in their greatest numbers in the Parsons Lake study area. A few were seen in the outer Mackenzie Delta and along the gathering pipeline route.

Population Size

The North American whimbrel population is estimated to be 57,000 birds, of which about 2,600 nest on the Mackenzie Delta. The whimbrel is a common breeder on upland tundra in the Mackenzie Delta (Johnson and Herter 1989). The population on Richards Island was estimated to be about 750 birds in 1972 and 1973.

Population Density

A study of breeding shorebirds in 1991 and 1992 surveyed 87 ground plots on the outer Mackenzie Delta, including on Niglintgak and Taglu islands. The estimated density over the two years was 3.3 pairs/km^2.

Population Trends and Human Influences

The population trend for whimbrels in the production area is currently unknown. International shorebird survey data indicated a major decline in migration stopovers along the Atlantic coast from 1972 to 1983, but this might have been an artifact of a small sample size. An analysis of maritime shorebird survey data from 1974 to 1991 indicated no obvious trends in numbers.

Mortality

Gulls, ravens, jaegers, raptors, weasels, Arctic fox and red fox take eggs and young. Predators of adults include red fox and gyrfalcon. No whimbrels were harvested in the Inuvialuit Settlement Region, Gwich'in or Sahtu Settlement Areas (Joint Secretariat 2003; SRRB 2003; GRRB 2004).

Seasonal Occurrence

Whimbrels arrive on the Mackenzie Delta in the last third of May. The earliest spring arrival recorded for the Yukon North Slope was May 26.

Pairs form soon after the birds arrive on the breeding grounds. On the Mackenzie Delta, six of nine nests hatched between July 6 and 16 and the remaining three hatched after July 16. The whimbrel clutch hatch date in the outer Mackenzie Delta in 1993 was estimated to be July 6.

Whimbrels in the western Arctic stage in coastal Alaska from mid-July to late August. Most whimbrels have left the Mackenzie Delta by mid August, with the latest recorded departure, in 1993, being August 20.

Food and Food Habits

The whimbrel diet is mostly insects, spiders and other invertebrates. On arrival at the breeding grounds, whimbrels subsist on the previous summer's berries, including crowberry, bog blueberry (*Vaccinium uliginosum*), mountain cranberry (*V. vitis-idaea*) and bearberry. Whimbrel feed primarily on Diptera as insects become abundant but also on Hymenoptera and Coleoptera. Churchill, Manitoba, whimbrel consumed 64% insects, 11% berries and 15% unidentified items (Skeel and Mallory 1996).

Movement Patterns

Local whimbrel movement patterns are not known.

Home Range

There is little information on the home range of this species, but one adult was observed 7 km from its nest site during the nesting period. Whimbrel can apparently disperse far from their hatching sites but afterward show fidelity to their breeding sites.

Habitat Use

General

Whimbrel breed on subarctic and alpine tundra and taiga in habitats ranging from dry heath uplands to poorly drained, hummocky grass–sedge, dwarf shrub and mossy lowlands. On the Mackenzie Delta, they frequent low-centred polygon lowland habitats, wet sedge tundra or high-centred polygon upland habitats.

Whimbrel on the outer Mackenzie Delta and at Parsons Lake are found mostly in upland habitats, particularly dwarf shrub–heath and high-centred polygon. Many are also are found in floodplain habitats (F.F. Slaney and Company Ltd. 1974). A study of breeding shorebirds in 1991 and 1992 in which 87 ground plots in the outer delta were surveyed, including some on Niglintgak and Taglu islands, found whimbrels only in the low-centre polygon and sedge habitat type.

Nesting

A study of whimbrel breeding habitat near Churchill, Manitoba from 1973 to 1976 found nests in three habitat types: hummock–bog, sedge–meadow and heath–tundra. Hummock-bogs are low areas characterized by sparsely scattered, or clumped, stunted black spruce and tamarack and by patches of small hummocks less than 30 cm high. The features are intermingled with patches of large lichen-covered hummocks up to 75 cm tall. Dwarf shrubs such as *Betula glandulosa* and *Rhododendron lapponicum* are also abundant. Sedge–meadows are low, wet areas without relief or trees and that have a continuous ground cover of grasses and sedges with scattered emergent shrubs. Heath–tundra habitats are gently rolling, high, dry treeless areas characterized by a dense ground cover of lichens, i.e., *Cladonia* sp., associated low vegetation and scattered ground-hugging dwarfed shrubs, e.g., *Saxifraga oppositifolia*.

