Figure 5.2 Kitikmiut Knowledge of Akhak (Grizzly Bear) in the Kogloktoakyok (Grays Bay) Project Area – adopted from Banci and Spicker (2024)

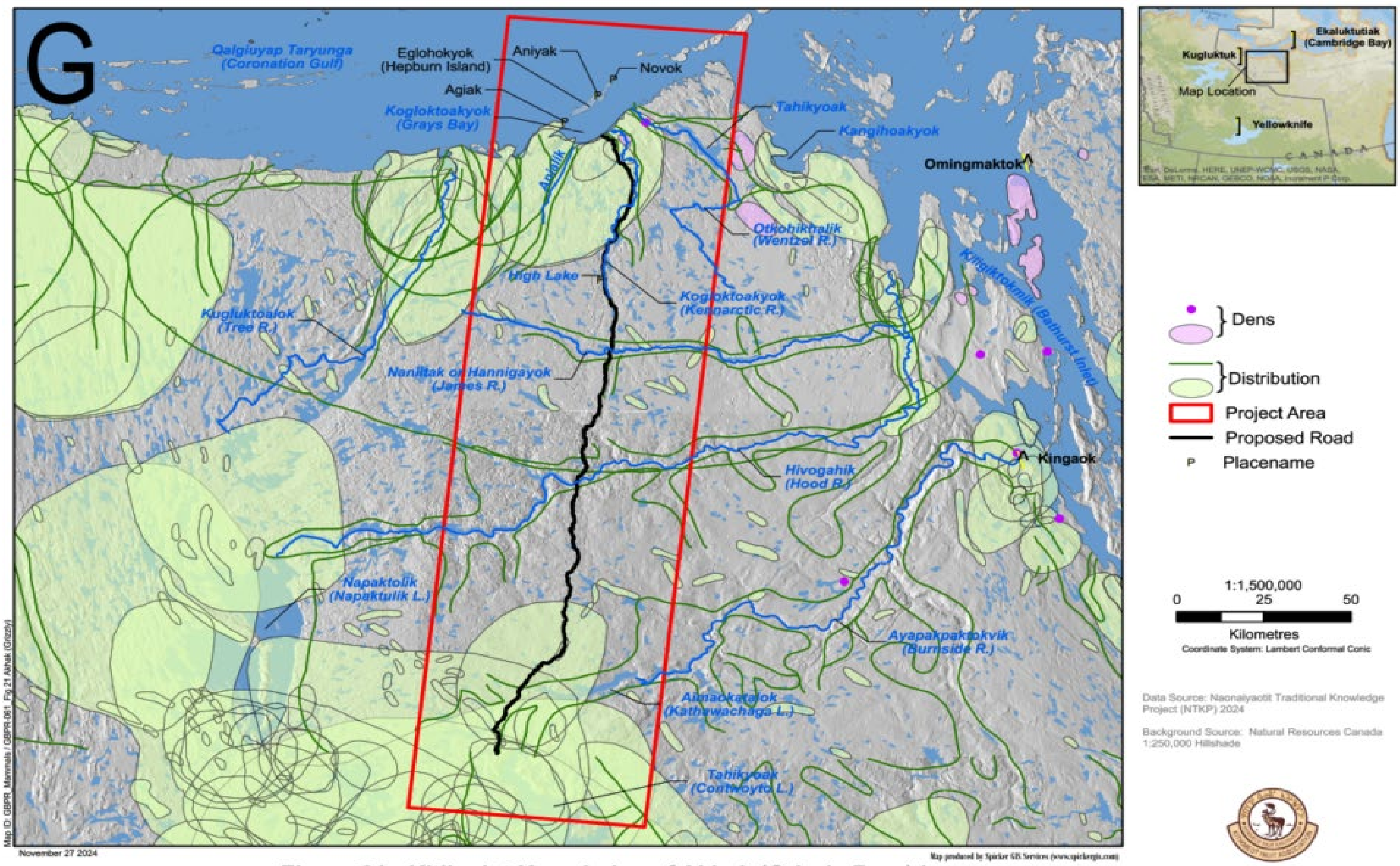


Figure 21: Kitikmiut Knowledge of Akhak (Grizzly Bear) in the Kogloktoakyok (Grays Bay) Project Area

5.2.1 Population

The western population of grizzly bears is designated as Special Concern by the SARA (Government of Canada 2018). NU has designated grizzly bears as Vulnerable (Canadian Endangered Species Conservation Council 2022), and the NT has not assessed or provided a status for the species (Government of Northwest Territories 2024a).

Barren-ground grizzly bears were the focus of research in the Kugluktuk area from 1988 to 1991, when 15 females were collared with standard VHF radios and monitored (Case and Buckland 1998). Between 1995 and 1999, 81 bears within the Slave Geological Province were fitted with satellite collars during the WKSS (McLoughlin et al. 2002a). This latter work especially resulted in an increased understanding of grizzly bear ecology, distribution, and abundance in the region.

In comparison with other populations in North America, grizzly bears within the Central Arctic have very large home ranges, and exist at low density in areas of low productivity and low-quality habitat (McLoughlin et al. 2000). Recorded densities in tundra habitat are among the lowest on the continent (COSEWIC 2012). Rough population estimates for grizzly bears within NU based on extrapolation of densities from local studies are 800 (minimum estimate) to 2,000 (typically a minimum of 3.5 to 4 bears/1,000 km²), with the majority of these in the Kitikmeot Region (COSEWIC 2012). P. McLoughlin (pers. comm., April 7, 2006) suggested these are overestimates, and that in the late 1990s at most 800 to 1,000 grizzly bears resided in all of NU.

Nearly 180 bears were identified through hair capture within a 39,000 km² study area north, west, and south of Kugluktuk in 2008 and 2009, suggesting annual densities of 5.9 – 6.2 bears/1,000 km² (Dumond et al. 2011). Thirty-one bears were sampled on a 3,700 km² grid in the Hope Bay area in 2010 (Rescan 2012). In 2011, the study area was 6,500km2 and 39 individual bears were sampled (Rescan 2012). On the border of NU and the NT in the Lac de Gras region a study completed by Barrueto et al. (2023) in 2013 & 2014, showed a density of 5.9 grizzly bears/1,000 km².

The 2012 Izok area DNA study identified 50 individual grizzly bears (22 males, 28 females), resulting in an estimated density of 8.7 bears/1,000 km² (Boulanger 2013a). Bear's hair were captured at 42 of the tripods (61%) over the course of the study. Between one and five individual bears were identified at individual tripods during the study, with fewer bears captured in portions of the far western and northern areas. Estimated density of females was higher than males (5.0 and 3.7 bears/1,000 km², respectively), likely related to higher detection probabilities at their home range centres (Boulanger 2013a).

The Kitikmeot region DNA study completed between 2021 and 2023 estimated bear densities for the west Kitikmeot region at 6.6 bears/1000 km² (359 grizzly bears) in 2021, 5.5 bears/1000 km² (262 bears) in the central Kitikmeot region in 2022, and 6.2 bears/1000 km² (306 grizzly bears) in the east Kitikmeot region in 2023 (Awan et al. 2025). Total population estimate for the entire Kitikmeot region was 927 grizzly bears (Awan et al. 2025). The Project falls within the central Kitikmeot region of this study.

Table 5.4 Estimates of Density and Population of Grizzly Bears in the Project Region

Year	Area/ Region	Density (# / 1,000 km^2)	Population	Reference
2008 & 2009	39,000 km² study area north, west, and south of Kugluktuk	5.6	n/a	(Dumond et al. 2011)
2012	Izok	8.7	n/a	(Boulanger 2013a)
2021	West Kitikmeot	6.6	359	(Awan et al. 2025)
2022	Central Kitikmeot	5.5	262	(Awan et al. 2025)
2023	East Kitikmeot	6.2	306	(Awan et al. 2025)

Although grizzly bears in the region are part of the Bathurst Inlet population group or cluster (grizzly bear [GB] management zone GB/02; Wildlife Research Section 2007), exchange rates among population units suggest that the grizzly bear population in the central Canadian Arctic should be treated as open and continuous (McLoughlin et al. 2002b). The abundance and distribution of grizzly bears within the Kitikmeot region may have changed over the past several decades, with increased reports of grizzly bears moving northward from the Arctic mainland and eastward into previously lightly populated areas (Keith and Arqviq 2006, Dumond 2007a, Slavik 2010). However, looking at the data from previous surveys, population density estimates have remained relatively constant (see Table 5.4).

Grizzly bears in general exhibit low intrinsic rates of increase, a result of late age at maturity, small litter sizes, and long intervals between litters. As populations living in low-productivity areas at the edge of grizzly bear range in North America, barren-ground populations would be expected to exhibit even lower rates of reproduction relative to other bear populations (McLoughlin et al. 2003a). However, while Case and Buckland (1998) and McLoughlin et al. (2003b) found comparatively late age at first reproduction, they observed relatively large litter sizes, low intervals between litters, and corresponding high natality rates. Although Inuvialuit and Inuit knowledge combined with previous survey data and modelling suggest the population of barren-ground grizzly bears in the Kugluktuk and WKSS studies to be stable to slightly increasing (Case and Buckland 1998; Philip D. McLoughlin et al. 2003a; Inuvik Community Corporation et al. 2006; Wildlife Management Advisory Council (North Slope) 2008; Thorpe Consulting Services Ltd. 2014a; Barrueto et al. 2023; Awan et al. 2025). Population viability modelling using data from the WKSS suggests that small increases to the current level of human-caused mortality greatly increase the risk of population reduction (McLoughlin et al. 2003b).

Forty-four incidental observations of grizzly bears were made within the RSA between 2004 and 2013, totalling 69 individual bears. Cubs were observed on 11 of these sightings, including cubs of the year, yearlings and 2-year olds (age of cubs not always recorded). Sows were accompanied by one or two cubs on most occasions, but a sow with three cubs was observed in 2012.

5.2.2 Harvest and Mortality

As of June 2019, non-resident sport hunting has an annual quota of 15 for the Kitikmeot region and 10 for Kivalliq region (Awan 2021). Non-residents are subject to a trophy fee, and harvest reporting is mandatory. Subsistence harvesting reports are voluntary and therefore existing data may not be complete (Awan 2021).

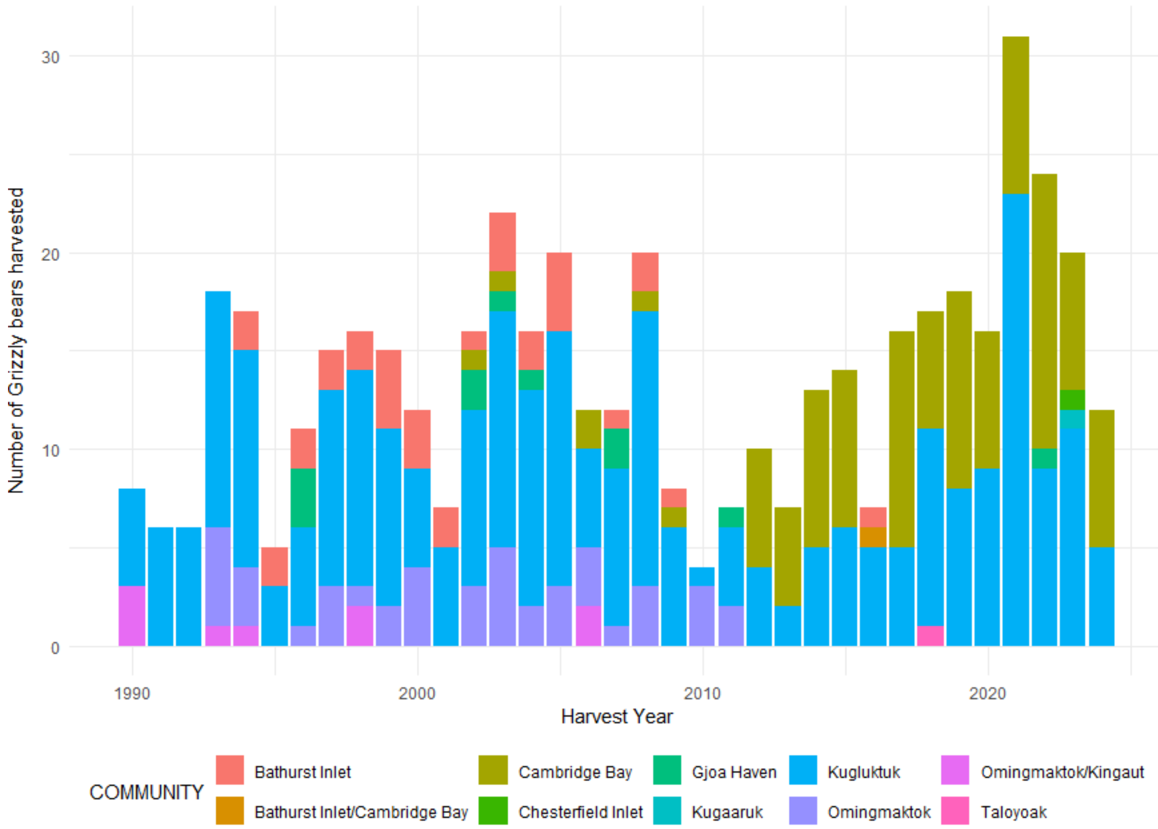
Priest and Usher (2004) recorded a harvest of 27 grizzly bears in the Kitikmeot Region between 1996 and 2001, the bulk of which came from Kugluktuk (78%). Nunavut-wide human-caused mortalities from 2001 to 2010 averaged 15 hunter kills and eight bears killed for defence and other causes annually (COSEWIC 2012). Mean rates of kill in response to conflicts with humans for the past decade, as a proportion of total known kill, were therefore roughly 30% in NU. Between 2009 and 2024, 6 grizzly bears were harvested in the Central Kitikmeot region (the area that the Project lies within) as described by Awan (2025).