Nesting success was notably higher in hummock–bogs than in sedge–meadows or heath–tundra. Nest density in hummock–bogs was three to four times higher than in the other habitat types, and the average distance between nests was less in hummock–bog, i.e., an average of 213.4 m and a range of 70 to 476 m, than in the other two habitat types, which had a range of 130 to 480 m.

The use of hummocks was a prominent nest site feature. Nests were found more often on hummocks than at random sites in hummock–bog and sedge–meadow. Heath–tundra is nearly hummock-free. Of 67 nests located, 56 were on hummocks, six on flat heath–tundra, four among sedges and one on gravel. Vegetation cover was also higher at nest sites than at random sites in hummock–bog and sedge–meadow habitats, and was uniformly high in heath–tundra. The presence of a shrub within 1 m of the nest site was characteristic.

Model Results

The results of the models are shown in Table 10-30 for nesting and Table 10-31 for foraging.

Table 10-30: Whimbrel Nesting Habitat Distribution – Tundra Ecological Zone

Habitat Value	Regional Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	614,371	24
Moderate	405,694	16
Low	400,178	16
Very low to none	1,097,510	44
No data	0	0
Total	2,517,753	100

Table 10-31: Whimbrel Foraging Habitat Distribution – Tundra Ecological Zone

Habitat Value	Regional Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	709,320	28
Moderate	397,321	16
Low	1,399,508	56
Very low to none	11,604	<1
No data	0	0
Total	2,517,753	100[a]

NOTE:
a Numbers do not total 100% because of rounding

The habitat model assigned higher value to vegetation types that included the following characteristics:

- low areas characterized with sparse, stunted black spruce and tamarack and abundant dwarf shrubs such as *Betula glandulosa* and *Rhododendron lapponicum*
- hummocks
- shrub within 1 m of nest
- high vegetation cover

Vegetation types with high value for nesting consisted of high- and low- centred polygons, delta high-centred polygons, delta high- and low-centred polygons, and black spruce/shrub heath. Moderate-value vegetation types for nesting were medium shrub, sedge – cotton-grass tussock, riparian sedge – cotton-grass, delta shrub, and riparian black spruce/shrub.

The original habitat values, assigned on the basis of vegetation characteristics, were adjusted for proximity to sources of sensory disturbance. The values for suitable vegetation communities were reduced by one if they were less than 30 m from disturbance.

The habitat model results predicted that almost one-quarter or 24% of the RSA had high habitat value for whimbrel in the Tundra Ecological Zone. Moderate-value habitat was predicted to be more limited in extent at 16%. Because there are currently few sources of disturbance in the RSA, sensory disturbance likely did not reduce the original habitat ratings.

10.3.1.20 Lesser Yellowlegs

Status

The lesser yellowlegs is not designated a species of concern by COSEWIC (2003), but populations in the Northwest Territories are listed as *sensitive* (GNWT 2000). The lesser yellowlegs is one of a group of boreal-nesting shorebirds currently considered of *conservation concern* by the CWS.

Abundance and Distribution

The lesser yellowlegs breeds only in North America, its range extending from western Alaska to below the treeline in north-central Quebec. It breeds throughout the Northwest Territories in forested areas (Godfrey 1986).

Population Size

The North American population of lesser yellowlegs is estimated to be 500,000 (Morrison et al. 2001), most of which are probably in Canada, even though the breeding range extends west into Alaska (Hayman et al. 1986). The regional population size is unknown.

Population Density

The regional population density is unknown. However, the species is not a colonial nester, and birds are likely to be well spaced in fairly low densities.

Population Trends and Human Influences

The population trend of lesser yellowlegs in the Northwest Territories is unknown but might be declining based on trends at southern migration points.

Mortality

Causes of mortality include botulism, exposure and predation. Adults are killed mostly by avian predators, particularly gyrfalcon, peregrine falcon and merlin. Northern harrier, sharp-shinned hawk, northern goshawk and short-eared owl are also predators of lesser yellowlegs. Eggs and nestlings are likely vulnerable to gulls, jaegers, common ravens, sandhill cranes and several mammalian nest predators (Johnson and Herter 1989). No lesser yellowlegs were harvested in the Inuvialuit Settlement Region, Gwich'in or Sahtu Settlement Areas (Joint Secretariat 2003; SRRB 2003; GRRB 2004).

Seasonal Occurrence

Arrival

Lesser yellowlegs arrive in the pipeline corridor in late April to early May. Median first arrival at Great Slave Lake was May 3, and the range was April 26 to May 5. Pairs form within a few days of arriving on breeding grounds, most by mid-May. The main group of breeding birds further north in the Mackenzie Valley likely arrives later in May (Tibbitts and Moskoff 1999).

Clutch Initiation

Egg laying begins 12 to 15 days after arrival on the breeding grounds, and incubation takes 22 to 23 days.

Hatching

In the Mackenzie Delta, one nest was observed hatching between June 29 and July 5, and newly hatched young have been found as late as July 21.

Departure

Fall migration out of the Mackenzie Delta was as late as August 27 in 1972 and August 15 in 1973. Fall migration likely begins in late July and early August. Failed breeders leave first, followed a few weeks later by breeders, females before males, then juveniles one to two weeks after that (Tibbitts and Moskoff 1999).

Food and Food Habits

The lesser yellowlegs captures most of its invertebrate prey by pecking it from shorelines or shallow water. Insect eggs and larvae, snails, spiders and beetles are important prey on the breeding grounds. In winter, they capture various species of insects, worms, crustaceans and small fish (van Gils and Wiersma 1996).

Movement Patterns

Courting and incubating adults can travel as far as 13 km to shared feeding areas.

Home Range

Information on home ranges and the extent of territoriality is limited by the secretive nesting habits of the species. Brood-rearing adults have been found as far as 3 km from their nest sites, and adults have been found as far as 13 km from their nest sites before hatching.

Habitat Use

General

The lesser yellowlegs breeds in drier, more vegetated habitats, but occasionally in wet bogs and open muskegs, in open boreal forest and in forest–tundra transition areas. They are relatively rare in adjacent subarctic tundra. A typical nesting area is a combination of shallow wetlands, trees or shrubs, and open areas. The lesser yellowlegs nests in anthropogenic habitats such as seismic and gas pipeline rights-of-way, road allowances and mine clearings (Peck and James 1983; Campbell et al. 1990).

Nesting

Lesser yellowlegs nests are most common on dry, mossy ridges or hummocks, next to fallen branches and logs and underneath low shrubs or small trees. Dense vegetation and standing dead shrubs or trees characterize sites. Commonly associated plants include birch species, willow species, sweet gale, Labrador tea, Arctic rose, aspen, poplar and black spruce. Nests are typically between 30 and 200 m from a water source, but were also reported within metres of small pools and as far as 850 m from any wetland.

Nesting habitat can be:

- open or semi-open coniferous or deciduous forest interspersed with marshes, bogs, ponds, lakes and sedge meadows
- burned-over barrens littered with fallen trees and beside muskeg
- bogs or fens dotted with small wooded islands
- grass meadows with patches of tall second-growth shrubs
- damp tussock–heath tundra beside bogs

Standing water was the most common attribute of sites supporting this species during the breeding season (Schweinsburg 1974).

Model Results, by Ecological Zone

The results of the model are presented in Table 10-32.

Table 10-32: Lesser Yellowlegs Nesting Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone					
	Transition Forest		North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
High	93,981	11	21,630	1	75,974	2
Moderate	207,253	24	262,027	8	366,053	9
Low	69,808	8	1,017,517	33	363,290	9
Very low to none	479,035	56	1,786,169	58	3,130,512	80
No data	0	0	0	0	0	0
Total	850,077	100[a]	3,087,343	100	3,935,829	100

NOTE:
a Numbers do not total 100% because of rounding

Important characteristics of vegetation types in the habitat model were:

- dry, mossy ridges or hummocks
- dense vegetation and standing dead shrubs or trees
- *Betula* spp., *Salix* spp., *Myrica gale, Ledum* spp., *Rosa* spp., *Populus* spp., *Picea mariana*
- standing water

- shallow, vegetation-filled ponds, surrounded by shrubs, tall sedges or both, for brood rearing

In the Transition Forest Ecological Zone, high-value vegetation types for nesting were black spruce – tamarack/bog bilberry/golden moss, and black spruce/shrub heath. Moderate-value vegetation types for nesting in this zone were white spruce/stair-step moss, white spruce – black spruce/shrubby cinquefoil, willow – ground birch, tamarack/sedge/brown moss, and shrub fen.

High-value vegetation types for nesting in the North Taiga Plains Ecological Zone were black spruce – tamarack/bog bilberry/golden moss, and treed fen. Moderate-value vegetation types for nesting in this zone were white spruce/stair-step moss, white spruce – black spruce/shrubby cinquefoil, willow – ground birch, willow/River alder, black spruce/ground birch/red bearberry, tamarack/sedge/brown moss, and shrub fen.