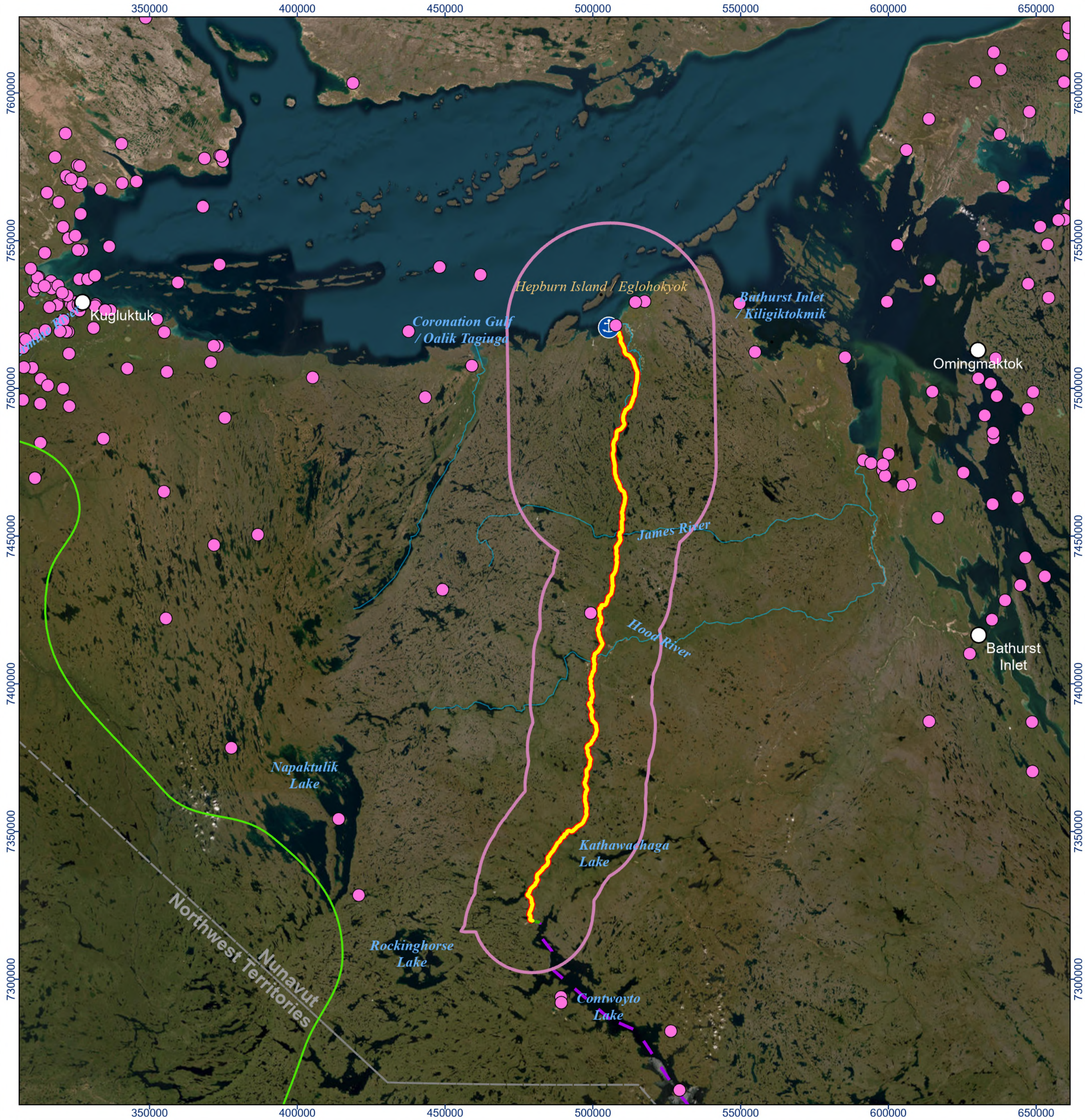
From 2013 to 2019 a total of 232 grizzly bears were reported harvested in NU, 93 from the Kitikmeot and 139 from the Kivalliq region (Awan 2021). Grizzly bear harvest was concentrated in the western Kitikmeot, in the vicinity of Kugluktuk, Cambridge Bay and along the traditional travel route from Cambridge Bay to the Bathurst Inlet area. The proportion of adults in the Kitikmeot harvest was 60%. The average harvest in the Kitikmeot from 2013 to 2019 appears to be relatively stable (average of 13 bears harvested/year) with a slight increase in the last three hunting seasons (Awan 2021). The NWMB regulated the non-resident/non-resident foreigner sport hunt of grizzly bears by an annual quota of 10 for the Kitikmeot region, but in June 2019 the NWMB increased their annual sport hunt quota from 10 to 15 tags (Awan 2021).

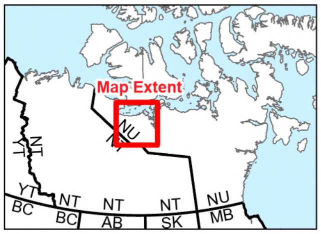
Additionally, grizzly bear harvest records from 1990 to 2024 in the Kitikmeot region showed a total of 478 individuals harvested during those years (Leclerc 2025c). Most of the grizzly bears were harvested by hunters from Kugluktuk (57%) and by hunters from Cambridge Bay (22%), with the next highest numbers coming from Omingmaktok (9%) and Bathurst Inlet (7%), Gjoa Haven (2%), and Omingmaktok/Kingaut (2%) (see Figure 5.3 and Figure 5.4). Only one grizzly bear was reported harvested for the communities of Bathurst Inlet/Cambridge Bay, Kugaaruk, Taloyoak and Chesterfield Inlet. The majority of the grizzly bears harvested during this time were male (77%) while 23% were female (Leclerc 2025c).

When plotted, kill data from GN-DOE show a concentration of kills in the Kugluktuk and Bathurst Inlet areas (see Figure 5.3 and Figure 5.4) from 1995 to 2009. From 2012 through 2024, most kills were concentrated in Kugluktuk and Cambridge Bay. Where sex of the bear was identified, 84% were males (n = 434). Under proposed TAH management, the recommended annual quota is six grizzly bears from the Bathurst Inlet population (GB/02; Wildlife Research Section 2007). Under TAH management, problem kills in NU will come off the quota, as opposed to the current system of no quota reductions from problem kills. However, these recommendation has not be accepted for grizzly bear management, as there’s no TAH in NU (Awan 2021).

Figure 5.3 Total numbers of grizzly bears harvested in the Kitikmeot region by year and by each community between 1990-2024 (derived from Leclerc 2025a).







- Grizzly Bear Mortality Location
- Grays Bay Port
- Grays Bay Road
- Grays Bay Winter Road
- Tibbitt to Contwoyto Winter Road
- Territorial Boundary
- Treeline
- Watercourse
- Wildlife Regional Study Area (RSA)

0 25 50 Kilometres

(At original document size of 8.5x11) 1:2,000,000

N

Notes

1. Coordinate System: WGS 1984 UTM Zone 12N

2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)
Publication Date: Unknown
Downloaded: September 7, 2021
Last Checked: September 7, 2021

Project Location
West Kitikmeot Region
Nunavut

Prepared by OliviaLeblanc on 2026-02-20

Client/Project 24Y0376

West Kitikmeot Resources Corp (WKR)
Grays Bay Road and Port

Figure No.
5.4

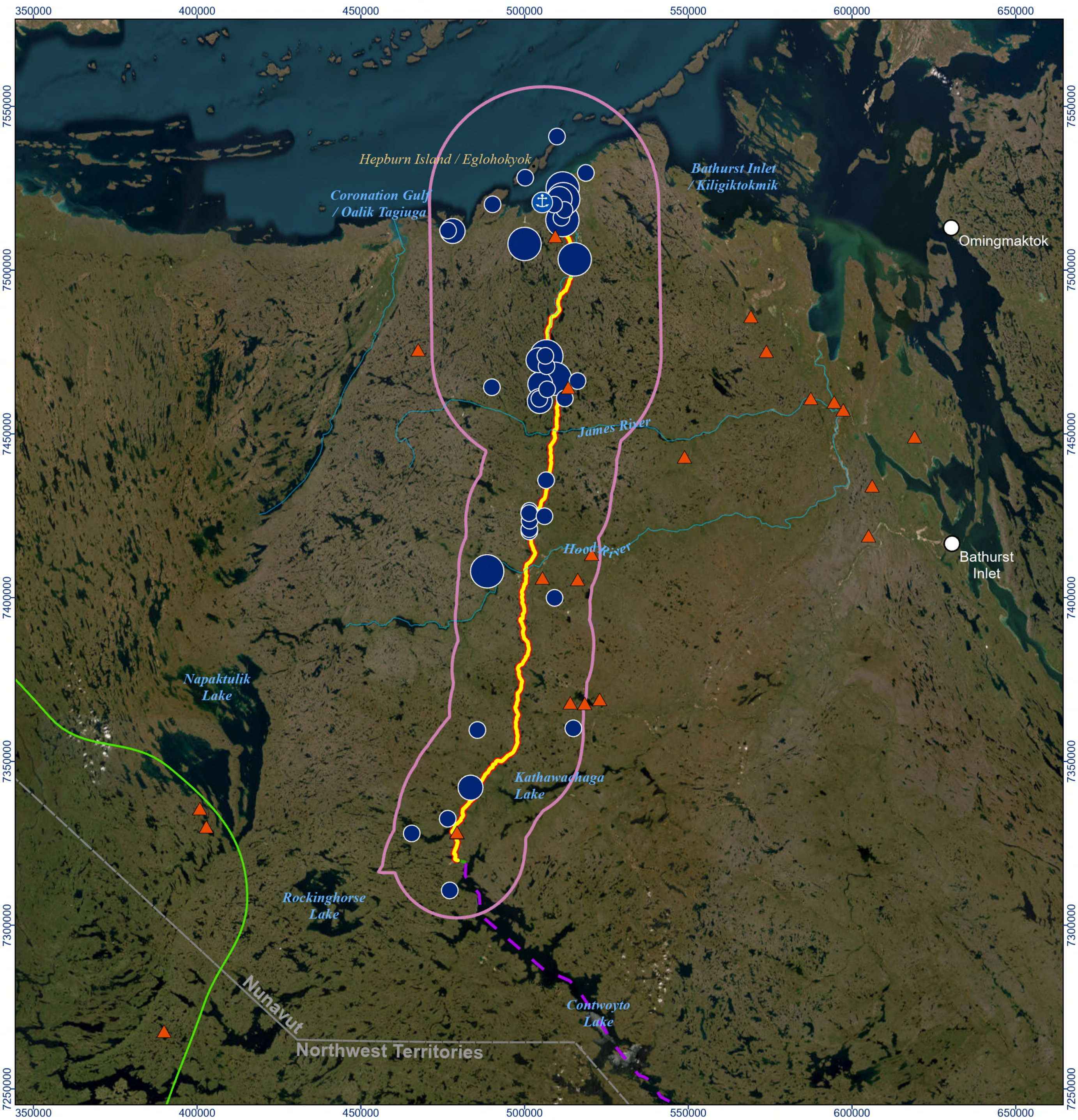
Title
Documented Grizzly Bear Mortalities in the Vicinity of the Grays Bay Road and Port Project Regional Study Area, 1990 to 2024

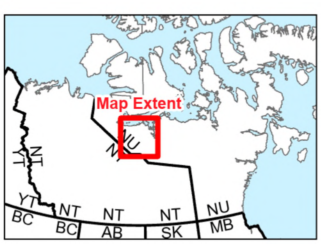
Path: L:\PROJECTS\2024\WH\24Y0029_GBRP\BirdBaselineUpdates_2025.aprx\24Y0376_WildBaseline_Fig5-4_GrizzlyMortalities_20260220; Revised: 2026-02-20 By: OliviaLeblanc

5.2.3 Movements and Distribution

Grizzly bear have expanded their range in the Central Arctic, with community members in Cambridge Bay alerting biologists to sightings on the south coast of Victoria Island starting in the late 1990s (NTKP 2018). Today, their occurrence on Victoria Island is no longer a rarity (Gunn 1991; Dumond 2007a; Slavik 2010; COSEWIC 2012; Thorpe Consulting Services Ltd. 2014b,a). The range of grizzly bears has been expanding northwards, particularly from 2000 to 2015, with community members reporting grizzly bears crossing the Coronation Gulf to Victoria Island for the first time in living memory (Thorpe Consulting Services Ltd. 2014a, b; NTKP 2018). Grizzly bears are also said to be coming closer to communities in search of food and becoming more of a nuisance (Golder Associates Ltd. 2010).

Grizzly bears occur throughout the Project area. Although observations appear to be more numerous in the Ulu, High Lake, and Grays Bay areas (see Figure 5.5), these in part reflect greater presence by observers in those areas. It is unclear whether densities differ between coastal and interior portions of the Project area. Based on a study by Awan et al. (2025) the sub-grid sampled in the north had a lower density (2.4 grizzly bears/1,000 km^2) then the sub-grid in the south (5.8 grizzly bears/1,000 km^2). Grizzly bears were observed incidentally throughout the Project area (see Figure 5.5). Seasonal migrations to higher quality food sources likely occur; the calving Bathurst caribou herd along the Hood River likely attracts a relatively high number of bears in June, and seasonal fish sources along the coast may draw in bears as well (Wildlife Management Advisory Council (North Slope) 2008, Thorpe Consulting Services Ltd. 2014a). Mean home range sizes for grizzly bears from the Central Arctic varied from 2,100 km^2 for females to 7,245 km^2 for males (using a 95% fixed kernel estimate), and are the largest home ranges recorded in North America (McLoughlin et al. 2003a; COSEWIC 2012).





Grizzly Bear Den Site
Grays Bay Port
Grays Bay Road
Grays Bay Winter Road
Tibbitt to Contwoyto Winter Road
Territorial Boundary
Treeline
Watercourse
Wildlife Regional Study Area (RSA)

Total
1 Grizzly Bear
2 Grizzly Bears
3 - 5 Grizzly Bears

0 25 50 Kilometres
(At original document size of 8.5x11) 1:1,800,000

N

Notes
1. Coordinate System: WGS 1984 UTM Zone 12N
2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)
Publication Date: Unknown
Downloaded: September 7, 2021
Last Checked: September 7, 2021

WEST KITIKMEOT RESOURCES CORP
EDI ENVIRONMENTAL DYNAMICS INC.