The vegetation types in the South Taiga Plains Ecological Zone with high value for nesting were black spruce – tamarack/bog bilberry/golden moss, black spruce/ground birch/red bearberry, and treed fen. Moderate-value vegetation types in this zone were: white spruce/stair-step moss, white spruce – black spruce/shrubby cinquefoil, willow – ground birch, willow / river alder, balsam popular/river alder, tamarack/sedge/brown moss, and shrub fen.

The original habitat values, assigned on the basis of vegetation characteristics, were adjusted for proximity to waterbodies and sources of sensory disturbance, and for fire history. The distance to the nearest waterbody is important for evaluating the suitability of habitat for nesting lesser yellowlegs. Lesser yellowlegs nests are typically located greater than 30 m and less than 200 m from waterbodies. Accordingly, the habitat ratings were adjusted to account for this. Ratings for habitat outside of this range were reduced. In addition, the suitability of all habitats greater than 850 m from the nearest waterbody was reduced to the lowest value. Ratings of suitable habitat that had been burned between 2001and 2003 were adjusted to very low to none.

The Transition Forest Ecological Zone had the largest proportion of high- and moderate-value habitat for lesser yellowlegs (see Table 10-32, shown previously). This ecological zone also had the largest total area of high-value habitat at 93,981 hectares, but the smallest area of moderate-value habitat at 207,253 hectares. The South Taiga Plains Ecological Zone had the largest amount of moderate-value habitat at 366,053 hectares. The North Taiga Plains Ecological Zone had the smallest total area and percentage of high-value habitat at 21,630 hectares.

10.3.1.21 Arctic Tern

Status

The Arctic tern is designated *secure* in the Northwest Territories (GNWT 2000) and is not listed nationally (COSEWIC 2004). However, because Arctic terns nest colonially, local nesting populations are susceptible to disturbance and habitat loss.

Abundance and Distribution

Arctic terns nest in most of the Northwest Territories and are common migrants and breeders in the Beaufort Sea area (Johnson and Herter 1989). Their world breeding range is circumpolar in Arctic, subarctic and taiga regions (Hatch 2002), and they have the longest migration of any bird species in the world. They breed in Arctic and subarctic regions and migrate to the Antarctic Ocean for the nonbreeding season, an annual round-trip of nearly 40,000 km.

Arctic terns typically nest in colonies, although solitary pairs are occasionally found (Burger and Gochfeld 1996). They commonly nest on lakeshores throughout the Mackenzie Delta (Martell et al. 1984), although the status and distribution of breeding colonies along the Mackenzie River are not well known. Arctic terns were often observed in the production area during surveys in 2001 and 2002. See the following figures:

- Figure 10-42: Arctic Tern Aerial Survey– Outer Mackenzie Delta, July 2001 and 2002
- Figure 10-43: Arctic Tern Aerial Survey – Parsons Lake, July 2001 and 2002
- Figure 10-44: Arctic Tern Aerial Survey – Gathering Pipelines, June 2002

Arctic terns appear to be less widespread along the pipeline corridor than in the production area. They were usually observed in small numbers during June 2001 and May 2002 aerial surveys along the pipeline corridor. The one exception was the high numbers recorded during aerial surveys at Travaillant Lake in the Gwich'in Settlement Area.

F.F. Slaney and Company Ltd. (1974) reported that Arctic terns were four times more numerous than glaucous gulls in their study area in the northeast quadrant of the Mackenzie Delta and on Richards Island.

Figure 10.42 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Figure 10.43 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Figure 10.44 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Population Size

There are no population estimates available for most of the species' range, including the Canadian Arctic and subarctic.

Population Density

The regional population density of Arctic terns is unknown, but nesting colonies were widespread during surveys in 2001 and 2002.

Population Trends and Human Influences

Regional population trends are unknown.

Mortality

Falcons, owls and mink can kill adult terns. Gulls, ravens and fox are major predators of eggs and young. No Arctic terns were harvested in the Inuvialuit Settlement Region, Gwich'in or Sahtu Settlement Areas (Joint Secretariat 2003; SRRB 2003; GRRB 2004).

Seasonal Occurrence

Arrival

Arctic terns first arrive in the production area in late May and the first week of June. They were observed in the production area during spring surveys in the last few days of May and first few days of June 2002.

Arctic terns were observed during spring surveys in late May 2002 along the pipeline corridor and the Mackenzie River in the Gwich'in Settlement Area and Sahtu Settlement Area. Information about the phenology of the nesting cycle in the pipeline corridor is limited.