Project Location
West Kitikmeot Region
Nunavut

Prepared by OliviaLeblanc on 2026-02-20

Client/Project
24Y0376
West Kitikmeot Resources Corp (WKR)
Grays Bay Road and Port

Figure No.
5.5

Title
Grizzly Bear Den Site Locations within the Vicinity of the Grays Bay Road and Port Project Regional Study Area, 1996 to 2012, and Observations within the RSA, 2003 to 2013

Path: L:\PROJECTS\2024\WH\24Y0029_GBRP\BirdBaselineUpdates_2025.aprx\24Y0376_WildBaseline_Fig5-5_GrizzlyDenObservations_20260220; Revised: 2026-02-20 By: OliviaLeblanc

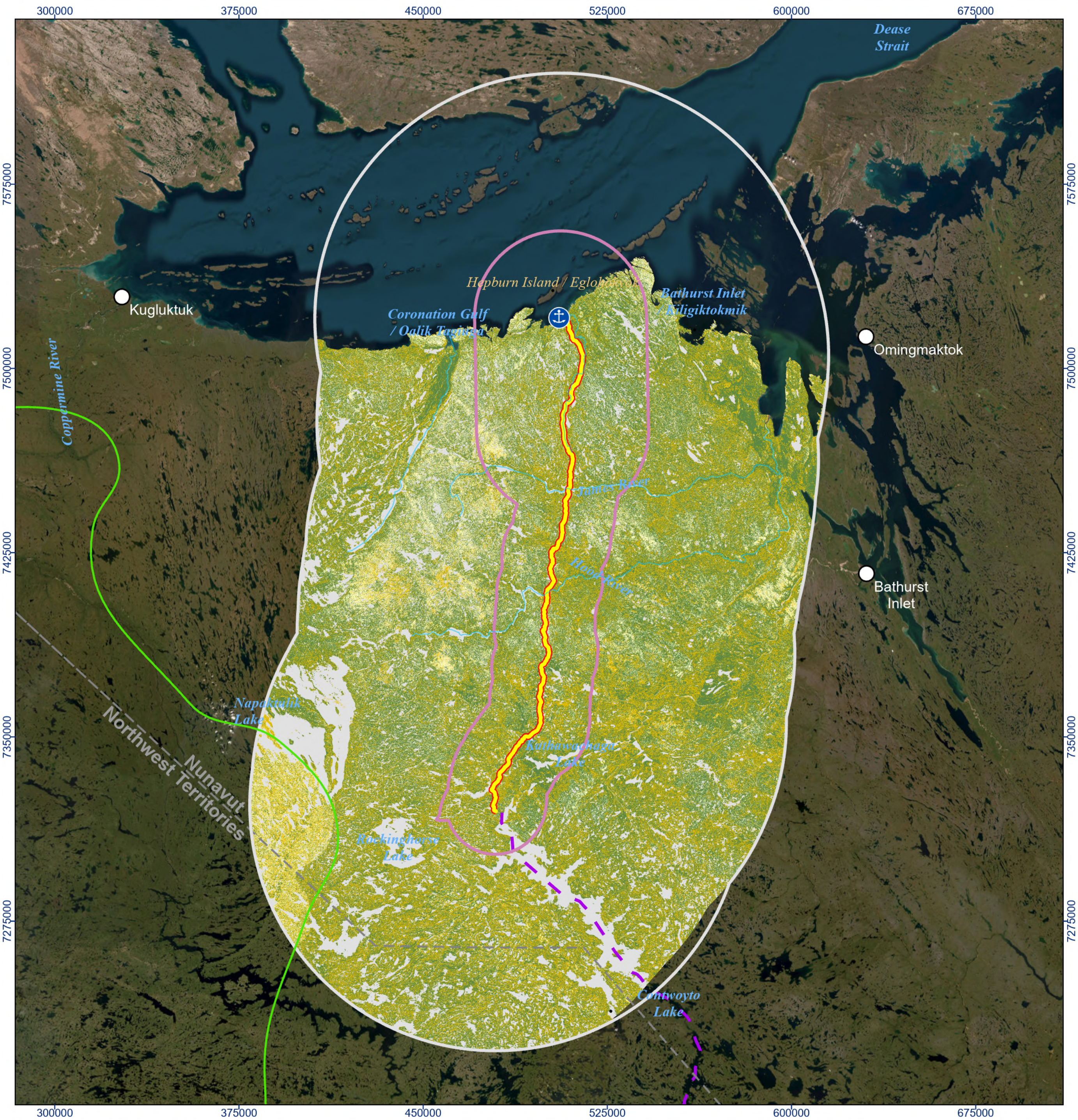
5.2.4 Habitat Use and Diet

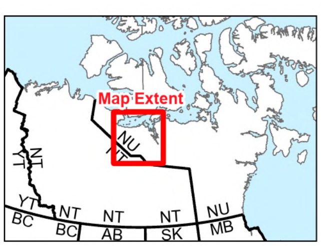
Studies by McLoughlin et al. (2002a) indicated selection of esker, tussock/hummock tundra, lichen veneer (flat islands and low peninsulas with continuous mats of lichen), birch seep, and riparian tall shrub habitats at the landscape scale, with no major differences between sexes. Inuit Knowledge holders and scientists both observed that within home ranges all bears generally selected for eskers and tall shrub riparian habitats (De Beer Canada Inc. 2013), with tussock/hummock tundra favoured by males. These habitat selection patterns likely result from food availability and abundance (McLoughlin et al. 2002a), but because of the resolution of the data (satellite-collar data and digital vegetation coverage), results should be considered to be relatively coarse. Eskers harbour berry-producing shrubs and ground squirrels, and are used seasonally when those food sources are available (Gau et al. 2002). Riparian zones contain preferred horsetails and sedges and are often used by caribou for feeding. Females with cubs differed from males and lone females in their habitat use, possibly to reduce interactions with other predatory bears (McLoughlin et al. 2002a).

Habitat suitability values for grizzly bear developed by Johnson (unpublished data) were applied for habitat modelling (see Figure 5.6). Heath tundra and shrub habitats were considered high-quality habitats. Modelled grizzly bear habitat showed lower quality habitat in the more bedrock/boulder cover classes west and southwest of High Lake and broadly within the treeline transition zone. Approximately 34% (25,015 km²) of the area modelled was considered high-quality grizzly bear habitat, 20% (15,209 km²).

> *C21 ""The newborn caribou calves are born in June after the rivers are flowing. The grizzly bears hunt them when the newborn calves are learning how to run. The calves are still slow so they catch them, just like eating hikhik. Sometimes the female caribou get killed when trying to protect their calves. The caribou don't have teeth but they have antlers, which they try to use to protect their young. Once the grizzly bears bite the caribou by the neck the caribou are dead" (Banci and Spicker 2024).*

Isotope analysis supports the conclusion of a heavy meat diet; a continent-wide study showed that Central Arctic bears with access to caribou consistently had the highest terrestrial meat consumption of any population sampled in North America (Mowat and Heard 2006). Green vegetation (primarily horsetail and sedges) formed the greatest component of the diet in early summer, and berries increased in importance in late summer (NTKP 2018). Arctic ground squirrels (*hikhik*) formed a small portion of the diet in all seasons except early summer.





Grays Bay Port
Grays Bay Road
Tibbitt to Contwoyto Winter Road
Territorial Boundary
Treeline
Watercourse
Wildlife Regional Study Area (RSA)
Grizzly Bear Regional Assessment Area

Grizzly Bear Habitat Suitability Classes

Nil
Low Suitability
Moderate Suitability
High Suitability

0 25 50 Kilometres
(At original document size of 8.5x11) 1:2,400,000

N

Notes

1. Coordinate System: WGS 1984 UTM Zone 12N
2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)
Publication Date: Unknown
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Project Location
West Kitikmeot Region
Nunavut

Prepared by OliviaLeblanc on 2026-02-20

Client/Project 24Y0376
West Kitikmeot Resources Corp (WKR)
Grays Bay Road and Port

Figure No.
5.6

Title
Grizzly Bear Habitat Suitability Map

Path: L:\PROJECTS\2024\WH\24Y0029_GBRP\BirdBaselineUpdates_2025.aprx\24Y0376_WildBaseline_Fig5-6_Grizzly_HabSuitability_20260220; Revised: 2026-02-20 By: OliviaLeblanc

Grizzly bears may also prey on marine animals, including marine mammal carcasses, Arctic char (late July through August), or resident fish (lake trout or land-locked Arctic char; Wildlife Management Advisory Council (North Slope; WMAC) 2008). The use of these food sources is likely opportunistic (Edwards et al. 2011), whereby bears may scavenge remains, capture fish moving in shallow streams between deeper lakes or pools, or capture fish during the migration of spawning Arctic char at cascades or obstructions to movement. Grizzly bears may also prey on seals, particularly in the spring; one interviewee told a story of seeing a grizzly taking seals out on the ice in the spring (Wildlife Management Advisory Council (North Slope) 2008).

> "*And sometimes we see their track on the ice hunting seal, hunting seal just like the polar bear*" (Pat Ekpakohak (Ulukhaktok), in Slavik 2010).

In mid-June 2004, marine mammal surveys along the coast detected four grizzly bears adjacent to or on the sea ice, including one bear 20 km from the mainland. When the fall berry crop is poor within Inuvialuit lands, more bears were seen scavenging whale carcasses on the coast (Wildlife Management Advisory Council (North Slope) 2008).

The WKSS research examined 56 grizzly bear dens (McLoughlin et al. 2002c). The majority of grizzly bears entered dens in the last two weeks of October and emerged in early May. Although esker habitat was selected more than expected by chance, 60% of the dens were in heath tundra and heath-boulder habitats, with most of the remaining dens in riparian tall shrub and birch seep habitats. The majority of dens had a south or west exposure and were constructed under tall shrubs that likely help to support the ceiling. The substrate was generally well drained. Most dens collapsed by mid-summer, thus most bears likely dig new dens each year (McLoughlin et al. 2002c). Inuit Knowledge indicated that grizzly bears like rough areas for denning (Wolfden Resources Inc. 2006). Concern for grizzly bear denning habitat in the region is high; the West Kitikmeot Regional Land Use Plan (WKRLUP) stipulates that works and activities must not disturb grizzly bears dens in or on eskers (Nunavut Planning Commission 2004).

Thirteen I den sites were recorded within 100 km of the Project, providing details on den sites specific to the northern mainland and on sites that may not have been included in the overall research summary (McLoughlin et al. 2002c). The bulk of these sites were <12 km from the Hood, James, and Burnside rivers and their tributaries. One of the sites was approximately 15 km southeast of the High Lake camp, and several were 15 to 25 km east of the proposed road alignment. These northern den sites were in heath (n = 6), esker (4), and tall shrub riparian (3) habitats, at a range of distances from water (5 to 2,000 m), with a preference for all but north aspects, in the top to middle portions of moderately steep slopes (mean of 27°). At most sites the soil was sand-dominated with shrubs, presumably to help stabilize the substrate. Dens used by two bears in successive years (1998 and 1999) were 9 and 42 km apart.

Few grizzly dens were verified during Project field work, with suspected dens located south of Grays Bay (mid-slope on a hill), and near Jericho (in glacio-fluvial material). Outside of the RSA (approximately 30 km southwest of the Izok area), one of the wolverine DNA posts was inadvertently placed about 10 m from a grizzly bear den.

5.3 Wolf

Grey wolves are found throughout much of northern and western Canada; within this range, they are often categorized into different subspecies based on distribution, behaviour, genetics, and physiological differences. Within northern Canada, wolves are often grouped in the following three categories: 1) timber wolves that live below the treeline and primarily depend on non-migratory prey such as moose; 2) tundra wolves that travel between the Arctic tundra in the summer and area below the treeline in the winter and depend largely on barren-ground caribou populations; and, 3) Arctic or island wolves that live on the Arctic islands and prey mostly on caribou, muskox and Arctic hares (*okalik*; *Lepus arcticus*) (Carmichael 2007; Musiani et al. 2007). At the federal level, the COSEWIC has assessed the northern populations of the grey wolf (*Canis lupus occidentalis*) as ‘Not at Risk’ (1999) due to a large, widespread population with no evidence of decline over the 10 years prior to assessment, while the Arctic form (*C. l. arctos*) was assessed as ‘Data Deficient’ (1999) as a result of insufficient data on population numbers, trends, and diet (COSEWIC 2011). Within NU, the conservation status of wolves is considered ‘Secure’ (Canadian Endangered Species Conservation Council 2022).

Wolves are found throughout the RSA and are generally considered tundra wolves; however, there may be some interaction with Arctic island wolves from Victoria Island during the winter months as the wolves follow the Dolphin and Union caribou across the Coronation Gulf to winter on the mainland (Carmichael et al. 2001; Carmichael 2007). The ecology of wolves in the region is most closely associated with caribou, as wolves tend to prey predominantly upon caribou during most of the year (Kuyt 1972, Williams 1990, Heard and Williams 1992, Wiebe et al. 2009). These wolves generally follow caribou herds on their annual migration, except during the denning period, which generally runs from parturition in mid- to late May, through to September or October when the pups can travel with the adults (Heard and Williams 1992; Walton et al. 2001; Cluff et al. 2002; Musiani et al. 2007; Klaczek et al. 2015).Within the tundra, wolves showed no preference for denning near caribou calving range (Heard and Williams 1992).

Inuit Knowledge recognizes that wolves occur throughout the Kitikmeot region; however, knowledge on wolf occurrence in the Project area is primarily along the Grays Bay coastline, the area between the James River and the Hood River, and is the southern portion of the Grays Bay Project area (see Figure 5.7). The identified areas of wolf occurrence show a correlation to the Inuit’s historic travel routes through the Project area and Kitikmeot region. Inuit Knowledge identified wolf dens to primarily occur in the south portion of the Project region, and on the west side of Bathurst Inlet and near Kingaok (see Figure 5.7).

Figure 5.7 Kitikmiut Knowledge of Amagok (Wolf) in the Kogloktoakyok (Grays Bay) Project Area – adopted from Banci and Spicker (2024)

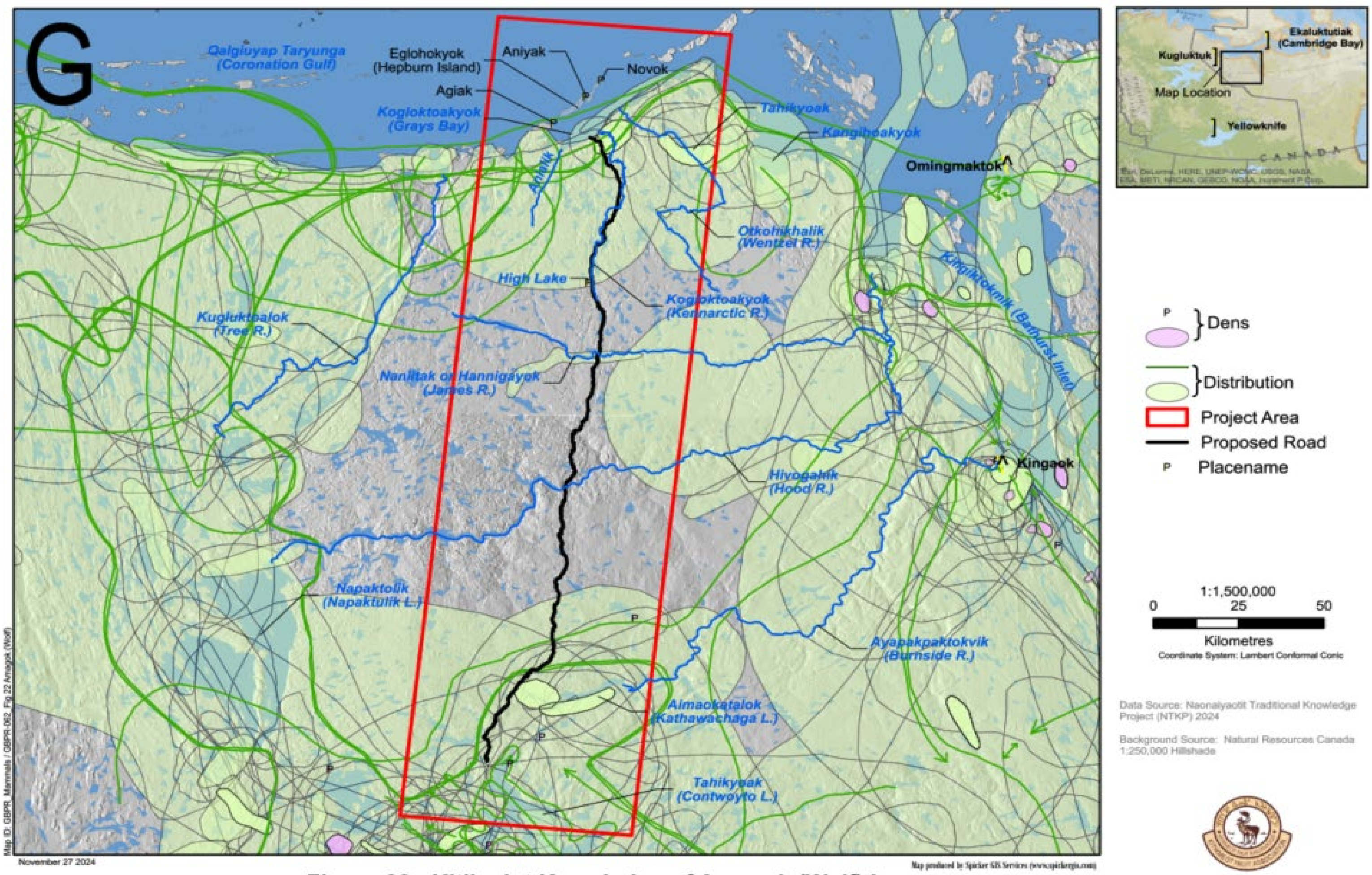


Figure 22: Kitikmiut Knowledge of Amagok (Wolf) in the Kogloktoakyok (Grays Bay) Project Area

5.3.1 Population

Wolf populations are difficult to estimate, especially populations that rely on migratory barren-ground caribou resulting in large annual home ranges (Adamczewski et al. 2009). Also, wolves are present in areas at relatively low densities, and are more active during hours of darkness (Adamczewski et al. 2009). Due to the difficulties defining and determining wolf populations, den site occupancy often is used to establish population trend.

When the Bathurst caribou population was higher in the late 1990s (~350,000 animals), it was believed the herd supported approximately 1,000 wolves; however, wolf den occupancy on the Bathurst summer range decreased through the 1990s (Gunn et al. 2011). Another study estimated wolves were responsible for killing approximately 55,500 Bathurst caribou annually, representing 16% of the 1990 herd population, and translating to an estimated 2,250 wolves on the Bathurst range (Case et al. 1996). The abundance of wolves on the Bathurst caribou herd's winter range was estimated at 211 (± 66 SE) wolves during a stratified random survey in 2006—a much lower than expected result (Mattson et al. 2009).

Between 1996 and 2009, an average of 20.5 wolf dens (a range of 14 to 28; *n* = 292) were active on the Bathurst herd's summer range in early summer (May to June; Adamczewski et al. 2009). Between 1996 and 2003, Frame et al. (2008) found that the number of pups per den varied from 0.6 (0.37 SE) to 4.1 (0.92 SE) pups per den, with a mean of 2.7 (0.31 SE) pups per den. A major decrease in the number of dens active in June that remain active in August may suggest that pup mortality has increased, likely a result of the decline in the Bathurst herd. Declines in pack size have also been observed in conjunction with the Bathurst herd's decline, with around 6 to 8 adults per den noted in the late 1990s and only around 2 to 4 adults observed per den in the early 2010s (Cluff, pers. comm., March 15, 2012; Frame et al. 2008). Low rates of pup recruitment and high den abandonment were correlated with declining numbers of Bathurst caribou and contraction of late-summer distribution of the herd towards the calving range, and likely resulted in a numeric response in wolf densities with declining caribou numbers (Klaczek et al. 2016). High rates of den abandonment and low pup recruitment were also observed during the 2013 and 2014 denning periods (Government of Northwest Territories 2014). Contrary to measured declines, Inuit Knowledge suggest that wolf populations were increasing, with more animals coming closer to communities and being harvested (Thorpe Consulting Services Ltd. 2014b).

Surveys completed in the North Slave Region of the Northwest Territories in the boreal forest in 2023 and 2024 found 2 and 7 active wolf dens, respectively, while in 2012 there were 22 active dens in the same area (Wilson et al. 2025). Zero to three pups were seen at each den in 2023 and 2024 (Wilson et al. 2025).

5.3.2 Harvest and Mortality

Local Inuit hunt wolves on an opportunistic basis, primarily by shooting from snow machines and to a lesser extent by trapping. Wolves can concentrate near large herds of wintering caribou, occasionally resulting in high wolf harvests if these concentrations occur in open tundra areas around communities. Upwards of 850 wolves were killed near Kugluktuk during winter 1978–1979 when a large part of either the Bathurst or Bluenose-East caribou herd wintered near that community, and similar results have been reported for other Western Arctic communities (Hayes and Gunson 1995). Kugluktuk residents have reported numerous wolves between Grays Bay and High Lake (Wolfden Resources Inc. 2006). Wolves were also trapped within the winter range of the Bathurst herd, with records of 104 wolves harvested by a single trapper from Fort Reliance in 2006 (Adamczewski et al. 2009). During 2023-2024, 154 wolves were harvested in the North Slave Region of the Northwest Territories in an area that overlaps the Bathurst caribou winter range (Wilson et al. 2025). The GN-DOE did not recommend a TAH for wolves in the mainland portion of NU (Wildlife Research Section 2007), and no TAH is currently in effect (Awan et al., 2023).

Reported wolf kills in the region for 2011 to 2015 (M. Aswan, GN, unpublished data, December 2016) were focused on the communities of Kugluktuk and Cambridge Bay, with no recorded harvest within the Project RSA (see Figure 5.8). Just over half of reported kills were males (*n* = 98), while around 43% were females (*n* = 77), and less than 3% were unknown (*n* = 5). During the 2019 harvest year (July 1, 2018 to June 30, 2019) in Kitikmeot, 146 wolves (60% male) were harvested primarily by hunters from Kugluktuk, and between 2019-2020 in Kitikmeot 155 wolves (54% male) were harvested (Awan et al. 2023b).

Starting in 2018-2019 in the Kitikmeot region and expanding to all of NU in 2019–2020, the GN offered compensation to local hunters to harvest wolves and provide sample and location data, through the Support for Active Harvesters program (Awan et al. 2023b). A total of 1,500 wolves were killed by hunters within NU over 3 years between 2018-2021, and these harvest data were examined to describe the spatial and temporal patterns of the NU wolf harvest in relation to caribou densities based on collared individuals (Awan et al. 2023b). Within the Kitikmeot region during the -2019 harvest year, 146 wolves were recorded harvested by 52 hunters primarily from Kugluktuk, with a high proportion of the harvest during October-December comprised of juveniles (Awan et al. 2023b). Across NU during the 2020 harvest year, 658 wolves were recorded harvested, and during the 2021 harvest year a total of 699 wolves were recorded harvested (Awan et al. 2023b). Most of the harvest (~65%) was done by hunters from Arviat, Baker Lake and Kugluktuk, and nearly all (99%) of the wolves were shot and the remainder were trapped (Awan et al. 2023b).

5.3.3 Movements and Distribution

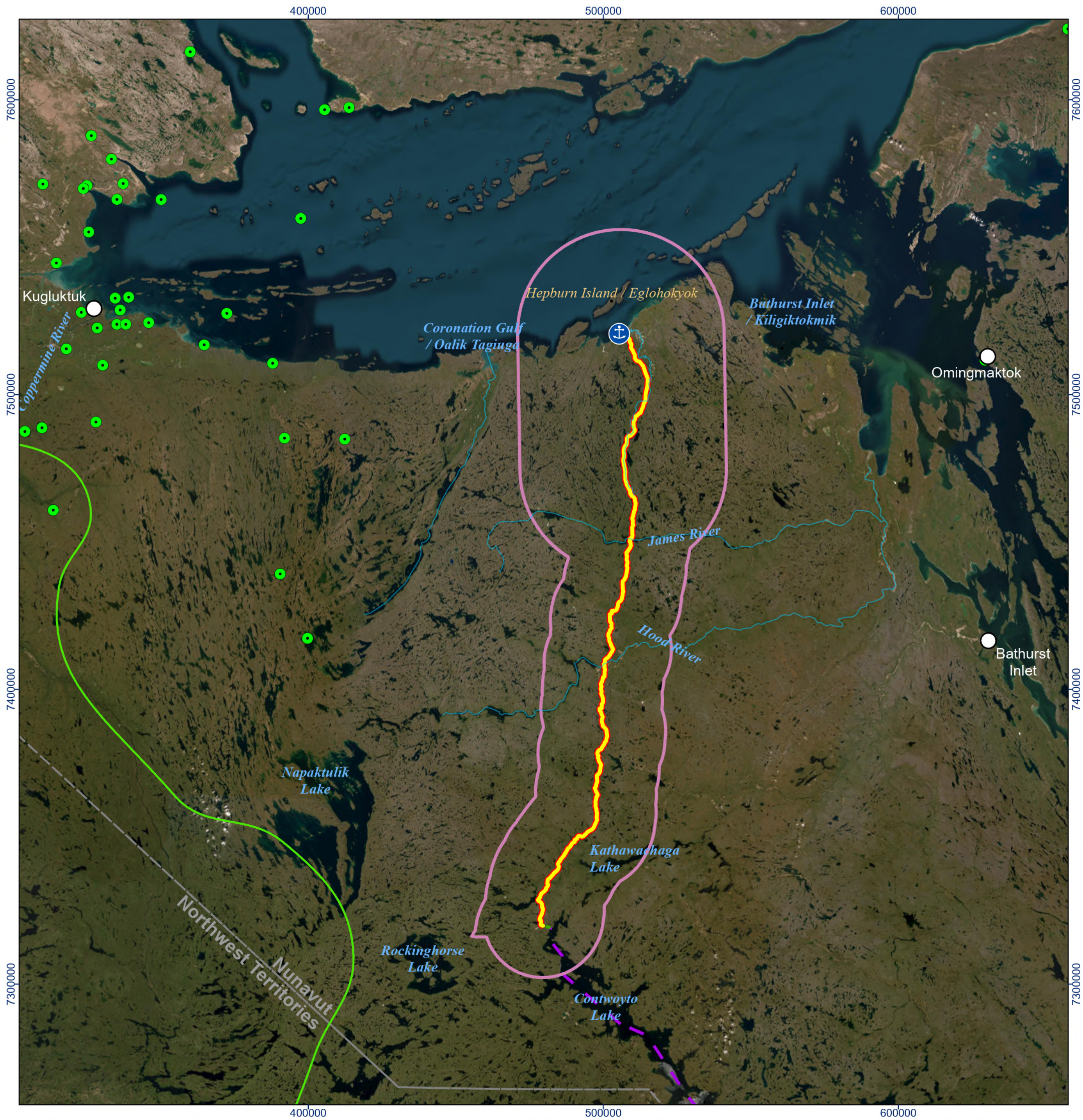
Several studies have examined tundra wolves in the central Canadian barrens, including those associated with the Bathurst caribou herd (e.g., Heard and Williams 1992; Walton et al. 2001; Cluff et al. 2002; Frame et al. 2004, 2008; McLoughlin et al. 2004; Musiani et al. 2007; Klaczek et al. 2015, 2016). Except during the denning period, these animals do not maintain permanent territories but are migratory. They follow caribou from wintering areas south of the treeline to denning areas in the tundra just north of treeline (Heard and Williams 1992), resulting in extensive annual ranges, averaging 43,700 km² (Cluff et al. 2002).

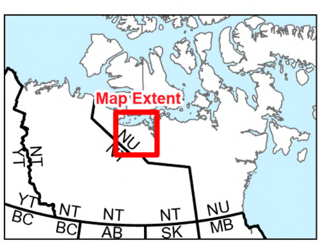
A large number of the wolves found within the RSA, particularly those denning in the southern sections of the RSA and within the Izok to Lupin areas, are believed to be associated with the Bathurst caribou herd; however, not all wolves within the study area are expected to follow this migratory pattern. Genetic studies on northern wolves found that although the Victoria Island wolf population is genetically distinct from mainland wolf populations, there is evidence of island-mainland gene movement, believed to be associated with the movement of the Dolphin and Union caribou herd (Carmichael et al. 2001; Carmichael 2007). Presumably, some of these wolves spend the summer denning period on

Victoria Island, follow the caribou over to the mainland for the winter months, and then return to Victoria Island in the spring. Additionally, baseline field surveys in 2012 documented two adult wolves at a den site just south of Coronation Gulf. Although they likely take advantage of the presence of the Dolphin and Union caribou in the winter months, this pack evidently did not follow the local caribou herds during the spring and summer months. A study on wolves within the range of the migratory Western Arctic caribou herd in northwestern Alaska found that these animals do not migrate with the caribou; caribou are the main prey when they are present, but when caribou numbers drop, wolves switch to preying on moose (Ballard et al. 1997). The wolf pack observed denning near Coronation Gulf may follow a similar strategy, switching to alternative prey such as moose, muskox, or various smaller animals during the spring through fall period.

Arrival on summer (denning) range occurs in April and the first half of May, with departure in late October or early November. Very few wolves actually den on or near the caribou calving range (see Figure 5.9); denning in the tundra tends to occur closer to treeline, likely a strategy to optimize timing and access to caribou for rearing pups since post-calving movements often bring the caribou back to the denning wolves when the nutritional demands of the pups are greatest (Heard and Williams 1992; Cluff et al. 2002). Summer ranges are much smaller than other seasonal ranges as wolves are restricted to areas near the den site. In a study by Cluff et al. (2002), home ranges averaged 589 ± 152 km² (n = 16) and 2,273 ± 953 km² (n = 11) for female and male wolves, respectively. Since denning often occurs near treeline, distant from areas of high caribou density, diet during the summer, while still predominantly caribou, may become more diverse (Kuyt 1972); and adult wolves may undertake long-distance summer excursions, ostensibly towards calving range with higher densities of caribou (Cluff et al. 2002; Frame et al. 2004). July may be a critical time for wolves in this area, as caribou are generally farthest from the treeline, and consequently far from denning sites (Williams pers. comm. *in* Bromley and Buckland 1995).

Numerous wolf observations were recorded in the RSA across all seasons. Although many were likely repeated observations of the same individuals, wolf observations were distributed throughout the RSA, with more sightings recorded in the Ulu to Grays Bay area (northern RSA) than the southern RSA (see Figure 5.9).





- Wolf Harvest Location
- Grays Bay Port
- Grays Bay Road
- Grays Bay Winter Road
- Tibbitt to Contwoyto Winter Road
- Territorial Boundary
- Treeline
- Watercourse
- Wildlife Regional Study Area (RSA)

0 25 50 Kilometres
(At original document size of 8.5x11) 1:2,000,000
N

Notes
1. Coordinate System: WGS 1984 UTM Zone 12N
2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)
Publication Date: Unknown
Downloaded: September 7, 2021
Last Checked: September 7, 2021

WEST KITIKMEOT RESOURCES CORP
EDI ENVIRONMENTAL DYNAMICS INC.