Clutch Initiation

Most eggs are laid in late June and early July.

Hatching

The incubation period is usually 21 to 23 days, so hatching likely occurs in mid- to late July.

Departure

Field surveys in 2001 and 2002 indicated that the highest Arctic tern densities were in June and July. By August, some Arctic terns had left the breeding grounds, and none were recorded in September surveys.

Food and Food Habits

Small fish is the main food of Arctic terns, although they also eat crustaceans, molluscs, insects, amphipods, euphausiids, berries and fish offal (Burger and Gochfeld 1996).

Movement Patterns

There is no information about local movement patterns.

Home Range

Breeders forage within 10 km of the nest, occasionally as far as 30 km. Fidelity to nesting colonies is thought to be high.

Habitat Use

Literature

Nesting habitat is varied and includes tundra, sandy beaches, shingle beaches, hummocks, fields, gravel ridges and islands in lakes, and is usually in coastal areas. Arctic terns prefer to nest on sites with little vegetation.

Model Results, by Ecological Zone

No habitat model was prepared for Arctic tern because no digital mapping information was available about islands in lakes and ponds, which are preferred locations for Arctic tern nesting colonies.

10.3.1.22 Boreal Chickadee

Status

The boreal chickadee is not listed as a species of concern nationally (COSEWIC 2004) and is not ranked in Alaska or in any province. The species is designated *sensitive* in the Northwest Territories (GNWT 2000) but not in neighbouring Yukon. Boreal chickadees breed and overwinter throughout the boreal forest region (Godfrey 1986).

Abundance and Distribution

The boreal chickadee lives only in North America (Ficken et al. 1996). It ranges from western Alaska to Newfoundland south to about the 49th parallel.

Boreal chickadees are found throughout the Mackenzie Valley and southern Northwest Territories. Martell et al. (1984) considered this species uncommon in forested regions of the Mackenzie Delta. Boreal chickadees are also found throughout northwestern Alberta.

The boreal chickadee is resident throughout its range and is nonmigratory, although it makes lengthy and irregular irruptive movements in some years.

Population Size

The regional population size is unknown.

Population Density

Breeding bird densities vary within the boreal forest region based, in part, on site-specific habitat conditions and spruce budworm outbreaks. The species is abundant nowhere, and even during budworm outbreaks it never comprises more than 1% of boreal breeding birds.

Population Trends and Human Influences

There is no information on population trends in the Northwest Territories. Populations are stable in Alberta (Semenchuk 1992).

Mortality

There is very little information about mortality of this species, although there is one report of young taken by a red squirrel.

Seasonal Occurrence

Boreal chickadees occur in the Mackenzie Valley and Mackenzie Delta throughout the year. Although information about the phenology of their annual cycle specific to the pipeline corridor is lacking, patterns in other areas likely apply in the Northwest Territories. Pairs form during the winter flocking period. Nests are typically built in early to mid May in southern parts of their range, e.g., Algonquin Park, Ontario, but nesting is likely to be later in the Northwest Territories. The duration of the egg laying and incubation periods vary across the species range. Eggs are usually laid between mid May and mid June, and the incubation period is 11 to 16 days. Young leave the nest about 18 days after hatching and remain with adults for about two weeks after leaving the nest.

Food and Food Habits

This species feeds on seeds and arthropods, primarily tree-infesting insects and spiders, their pupae and eggs, occasional fruit and the seeds of conifers and birch trees. They store their food for winter consumption and sometimes visit artificial feeding stations.

Movement Patterns

There is no information on local movement patterns for this species.

Home Range

There is no information about the size of the annual boreal chickadee home range. Territories in Algonquin Park, Ontario, are large, i.e., more than 5 ha, for such a small passerine, but precise data is lacking.

Habitat Use

General

The boreal chickadee breeds in:

- variable-aged coniferous woodland, usually spruce-dominant
- mixed coniferous and deciduous woodland
- pure deciduous stands, to a lesser extent

Breeding habitat often includes wetter areas. This species prefers more mature spruce stands in winter.

Nesting

Boreal chickadees excavate and nest in tree cavities but will also use nest boxes. Cavity trees selected are usually those with soft heartwood, although no particular tree species is preferred. Peck and James (1983) reported most Ontario nests are in dead trees. Boreal chickadees also use natural tree cavities and small cavities excavated by other species.