Project Location
West Kitikmeot Region
Nunavut

Prepared by OliviaLeblanc on 2026-02-20

Client/Project
24Y0376
West Kitikmeot Resources Corp (WKR)
Grays Bay Road and Port

Figure No.
5.8

Title
Documented Wolf Mortalities in the Vicinity of the Grays Bay Road and Port Project Regional Study Area, 2011–2015

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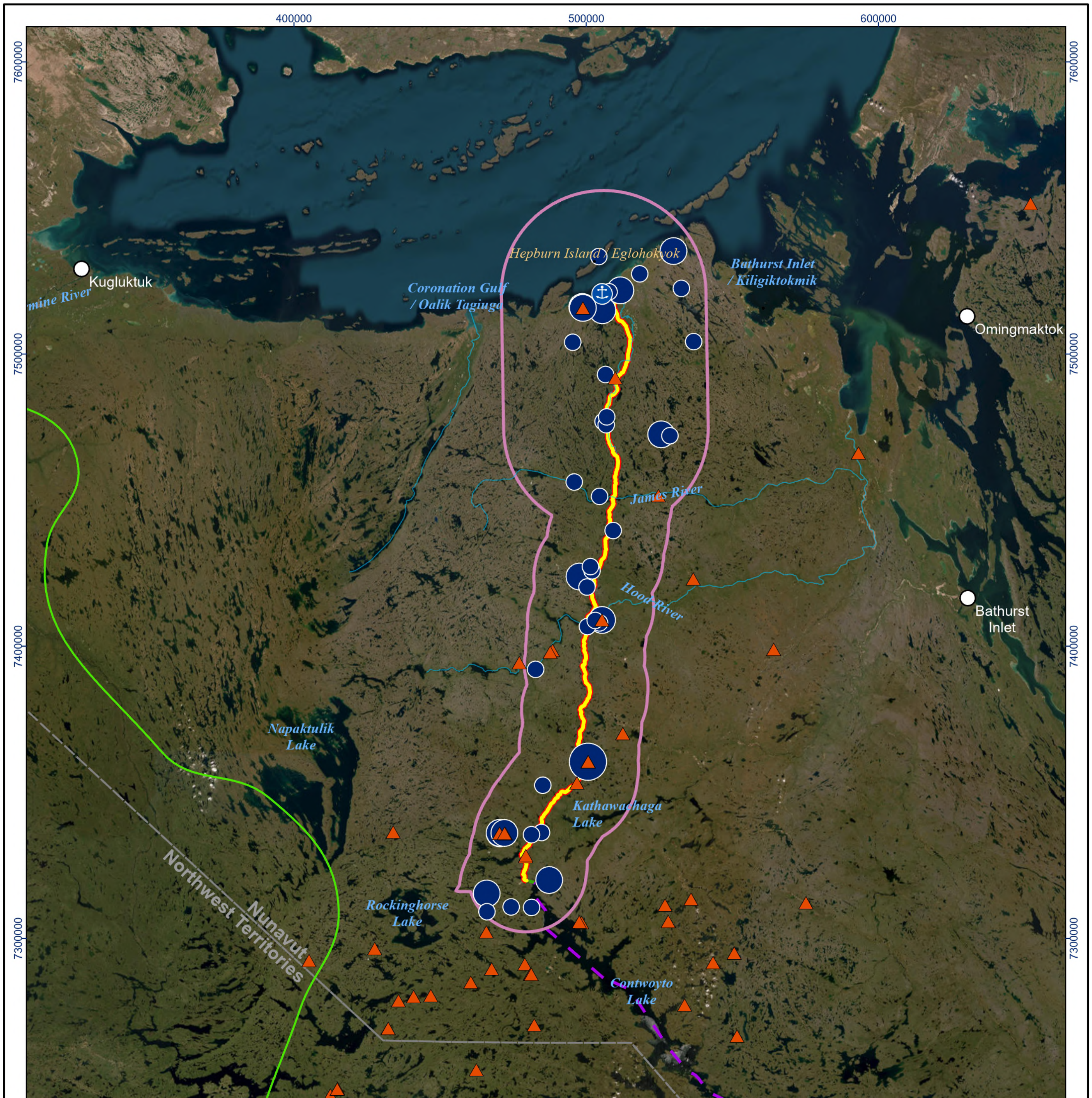
5.3.4 Habitat Use and Diet

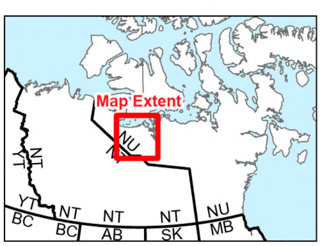
Caribou comprise the bulk of the diet of wolves throughout the year, although other prey such as rodents, birds, eggs, fish, Arctic hare, and muskox may be locally or seasonally important, particularly in areas temporarily devoid of caribou (Kuyt 1969; Kuyt 1972; Williams 1990; Wiebe et al. 2009). Wolves on Victoria Island prey primarily upon muskoxen, comprising approximately 90% of their diet; but wolves in this area do have the opportunity to prey upon either Peary or Dolphin and Union caribou (Larter 2013).

Denning on the tundra is almost exclusively in eskers, other glacial-fluvial formations, or river banks where the sand or gravel substrate facilitates digging (Cluff et al. 2002; McLoughlin et al. 2004; Wolfden Resources Inc. 2006, Klaczek et al. 2015). Denning habitat may be limiting in this region due to the prevalence of bedrock, water bodies, and permafrost which prohibit digging, and the distribution of eskers may be a limiting factor when wolf population densities are high (Klaczek et al. 2015). Studies of the habitat selection of wolves in this area have found selection for esker habitats at the home range scale, indicating that the availability of esker habitats is a key component in the selection of summer home ranges (Cluff et al. 2002; McLoughlin et al. 2004; Klaczek et al. 2015). Within a home range, studies have found little selection for specific habitats, indicating that wolves do not preferentially use any habitat types (other than possibly bedrock) during their daily movements (Cluff et al. 2002; McLoughlin et al. 2004). Den sites may be used repeatedly over time, resulting in traditional denning areas (Walton et al. 2001; Wolfden Resources Inc. 2006). Wolf den sites have been documented and are shown in Figure 5.9.

Between 2004 and 2012, six active wolf dens were located within the RSA. Active dens were in eskers (two), glacio-fluvial banks or ridges associated with rivers (three), and unknown (data not recorded; one). Observations of wolves at active den sites ranged from 0 to 5 adults and 0 to 2 pups.

The 2012 field season was the most intensive terrestrial wildlife program within the RSA. During 2012, four active dens were observed within the RSA including one near the coastline at Grays Bay, two northwest of Jericho, and one south of Ulu. It is unknown whether these four dens represent four separate packs or if some of the dens were used by the same pack at different times throughout the denning period; however, based on the timing of the observations and the locations of the various den sites, a conservative estimate indicates that there were at least three or four packs denning within the RSA in 2012.





- Wolf Den Site
- Grays Bay Port
- Grays Bay Road
- Grays Bay Winter Road
- Tibbitt to Contwoyto Winter Road
- Territorial Boundary
- Treeline
- Watercourse
- Wildlife Regional Study Area (RSA)

Wolf Observations

- 1 Wolf
- 2 - 4 Wolves
- 5 - 7 Wolves

0 25 50 Kilometres

(At original document size of 8.5x11) 1:2,000,000

N

Notes

1. Coordinate System: WGS 1984 UTM Zone 12N

2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)

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WEST KITIKMEOT RESOURCES CORP

EDI ENVIRONMENTAL DYNAMICS INC.

Project Location

West Kitikmeot Region

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West Kitikmeot Resources Corp (WKR)

Grays Bay Road and Port

Figure No.

5.9

Title

Wolf Den Sites within the Vicinity of the Grays Bay Road and Port Project Regional Study Area, 1996 to 2014, and Observations within the Regional Study Area, 2004–2013

Path: L:\PROJECTS\2024\WH\24Y0029_GBRP\BirdBaselineUpdates_2025.aprx\24Y0376_WildBaseline_Fig5-9_WolfDenObservations_20260220; Revised: 2026-02-20 By: OliviaLeblanc

5.4 Wolverine

Wolverines are solitary carnivores with low population densities and large home ranges that range throughout most of northern and western Canada (COSEWIC 2014). They are both scavengers and predators, relying on a diversity of foods including birds, small mammals, and large prey such as ungulates to offset the uncertainty of food availability in the harsh northern environment. Wolverines are an important cultural and economic resource for the people of the NT and NU. Inuit speak highly of the wolverine for its intelligence and cunning (Banci and Spicker 2024).

Research initiated in 1996 northwest of Lac de Gras in the central barrens has substantially increased the understanding of the ecology of northern wolverines (Mulders 2000; Mulders et al. 2007). Abundance studies using identification of individuals using DNA from remotely obtained hair have been completed at several mine sites and the Daring Lake, NT research station since 2005 (Mulders et al. 2007; Boulanger and Mulders 2008, 2013), and within study areas in western Kivalliq, NU (M. Aswan, GN, unpublished data, October 2016). Regionally, additional genetic mark-recapture population studies were undertaken in the Izok area in 2012 and at Napaktulik (Takijuq) Lake (partially in W-RAA) in 2018/2019 (Boulanger 2013b; Awan et al. 2020).

Inuit Knowledge identified wolverine to occur throughout the Kitikmeot region. Within the Project Area, wolverine occurrence was identified along the Grays Bay coastline and adjacent uplands, along the James River, and around Contwoyto Lake and Kathawachaga Lake (see Figure 5.10). Wolverine occurrence as identified by Inuit Knowledge is associated within historic Inuit travel routes through the Kitikmeot region. The southern boundary of the Project area is known to contain numerous wolverine dens as identified by Inuit Knowledge (see Figure 5.10).

Regulators have raised concerns about the health of wolverine populations in the Arctic (Johnson et al. 2005; Mulders et al. 2007). Wolverines have been killed or translocated from several mining developments in past decades (e.g., Diavik Diamond Mines Inc. [2003]; BHP Billiton [2006]). Thus, there is the potential for cumulative impacts from disturbance and increased mortality on populations that may lead to declines in abundance (Johnson et al. 2005; Mulders et al. 2007).

Figure 5.10 Kitikmiut Knowledge of Kalvik (Wolverine) in the Kogloktoakyok (Grays Bay) Project Area – adopted from Banci and Spicker (2024)

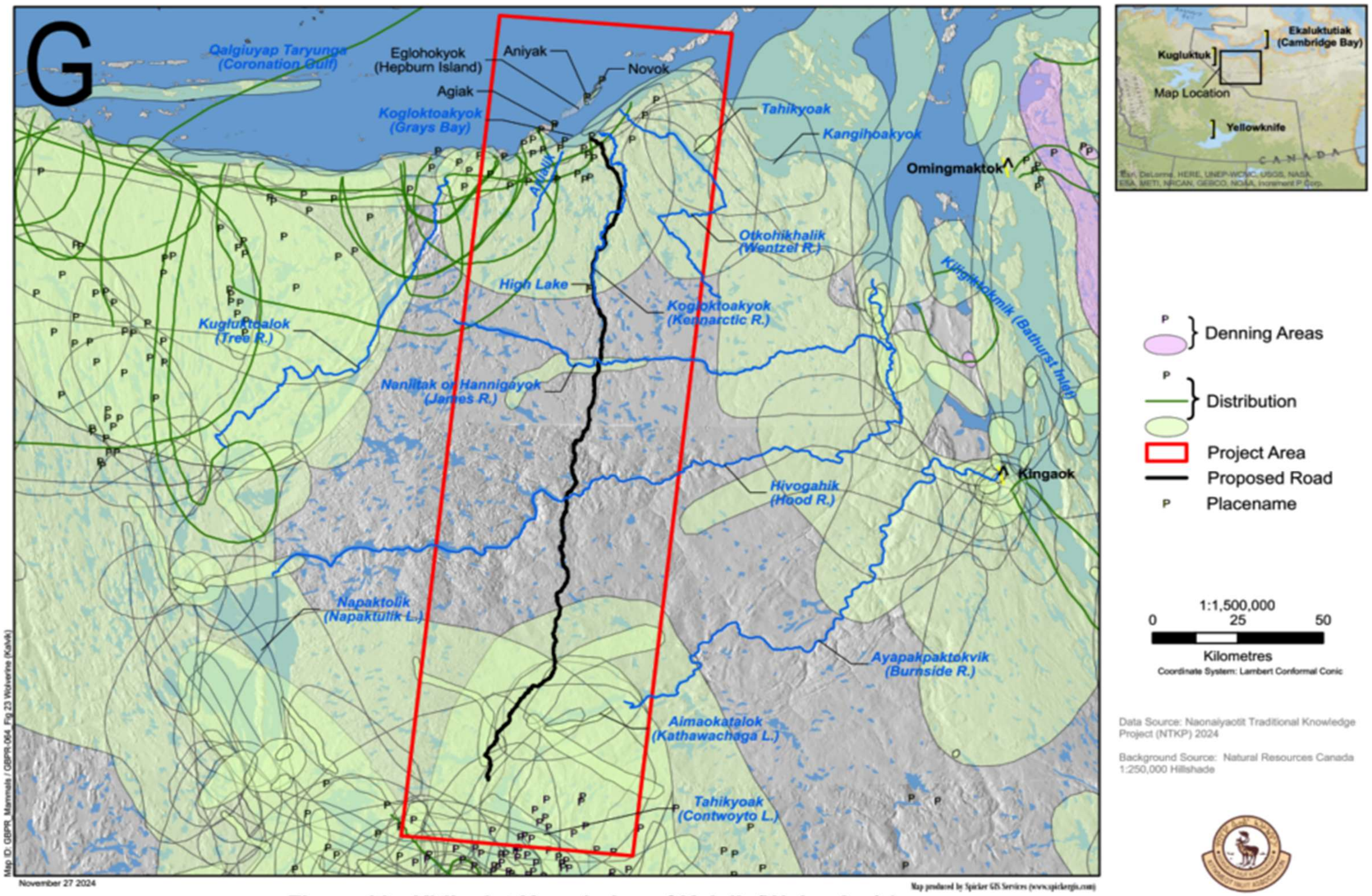


Figure 23: Kitikmiut Knowledge of Kalvik (Wolverine) in the Kogloktoakyok (Grays Bay) Project Area

5.4.1 Population

Wolverine is classified as a species of Special Concern by the SARA (Government of Canada 2018) because of naturally occurring low numbers, habitat fragmentation, climate change and human impacts. Wolverines are listed as Secure by the GN (Canadian Endangered Species Conservation Council 2022), and Not at Risk by the NT government (Government of Northwest Territories 2024a). Field studies since 2003 suggest wolverines are more abundant in parts of the NT and NU than previously thought, and the species appears to be expanding its range eastward and northward (COSEWIC 2014; Thorpe Consulting Services Ltd. 2014a).

A total of 29 wolverines were identified in the High Lake DNA survey in 2008; males comprised 55% of the individuals identified (see Table 5.5). Most wolverines were captured in the southern and eastern portions of the High Lake study area, with almost no captures in the northern portions (see Figure 5.11). Regionally, the Izok area DNA study in 2012 resulted in genotypes assigned to 23 animals, and males comprised 70% of the individuals identified (see Table 5.5). None of the 29 wolverines identified in the High Lake study in 2008 were detected at Izok in 2012.

Table 5.5 Number of Wolverines Captured, Number and Density of Wolverines on the Sampling Grids, and Capture Probability, from High Lake in 2008 and Izok in 2012[1]

Study Area	Sex	Captured	Average N (CI)[2]	Density (/1,000 km² [SE])[3]	Capture Probability[4]
RSA (High Lake area)	Males	16	10.0 (6.8–14.8)	3.3 (0.67)	0.61
	Females	13	10.5 (6.7–16.5)	3.5 (0.81)	0.88
	Pooled	29	20.5 (13.5–31.2)	6.9 (1.05)	
Regional[5]	Males	16	10.0 (6.8–14.8)	3.3 (0.67)	0.59
	Females	7	4.4 (2.5–7.7)	1.5 (0.43)	0.87
	Pooled	23	14.4 (9.3–22.5)	4.8 (0.79)	

Notes:

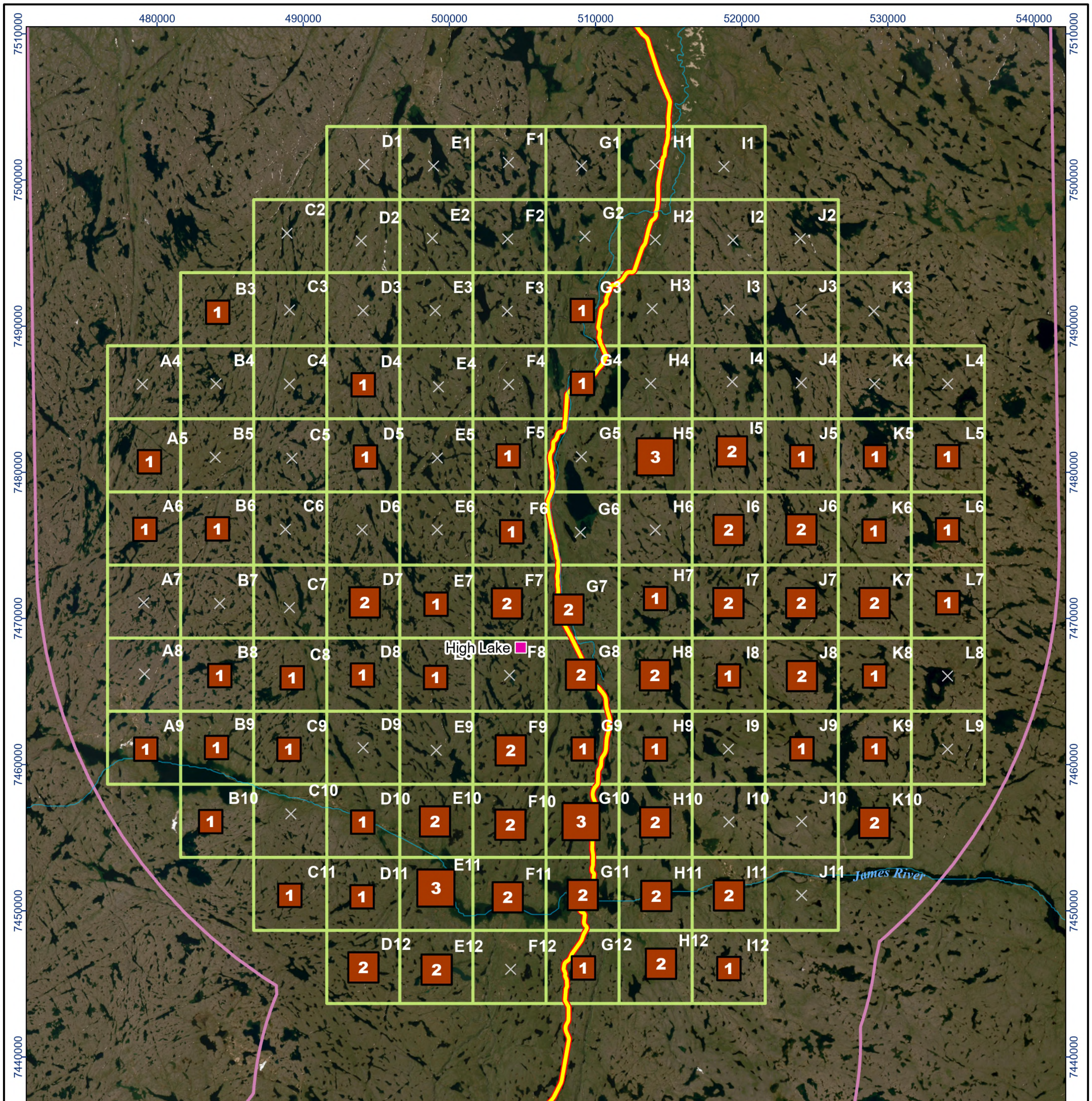
1 Estimated number of wolverines (N), density, and capture probabilities from (Boulanger 2013b).

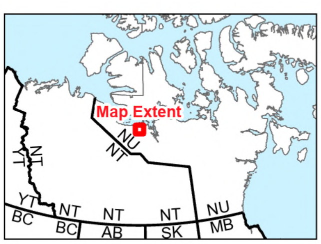
2 Average numbers of wolverines (N) on the sampling grid calculated using spatially explicit mark-recapture methods which considered closure (edge effect) and study duration.

3 Density (wolverines per 1,000 km²) calculated using spatially explicit mark-recapture methods.

4 Capture probability is the probability of capturing each identified wolverine in either capture session. Higher values provide more precise abundance or density estimates.

5 The term ‘regional’ is used to describe areas outside the RSA but are nearby. This regional data comes from studies completed in the Izok Lake area.





- Advanced Mineral Exploration Site
- Grays Bay Road
- Territorial Boundary
- Watercourse
- Wildlife Regional Study Area (RSA)
- Wolverine DNA Sampling Grid

Wolverine Captures

- No Wolverine
- 1 Wolverine
- 2 Wolverines
- 3 Wolverines

0 5 10 Kilometres

(At original document size of 8.5x11) 1:400,000

N

WEST KITIKMEOT RESOURCES CORP

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Notes

1. Coordinate System: WGS 1984 UTM Zone 12N

2. Data Sources: Government of Canada, Stantec, Downloaded by David Spry (Stantec GIS) in mid-December 2016 from ftp://ftp.maps.canada.ca/pub/nrcan_rncan/vector/canvec/fgdb/Hydro/ Last Modified 08-Nov-2016, Earthstar Geographics

Project Location
West Kitikmeot Region
Nunavut

Prepared by OliviaLeblanc on 2026-02-20

Client/Project 24Y0376

West Kitikmeot Resources Corp (WKR)
Grays Bay Road and Port

Figure No.
5.11

Title
Wolverine DNA Survey Grid and Captures, 2008

Path: L:\PROJECTS\2024\WH\24Y0029_GBRP\BirdBaselineUpdates_2025.aprx\24Y0376_WildBaseline_Fig5-11_WolverineDNACaps_20260220; Revised: 2026-02-20 By: OliviaLeblanc

Numbers of individuals captured on each study grid do not account for study area closure (edge effect) or study duration. Modelled density is the best metric to track populations over time and among areas, as density accounts for differences in study area size, closure violation, and study duration (Boulanger and Mulders 2008; Boulanger 2013a).

Wolverine ecology is closely linked with the ecology of caribou and wolves in the barrens. Wolverine densities on the barrens may be higher than first thought where large caribou herds exist and wolf predation on caribou is common (COSEWIC 2014). Densities of males were virtually equal between High Lake and Izok, but densities of females were over twice as great at High Lake (see Table 5.5)Error! Reference source not found.. The High Lake area is more rugged than the Izok area, with generally greater numbers of ungulates present during winter and spring. The comparatively lower density of wolverine females in the Izok area may be related to reduced food supply or available denning habitat. Pooled densities at High Lake and Izok were comparable with densities observed at Daring Lake, NT and the two diamond mines in the Lac de Gras area of the NT (3.9–11.4 wolverines/1,000 km²) during four capture sessions between 2005 and 2011 (Boulanger and Mulders 2013).

The 5 x 5 km cell design and proportionately larger study areas used at High Lake and Izok provided decreased closure violation and high capture probabilities, resulting in an efficient design for monitoring (Boulanger 2013b). Meta-analysis of multiple datasets (e.g., two or more years of survey) would increase the precisions of the estimates (Boulanger and Mulders 2008, 2013).

A wolverine DNA mark-recapture study was completed in 2018-2019 near Napaktulik Lake to establish baseline population abundance and density estimates for long-term regional monitoring (Awan et al. 2020). Twenty-two individual wolverines (11F:11M) were detected in 2018 and 27 wolverines (13F:14M) detected in 2019. Ten wolverines (6F:4M) identified in 2018 were also identified in 2019. Wolverine density in 2018 was estimated as 3.10 wolverines/1,000 km^2 (95% CI: 2.00-4.78), and 4.14 wolverines/1,000 km^2 (95% CI: 2.78-6.18) in 2019, with no significant difference between years. The median observed range of movement of detected males was similar between years (i.e., 24 km in 2018 and 22 km in 2019), but was noticeably different for detected females (i.e., 23 km in 2018 and 10 km in 2019). These results suggest that the population of wolverines surrounding the study area varies spatially and temporally. Wolverines in the Kitikmeot region exist at low densities and are being exposed to increasing levels of human activity through mining and subsistence harvest.

5.4.2 Harvest and Mortality

Wolverines are harvested throughout the North and are used for domestic consumption for their frost-resistant fur for parka trim, and for sale to auction houses. Inuit in the west Kitikmeot region keenly hunt wolverines wherever and whenever possible, resulting in moderate to high harvest near communities and along travel routes.

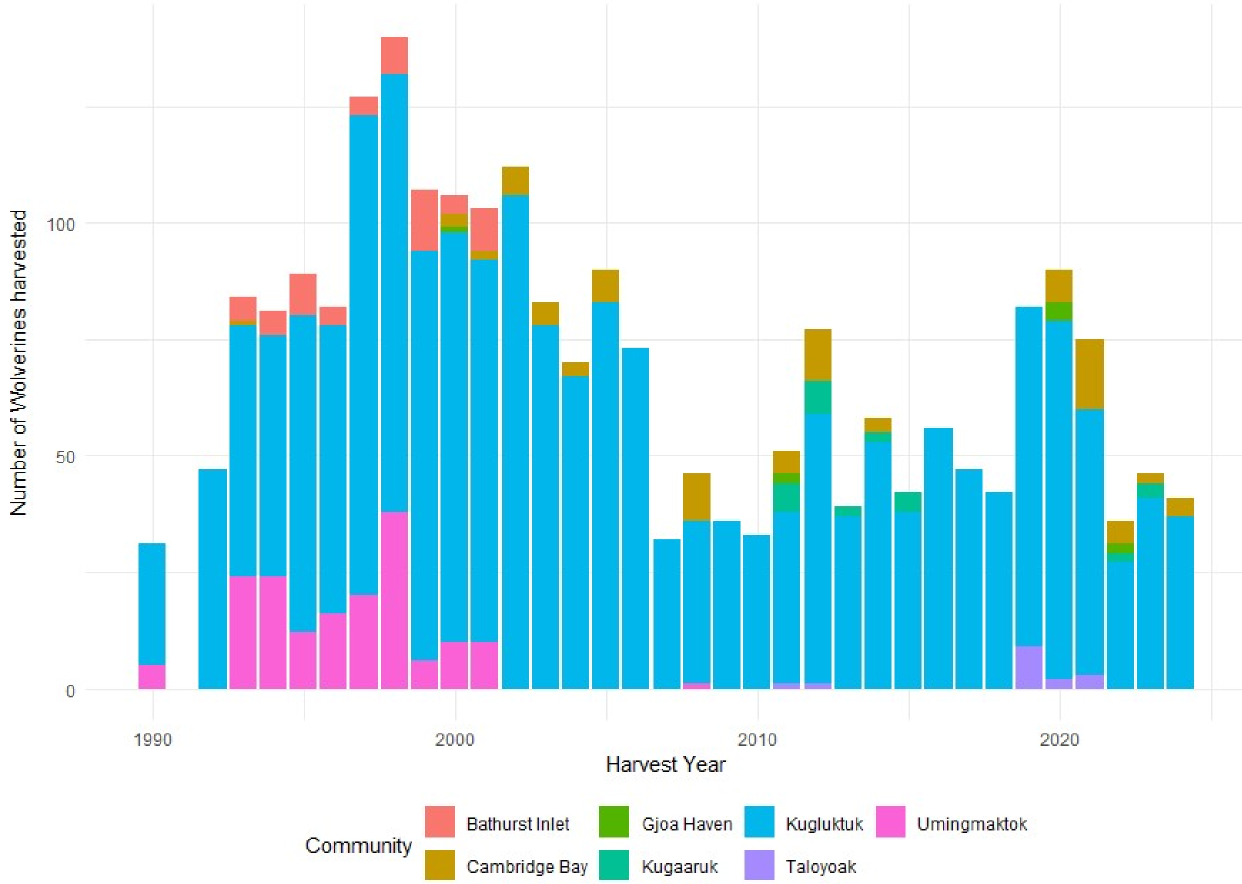
Carcass collections completed over four years in the Kitikmeot region in the late 1990s indicated most wolverines (78%) were shot, and the remainder were trapped, with a 1.9:1 ratio of males to females in the harvest (~66%; *n* = 473 wolverines; Mulders 2000). Juveniles and yearlings comprised a relatively high proportion of the harvest (34% and 35%, respectively). Carcass analysis suggests increases in both the proportion of females in the harvest and average female age as the number of wolverine harvested increases (Wildlife Research Section 2007). Low reproductive and potential growth rates suggest a low intrinsic rate of increase and limited resistance to overharvest, leading to the suggestion of a need for untrapped refugia to support harvests in adjacent areas (Mulders 2000, Krebs et al. 2004). The GN-DOE Wildlife Research Section (2007) considers wolverines in the mainland west Kitikmeot region to be abundant as part of a core area (W/01) and in 2007 recommended a TAH of 160 wolverines for the West Kitikmeot portion of the core area (W/01-KT). However, the NWMB has not implemented a TAH for wolverine. Currently, there is no quantitative limit on wolverine harvest by Inuit and there is no requirement for hunters to report their harvest (Awan 2025).