Tull (1975) noted the species in a range of woody habitat in both wet and dry conditions in breeding season, including lowland and upland areas, disturbed and undisturbed areas, deciduous- and coniferous-dominant communities, and open and closed canopies. Although white and black spruce were prominent at most sites, they were absent at others.

Salter and Davis (1974a) encountered breeding boreal chickadees in a mix of closed woodland types ranging from closed evergreen to closed deciduous scrub communities. The authors noted that boreal chickadees were most often observed in closed coniferous forest, in 48% of occurrences, and in closed deciduous scrub, in 29% of occurrences.

Model Results, by Ecological Zone

Boreal chickadee nesting habitat models were prepared for the Transition Forest Ecological Zone, North Taiga Plains Ecological Zone and South Taiga Plains Ecological Zone, but not for the Tundra Ecological Zone where the boreal chickadee does not usually occur (see Table 10-33).

Table 10-33: Baseline Boreal Chickadee Nesting Habitat Distribution – Regional Study Area

Habitat Value	Ecological Zone					
	Transition Forest		North Taiga Plains		South Taiga Plains	
	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)	Habitat Area (ha)	Habitat (%)
High	0	0	0	0	179,102	4
Moderate	34,960	4	677,059	22	5	<1%
Low	370,624	44	1,029,559	33	1,777,140	45
Very low to none	444,493	52	1,380,725	44	1,979,582	50
No data	0	0	0	0	0	0
Total	850,077	100	3,087,343	100[a]	3,935,829	100[a]

NOTE:
a Numbers do not total 100% because of rounding

Vegetation types with the following characteristics that are important for boreal chickadee nesting were given greater weight by the model:

- spruce dominant or mixed coniferous/deciduous woodland
- closed canopy

The moderate-value vegetation type for nesting in this zone was white spruce – black spruce – paper birch/green alder.

Moderate-value vegetation types for nesting were white spruce – black spruce/shrubby cinquefoil, and black spruce – tamarack/bog bilberry/golden moss.

High-value vegetation types for nesting in the South Taiga Plains Ecological Zone were white spruce/stair-step moss, and white spruce – black spruce/shrubby cinquefoil. Moderate-value vegetation types for nesting were aspen, white spruce/low-bush cranberry, white spruce – black spruce – paper birch/green alder, and black spruce – tamarack/bog bilberry/golden moss.

The Transition Forest and North Taiga Plains Ecological Zones had no high-value habitat for boreal chickadee (see Table 10-33, shown previously). The model predicted that the Transition Forest Ecological Zone had a small area of moderate-value habitat at 34,960 ha or 4%, whereas the North Taiga Plains Ecological Zone had a much larger area and percentage of moderate-value habitat at 677,059 ha or 22%. In contrast, the model predicted that the South Taiga Plains Ecological Zone had the largest area but smallest percentage of high-value habitat at 179,102 ha or 4%. However, this ecological zone had a very small area of moderate-value habitat at 5 ha or less than 1%.

10.3.2 Niglintgak

10.3.2.1 Barren-Ground Grizzly

Site-Specific Information

Historically, grizzly dens were found throughout the Richards Island area (BMMDA 2003). Niglintgak, in the Mackenzie Delta floodplain, floods regularly and provides little denning habitat for grizzly bears (AXYS 2002).

Niglintgak provides spring, summer and fall foraging habitat for bears. Foraging on reindeer or caribou carrion has been noted on Richards Island. Waterfowl nesting colonies, especially on Richards Island, near the Kendall Island Bird Sanctuary and along the Arctic coast, are important food sources for grizzlies. This is especially true for females with cubs in late May, June and July (Nagy 2003, personal communication). Most of the grizzly harvest in the tundra is south and east of Tuktoyaktuk and in the northern part of Richards Island.

Field Results

Aerial Surveys

No grizzly bears or dens were observed on the lease during aerial surveys in 2003.

Incidental Observations

Grizzly bear sign was recorded in the high- and low-centred polygons and disturbed habitat types.

Modelling Results

Modelling results indicated that in the Niglintgak LSA:

- 21% of the area was effective barren-ground grizzly fall forage habitat (see Table 10-34). None of the habitat at Niglintgak was rated as effective for foraging.
- 13% of the area was effective barren-ground grizzly denning habitat (see Table 10-35)
- 6% of the area was effective barren-ground grizzly spring forage habitat (see Table 10-36)

Table 10-34: Barren-Ground Grizzly Fall Forage Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	Habitat (%)
Very high	0	0
High	0	0
Moderate	1,391	21
Low	1,613	24
Very low	648	10
None	3,000	45
No data	25	<1

Table 10-35: Barren-Ground Grizzly Denning Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	Habitat (%)
Very high	184	3
High	0	0
Moderate	676	10
Low	6	<1
Very low	2,582	39
None	3,210	48
No data	20	<1

Table 10-36: Barren-Ground Grizzly Spring Forage Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	Habitat (%)
Very high	0	0
High	0	0
Moderate	377	6
Low	2,536	38
Very low	146	2
None	3,600	54
No data	20	<1

10.3.2.2 Greater White-Fronted Goose

Site-Specific Information

Mid-June surveys from 1991 to 1998 determined the density of greater white-fronted geese in Niglintgak to be 0 to 1/km². Campbell (1973) rated the degree of use of Niglintgak as moderate in spring and summer, based partly on the density of goose droppings. An estimated 15 greater white-fronted geese used Niglintgak in the 1973 nesting season.

Field Results

Greater white-fronted geese were recorded in 2001 to 2002 throughout the outer Mackenzie Delta in each month of surveys from May through September. White-fronted geese were relatively evenly distributed on the outer Mackenzie Delta as scattered nesting pairs during the spring migration and June nesting surveys. More large groups of greater white-fronted geese were observed in July, August and September, but fewer groups of one to 10 birds were recorded. Most of the largest groups were seen along the outer coast, but some were inland. These observations are consistent with the movement of geese from inland nesting areas to coastal brood-rearing sites.

Average monthly densities of greater white-fronted geese in the outer Mackenzie Delta, as derived from the aerial surveys, were 79 birds/100 km^2 in June, 279 in July, 88 in August and 246 in September.

Few greater white-fronted geese likely nest in Niglintgak, based on the pattern of distribution and abundance observed over the larger area during aerial surveys. Beginning in July, family groups from Niglintgak move to the coast in large flocks to moult.

Modelling Results

Modelling results indicated that in the Niglintgak LSA:

- 6% of the area was effective nesting habitat for the greater white-fronted goose (see Table 10-37)
- 57% of the area was effective foraging habitat for the greater white-fronted goose (see Table 10-38)

Table 10-37: Greater White-Fronted Goose Nesting Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	73	1
Moderate	356	5
Low	661	10
Very low to none	5,563	83
No data	25	<1
Total	6,679	100[a]

NOTE:
a Numbers do not total 100% because of rounding

Table 10-38: Greater White-Fronted Goose Foraging Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	638	10
Moderate	3,138	47
Low	0	0
Very low to none	2,877	43
No data	25	0
Total	6,679	100

10.3.2.3 Snow Goose

Site-Specific Information

Mid-June surveys from 1991 to 1998 determined the average density of snow geese in Niglintgak during the breeding season was 0 to 1 birds/km². The highest densities, more than 10 birds/km^2, were found on islands and along the coast near the nesting colony on Kendall Island. This area is not far from Niglintgak, but most snow geese remained near the coast and did not venture inland.

Many spring and fall migrant geese were noted on the Mackenzie Bay coast just north of Taglu in 1972 and 1973 (F.F. Slaney and Company Ltd. 1974).

Field Results

The Kendall Island Bird Sanctuary on the outer Mackenzie Delta was created in part to protect colonies of nesting snow geese. Most snow geese sightings during the aerial surveys were near Kendall Island or nearby along the coast. Snow geese and greater white-fronted geese were seen frequently and in large flocks in July and August along the outer coast of the Mackenzie Delta southeast of Kendall Island and north of Big Lake. Snow geese were seen along the coast of the outer delta, and few were seen inland in Niglintgak during aerial surveys.

Average monthly densities of snow geese in the outer Mackenzie Delta, as derived from the aerial surveys, were 56.9 birds/100 km^2 in June, 16.1 in July, 9.9 in August and 37.6 in September.

Modelling Results

A habitat model was not prepared for snow geese.

10.3.2.4 Tundra Swan

Site-Specific Information

June surveys in 1991 to 1998 determined the population density of tundra swan in Niglintgak during the breeding season was 0 to 1/km^2. Forty were estimated to be in Niglintgak during the 1973 nesting period (F.F. Slaney and Company Ltd. 1974).

Field Results

The outer Mackenzie Delta is an important area for nesting tundra swans, which were widely scattered throughout the outer delta in late May, June and July aerial surveys. There was evidence of large flocks of swans gathering along the coastal edges of the outer Mackenzie Delta beginning in July and continuing into August. This was not evident in September aerial surveys.