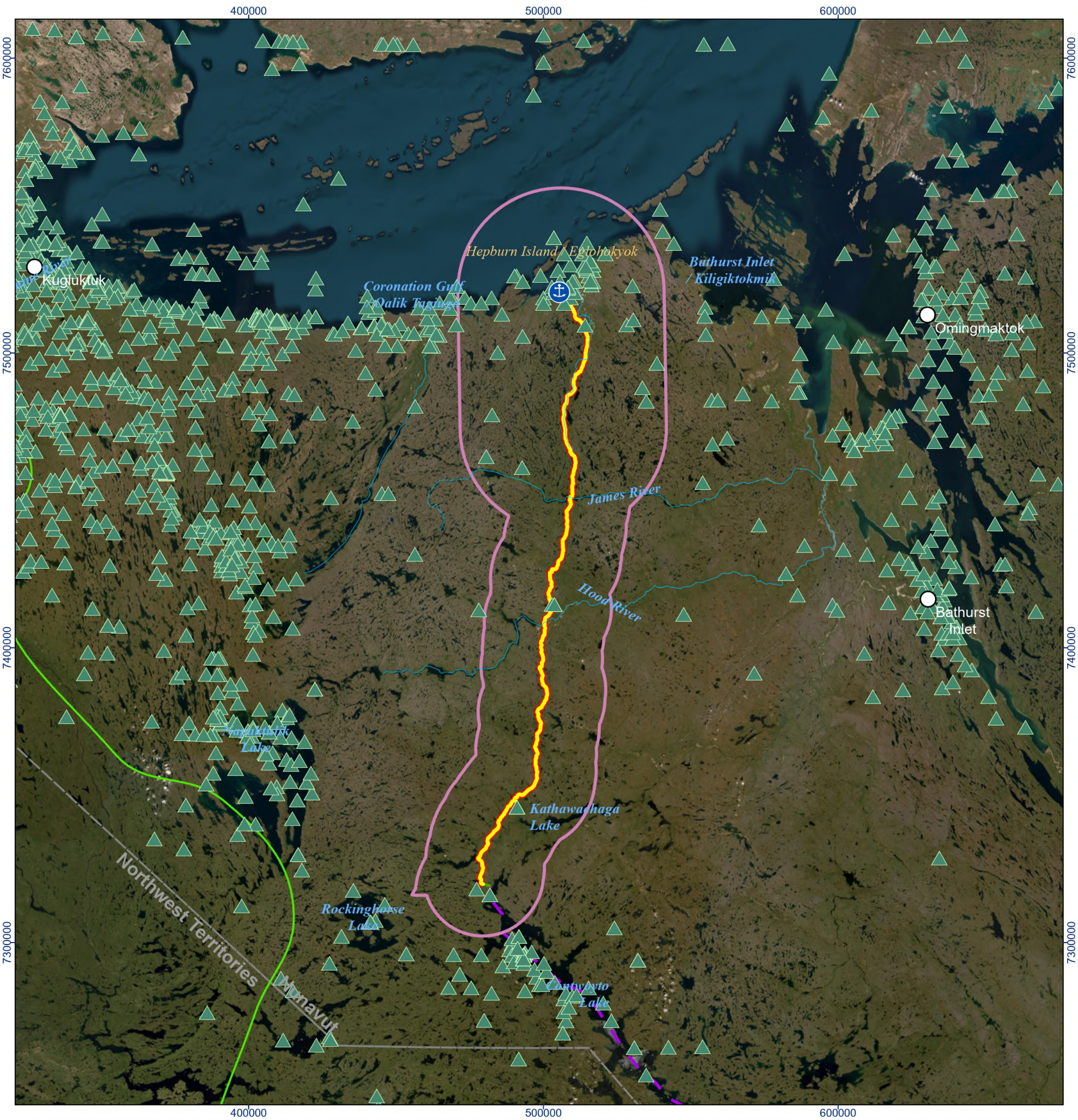
Wolverine carcass collections from Kugluktuk and the Bathurst Inlet area were completed to various degrees since the mid-1980s, with increased effort since 1995. These collections have shown far higher harvests than recorded in the fur auction system. On average about 120 wolverines were harvested per year in the west Kitikmeot in the second half of the 1990s (Mulders 2000). Based on harvest data obtained from GN and covering 1999 to 2015 (*n* = 1,293), most wolverines were harvested in areas southwest, south, and southeast of Kugluktuk, and to a lesser extent along the coast of Coronation Gulf and in the immediate vicinity of Bathurst Inlet, with limited harvest in the upland areas west of Bathurst Inlet, including the majority of the Project area (see Figure 5.12 and Figure 5.13; Mulders 2000; M. Awan, GN, unpublished data, December 2016). Annual harvests from 1999 to 2006 have declined from an average of 104 annually (range = 84–129), to an average of 51 annually (range = 40–77) from 2007 to 2015, though it is unclear whether this reflects reduced harvest effort or population size, or reduced collection or monitoring effort. Of the total harvest from 1999–2015 (*n* = 1,293), 67% were males, 33% were females, and less than 1% were unknown. During 2019–2024, the annual total reported wolverine harvest in NU was approximately 115 individuals (Awan 2025).

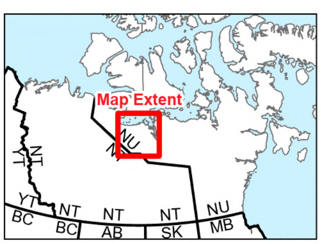
Overall, in NU, between 2014 and 2018 hunters submitted skulls and information about wolverine kill from a total of 310 harvested individuals (Awan 2020). Most of the harvest was done in the Kitikmeot region, near Kugluktuk, while Arviat and Baker Lake were the next highest contributors to the total harvest (Awan 2020). Most of the wolverines harvested were males, with approximately two times as many males harvested than females; and 59% of the harvested individuals were juveniles and yearlings while the other 41% were adults (Awan 2020). Eighty percent of these wolverines were hunted with a rifle, while 20% were trapped (Awan 2020). Inuit observations and recent harvest reports suggest that wolverine numbers in NU are either stable or slightly increasing, and the species may be expanding its range eastward and northward (COSEWIC 2014).

Between 2019 and 2024 hunters submitted skulls and kill information from 691 wolverines, with most coming from the Kitikmeot region (Awan 2025). Most of the wolverines harvested were males, with approximately two times as many males harvested than females; and 63% of the harvested individuals were juveniles and yearlings while the other 37% were adults (Awan 2025). Eighty-four percent of the wolverines were hunted with rifles and 16% were trapped.

Figure 5.12 Total numbers of wolverines harvested in the Kitikmeot region by year and by each community between 1990-2024 (derived from Leclerc 2025b).







- Wolverine Harvest Location
- Grays Bay Port
- Grays Bay Road
- Grays Bay Winter Road
- Tibbitt to Contwoyto Winter Road
- Territorial Boundary
- Treeline
- Watercourse
- Wildlife Regional Study Area (RSA)

0 25 50 Kilometres

(At original document size of 8.5x11) 1:2,000,000

N

Notes
1. Coordinate System: WGS 1984 UTM Zone 12N
2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)
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WEST KITIKMEOT RESOURCES CORP

EDI ENVIRONMENTAL DYNAMICS INC.

Project Location
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Grays Bay Road and Port

Figure No.
5.13

Title
Documented Wolverine Harvest within the Vicinity of the Grays Bay Road and Port Project Regional Study Area, 1999–2024

Path: L:\PROJECTS\2024\WH\24Y0029_GBRP\BirdBaselineUpdates_2025.aprx\24Y0376_WildBaseline_Fig5-13_WolverineHarvest_20260220; Revised: 2026-02-20 By: OliviaLeblanc

Records of harvested wolverines from 1990 to 2024 in the Kitikmeot region showed a total of 2,354 individuals harvested by hunters from 7 different communities (Leclerc 2025d). Most of these wolverines were harvested by hunters from Kugluktuk (1,987; 84%). With the next highest harvest numbers coming from Omingmaktok (166; 7%), Cambridge Bay (89; 4%) and Bathurst Inlet (61; 3%), Kugaaruk (26; 1%), Taloyoak (16; <1%), and Gjoa Haven (9; <1%) (see Figure 5.12). Most of the wolverines harvested were male (1,526; 65%), 786 (33%) were females and 22 (1%) individuals had sex as unknown (Leclerc 2025d). Eighty-two percent of the total harvested wolverines were hunted with a rifle, while 17% were trapped and the remaining 1% used other capturing methods (Leclerc 2025d).

Wolverine harvest within a 100 km radius of the proposed Project development has been primarily restricted to areas along or near the coast, and to a lesser extent in the southern portion of the Project area west of Contwoyto Lake (see Figure 5.13). Since 2008, only eight wolverine were recorded as harvested in the northern RSA (mainly along the coast), and only one in the southern RSA (Contwoyto Lake area). Human travel through the upland areas near High Lake may be difficult because of rocky terrain (M. Dumond, GN, pers. comm.), thus large parts of the Project area (except for adjacent to the coast and Contwoyto Lake) may partially function as a wolverine refugia from trapping and hunting.

Few data exist from the Arctic tundra to examine wolverine survival rates. Pooled studies from tundra study areas in the central NT, Alaska, and Yukon did not produce robust survival estimates because of low sample sizes and relatively few studies completed in the region (Krebs et al. 2004). Pooling data across tundra, boreal, and montane ecological zones found survival rates in untrapped/unhunted areas of 0.88 (0.127 standard deviation [SD]) for adult females and 0.87 (0.186 SD) for adult males. Within trapped/hunted areas survival rates dropped to 0.73 (0.149 SD) for adult females and 0.74 (0.122 SD) for adult males (Krebs et al. 2004). Rates determined for subadult males and females were less robust, but generally lower.

Eleven wolverine were intentionally killed at diamond mines in NT and NU during construction and operation since 1996 (cited in De Beers Canada Inc. 2013), usually following an extended period of habituation to the site and multiple deterrent attempts. All of these removals occurred with the permission of territorial wildlife authorities. At the Ekati Diamond Mine in NT, from 1997–2024 only one wolverine was killed from vehicle collision in 2024, while 10 died from non-vehicle-related causes during the same time period but none since 2005 (ERM Consultants Canada Ltd. 2025). A single wolverine was also accidentally hit and killed by a vehicle on the Tibbitt Contwoyto winter road in 1996 (Banci, pers. comm. In EBA Engineering Consultants Ltd. 2001).

Between 1998 and 2011, 27 wolverines were reported as either being killed or relocated from the Lac de Gras region in connection with mine-related activities (Mulders, unpublished data 2013 in Species at Risk Committee 2014). The frequency of wolverine incidents at mine sites has declined since the mid-2000s with enhanced waste management and mitigation (e.g., skirting of buildings).

5.4.3 Movements and Distribution

Several genetics studies have determined that northern wolverine populations exhibit a lack of population substructure based on microsatellite (nuclear) analysis (meaning they form one large breeding population; Wilson et al. 2000; Kyle and Strobeck 2001; Chappell et al. 2004), but mitochondrial data indicate broad genetic structuring due to female philopatry (the tendency to remain near their birthplace; Chappell et al. 2004). Within the broader Grays Bay Road and Port Project area, it is likely that wolverine populations are continuous and broadly overlapping.

Based on sample size, adult home ranges in the central barrens were 125 km² for females and 400 km² for males, while movements of yearlings resulted in ranges much larger in size (Mulders 2000).
Mean home range size for adult wolverines in other areas of North America and Scandinavia are up to three times larger (Species at Risk Committee 2014).

Thirty wolverine sightings have been documented by Project personnel from 2003–2013, including three groups of three individuals (see Figure 5.14). Most observations were clustered in the northern portion of the Project area, likely because of a combination of greater observer presence and better wolverine habitat compared with elsewhere.

Inuit Knowledge sources identify an abundance of wolverine in the Grays Bay area:

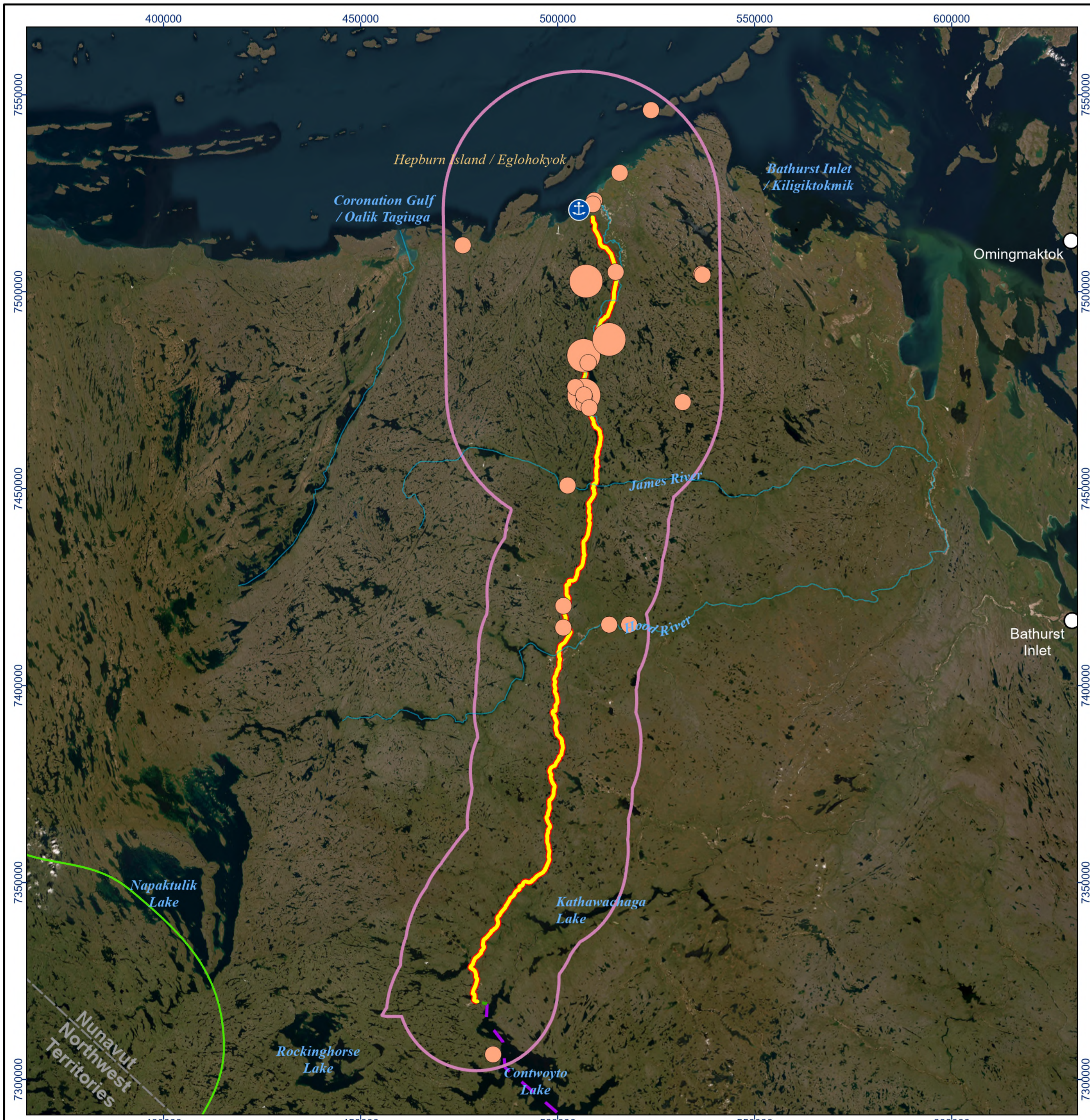
> *C4Kug JA-01 "I went to Grays Bay because there are wolverine, foxes, coloured foxes and tuktu. That's where Oniak's cabin is, on the river Kogloktoakyok. There are moose too. The caribou always stayed there, all around" (NTKP 2018).*

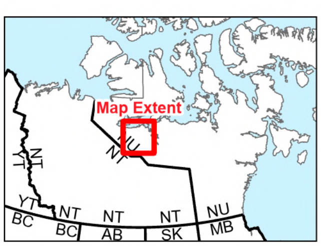
> *C562 CB-03 "Grays Bay is good hunting all over the area and sometimes caribou in the winter. It's a good hunting and trapping area. Fish and wolverine up towards High Lake area; charr and lake trout along Otkohikhalik (Wentzel River), good fishing. Caribou are hunted around Grays Bay. Grays Bay is also good for seals" (NTKP 2018)*.