Average monthly densities of tundra swans on the outer Mackenzie Delta, as derived from the aerial surveys, were 101.7 birds/100 km^2 in June, 136.2 in July, 178.9 in August and 69.0 in September.

It is likely that a few tundra swans nest in Niglintgak, based on the results of the aerial surveys. The family groups that move to the coast of the outer delta in July and August continue brood rearing and to moult.

Modelling Results

Modelling results indicate that in the Niglintgak LSA:

- 28% of the area is effective tundra swan nesting habitat (see Table 10-39). This is partly because of adjustments for proximity to waterbodies, made because of tundra swans’ preference to nest with 45 m of water

- 69% of the area is effective tundra swan foraging habitat (see Table 10-40)

Table 10-39: Tundra Swan Nesting Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	932	14
Moderate	959	14
Low	488	7
Very low to none	4,273	64
No data	25	<1
Total	6,679	100[a]

NOTE:
a Numbers do not total 100% because of rounding

Table 10-40: Tundra Swan Foraging Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	3,606	54
Moderate	973	15
Low	488	7
Very low to none	1,587	24
No data	25	<1
Total	6,679	100[a]

NOTE:
a Numbers do not total 100% because of rounding

10.3.2.5 Greater and Lesser Scaup

Site-Specific Information

June surveys from 1991 to 1998 found the population density of scaup in Niglintgak was 0 to 1/km². Scaup were the most numerous diving ducks in the 1972 to 1973 waterfowl surveys by F.F. Slaney and Company Ltd. (1974). An estimated 240 diving ducks, of which scaup were presumed to be the largest species group, were in Niglintgak during the nesting period.

Field Results

Greater scaup, lesser scaup, and scoters, were the most abundant diving ducks recorded in aerial surveys of the outer Mackenzie Delta. It is not usually possible to distinguish the two species of scaups during aerial surveys, so nearly all sightings were classed as unidentified scaup. Scaups were widely distributed in small groups in late May to early June, i.e., during spring migration and June aerial surveys. During the July, August and September aerial surveys, a greater proportion of the sightings were of larger flocks, most of which were seen in the central and southern parts of the survey area and not on the outer coast.

Average monthly densities of scaup on the outer Mackenzie Delta, derived from the aerial surveys, were 91.5 birds/100 km^2 in June, 61.7 in July, 61.4 in August and 97.4 in September.

Based on the results of the aerial surveys, scaup, i.e., probably greater scaup, likely nest in low densities in Niglintgak, where some of the lakes could be used for brood rearing and moulting.

Modelling Results

Modelling results indicate that in the Niglintgak LSA about 3% of the area is effective greater scaup habitat (see Table 10-41). This is largely a function of the adjustment made for proximity to waterbodies. Greater scaup usually place their nests within 1 m of waterbodies.

Table 10-41: Greater Scaup Nesting Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	**Habitat** (%)
High	1	<1
Moderate	218	3
Low	509	8
Very low to none	5,926	89
No data	25	<1
Total	6,679	100[a]

NOTE:
a Numbers do not total 100% because of rounding

10.3.2.6 Peregrine Falcon

Site-Specific Information

There are no records of peregrine falcon nest sites in Niglintgak (RWED 2004). The flat tundra does not provide suitable cliff-nesting habitat, although prey species are found there and peregrines might use the area for hunting.

Field Results

No peregrine falcons were observed during aerial surveys of the outer Mackenzie Delta.

Modelling Results

No habitat model was prepared for the peregrine falcon.

10.3.2.7 Whimbrel

Site-Specific Information

No whimbrel were found in Niglintgak during the 1973 nesting season (F.F. Slaney and Company Ltd. 1974). Gratto-Trevor (1994) also did not find any nesting whimbrel during studies on Niglintgak Island in 1991.

Field Results

One whimbrel was observed during aerial surveys of the outer Mackenzie Delta. However, whimbrels are not readily detected from fast-moving aircraft.

Modelling Results

Modelling results indicate that in the Niglintgak LSA:

- 41% of the area is effective whimbrel nesting habitat (see Table 10-42)
- 44% of the area is effective whimbrel foraging habitat, which is very similar to the results for nesting habitat (see Table 10-43)

Table 10-42: Whimbrel Nesting Habitat Distribution – Niglintgak

Habitat Value	Local Study Area	
	Habitat Area (ha)	Habitat (%)
High	373	6
Moderate	2,339	35
Low	401	6
Very low to none	3,539	53
No data	25	<1
Total	6,679	100[a]

NOTE:
a Numbers do not total 100% because of rounding