> *C31 "I didn't trap at Kogloktoakyok long ago (Grays Bay) but I used to get kalvik from there"* (NTKP 2018).

> *C43 "Lots of wolverine along Eglohokyok (Hepburn Island) on the northeast shore, then north on ocean (#24, also fox. Also I saw wolverine on ice just west of Eglohokyok when there was water on the ice (spring)"* (Banci and Spicker 2024).

> *C43 "He mapped an area with wolverine hunting inland west of Tahikyoak (large lake on Wentzel River). He noted that kalvik were hunted out when skidoos came but they were coming back because no-one hunts there now"* (NTKP 2018).





Grays Bay Port

Grays Bay Road

Grays Bay Winter Road

Tibbitt to Contwoyto Winter Road

Territorial Boundary

Treeline

Watercourse

Wildlife Regional Study Area (RSA)

Wolverine Observations

1 Wolverine

2 - 3 Wolverines

0 20 40 Kilometres

(At original document size of 8.5x11) 1:1,500,000

N

WEST KITIKMEOT RESOURCES CORP

EDI ENVIRONMENTAL DYNAMICS INC.

Notes

1. Coordinate System: WGS 1984 UTM Zone 12N

2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)

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West Kitikmeot Resources Corp (WKR)
Grays Bay Road and Port

Figure No.
5.14

Title
Wolverine Observations within the Grays Bay Road and Port Project Regional Study Area, 2003–2013

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Wolverine use sea ice for travel. Three wolverines were observed on sea ice in the northern portion of the Project area during marine mammal surveys in mid-June 2004, including two individual animals 15 km north of Hepburn Island. In mid-July 2008, a wolverine was observed during seabird nest surveys on the ice near the westernmost of the Jameson Islands, 10 km off the mainland. Wolverine was also detected during other studies on the mainland. Track counts along the proposed road route in March and April 2012 detected wolverine tracks between 10 km south of Ulu and Grays Bay (n = 16 sets of tracks), and none along the rest of the road alignment.

Within the 3,000 km² High Lake and Izok DNA study areas, movements of individual wolverines ranged from single captures, to up to 130 km (High Lake) and 127 km (Izok) among posts, and a maximum of 30 km (High Lake) and 48 km (Izok) linking the outer extent of captures. The two longest distances moved among posts within each study area were by males.

5.4.4 Habitat Use and Diet

Adequate, year-round food supply and den site availability best describe habitat used by wolverines, rather than any particular habitat association (COSEWIC 2014). Habitat ratings were generated for wolverine based on research completed in a relatively small study area in the central barrens. These ratings suggest that over half of the area evaluated is composed of low- and nil-quality habitats (see Figure 5.15). High-quality habitat generally occurs in sedge and tussock habitats, and was generally concentrated in a band from Grays Bay to Ulu, and scattered throughout much of the southern portion of the area evaluated.

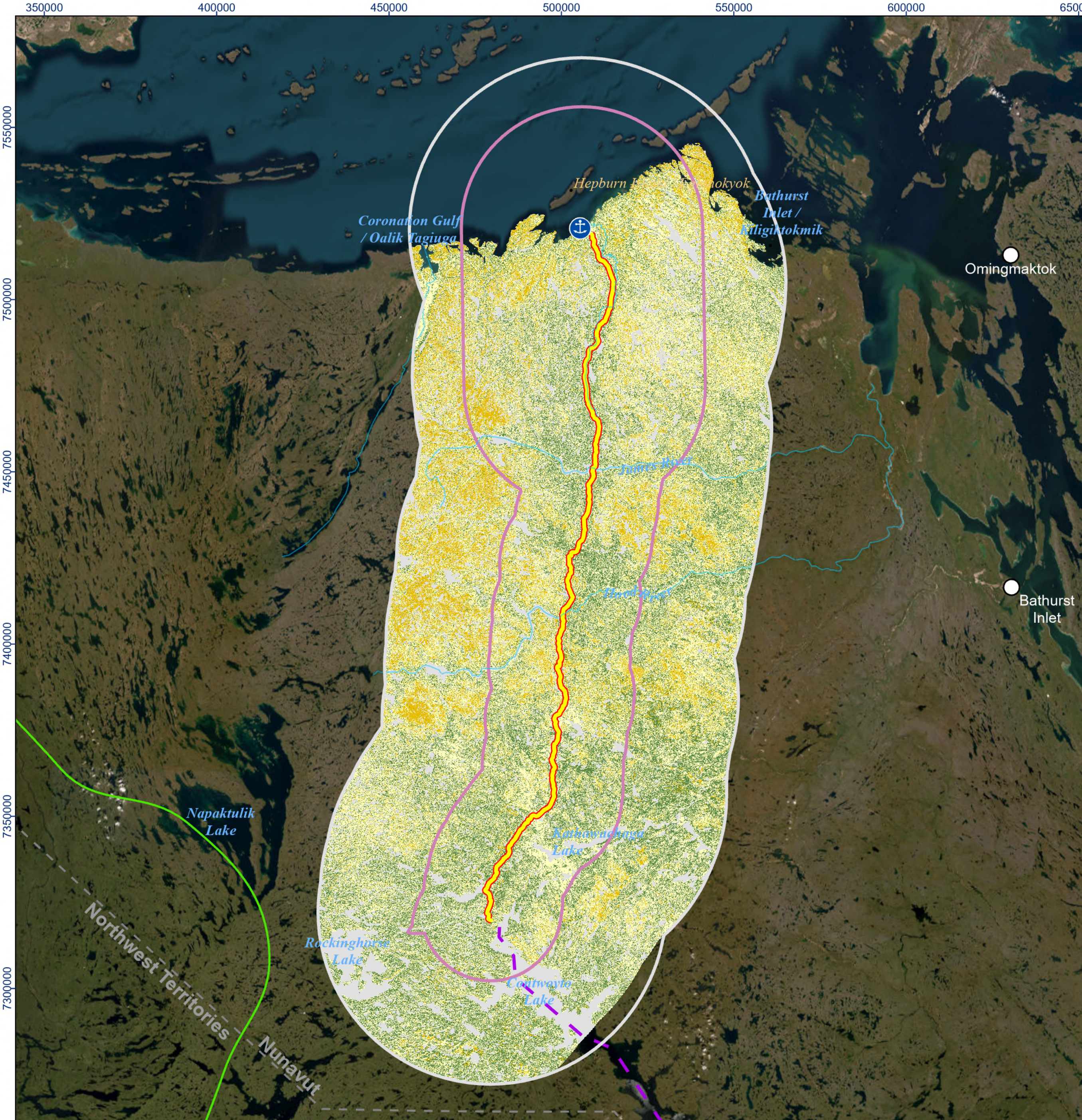
Approximately 21% (6,206 km²) of the evaluated area was considered high-quality wolverine habitat, 11% (3,144 km²) medium-quality habitat, 41% (11,760 km²) low-quality habitat, and 14% (4,139 km²) nil-quality habitat.

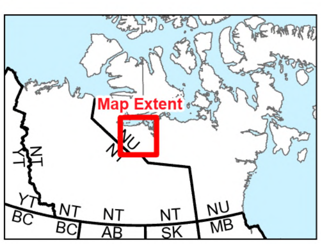
Den sites may have more specific habitat requirements (Species at Risk Committee 2014). Most natal den sites were associated with deep snow cover that persisted into spring, providing protection from predators and cold temperatures (Magoun and Copeland 1998). Denning habitat on the tundra may require rocky outcrops and extensive snowdrifts, which likely are not limited (Lee and Niptanatiak 1996; Wolfden Resources Inc. 2006). Repeated use of den sites has been observed (Lee and Niptanatiak 1996). The greater proportion of females in the High Lake area compared with the Izok area suggests that the former may be better natal habitat.

Wolverines are opportunistic predators that both actively hunt prey as well as scavenge (van Dijk et al. 2008), making them relatively versatile in their diet (Banci 1987; Mulders 2000; Lofroth et al. 2007; Species at Risk Committee 2014). Although wolverines obtain much of their diet from scavenging, they are proficient and tireless predators (NTKP 2018).

> "*Wolverine is another predator but it mainly feed of wolves and bear kills. Wolverine can also kill caribou. They chase them for a long time*" (citation in Dumond 2007a)

> "*We tracked a wolverine that chased caribou for over 50 miles*" (S.K.; A.N. in Dumond 2007a)





Grays Bay Port

Grays Bay Road

Tibbitt to Contwoyto Winter Road

Territorial Boundary

Treeline

Watercourse

Wildlife Regional Study Area (RSA)

Wolverine Regional Assessment Area

Wolverine Habitat Suitability Classes

Nil

Low Suitability

Moderate Suitability

High Suitability

0 25 50 Kilometres

(At original document size of 8.5x11) 1:1,750,000

N

Notes

1. Coordinate System: WGS 1984 UTM Zone 12N

2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)

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Grays Bay Road and Port

Figure No.

5.15

Title

Wolverine Habitat Suitability Map

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Although caribou (62%) and muskox (11%) formed the bulk of the wolverine's diet in the Kitikmeot region, a variety of other species are also eaten including Arctic ground squirrels, voles and lemmings, ptarmigan, and seal (Leporidae) (Mulders 2000). Grizzly bears and wolves generate carrion, which is an important food source for wolverines during winter (Species at Risk Committee 2014).

> *C565 "Wolverine like rough ground that is very rocky with holes, so there are a lot of wolverine in that area. There is also shallow water in that area for them to catch fish and berries and grass for them to eat. They like rough areas like the grizzly."* (Banci and Spicker 2024).

5.5 Foxes

Two fox species are present within NU: Arctic or white fox and red fox (Wildlife Research Section 2007). In the central Arctic, red foxes occur primarily as red and cross colour phases, but also as silver or black variations. Red foxes are about twice the size of Arctic foxes, and in areas where they overlap, the red fox is believed to be the more aggressive of the two, possibly displacing Arctic foxes as they expand northward (Macpherson 1969; Cypher 2003). Arctic foxes are primarily white in winter but also occur in a "blue" colour phase. Foxes are highly valued for their fur. During the first half of the 20th century, traders became established in the Arctic, and the distribution of foxes began to greatly influence the movements and hunting patterns of Inuit people (Freeman 1976).

> *"With increasing knowledge of the Copper Inuit, traders ultimately arrived in the region of the Coronation Gulf, and their influence began to substantially change the people's hunting patterns after 1916" (NTKP 2018).*

> *"In Period II [1916-1955], after the traders had become well established, these peoples' hunting patterns and seasonal movements were often strongly influenced by the real (or presumed) distribution and numbers of foxes, a species that had been of very little importance to them up to that time" (NTKP 2018).*

> *"The Contwoyto Lake area increased considerably in importance after the arrival of traders, for it had very good fox trapping grounds and excellent hunting" (NTKP 2018).*

Arctic foxes and red foxes in Arctic environments fluctuate widely in number, following the three to five year cycle in vole and lemming populations—their primary food source (Macpherson 1969; Garrott and Eberhardt 1987; Voigt 1987; Angerbjörn et al. 2008). Densities of red foxes are believed to be around 10/100 km² in the Arctic (Voigt 1987), while Arctic fox densities are highly variable (Angerbjörn et al. 2008). During Project surveys from 2004 to 2013, 47 fox observations were recorded; approximately 10% of these were Arctic fox, the remainder were red fox. Neither species is actively managed, with an overall lack of research and information available for all populations in the region (Wildlife Research Section 2007).

Within the Kitikmeot region, both fox species are important for trapping. Areas around Contwoyto, Itchen, and Napaktulik lakes were intensively trapped throughout the last century (Freeman 1976). Both species are trapped for their pelts (NTKP 2018), with Bathurst Inlet residents harvesting somewhat higher average numbers of red (coloured) foxes than Arctic foxes (24 and 18, respectively) and residents of other west Kitikmeot communities taking more Arctic fox (Priest and Usher 2004). Due to their high reproductive capacity, it is believed Arctic fox populations can be maintained under relatively high levels of harvest (Angerbjörn et al. 2008).

Arctic fox occurs throughout the Arctic regions of North America and Eurasia, while red fox have a wider distribution throughout the northern hemisphere. Red fox are thought to have expanded their distribution northward into the tundra over the past half-century (Voigt 1987; Cypher 2003). Arctic foxes have relatively small summer ranges; however, they may travel up to 90 km/day (Tarroux et al. 2010). In 2012, fox use (e.g., scat and dens) was detected during borrow pit surveys throughout the RSA.

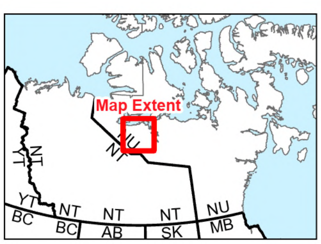
Red foxes and Arctic foxes hunt rodents and their numbers cycle with the populations of voles and lemmings. Foxes also feed on ground squirrels, Arctic hares, birds, bird eggs and young, berries, and scavenge ungulate meat from kills made by larger predators (Macpherson 1969; Cypher 2003; NTKP 2018). Foxes may follow caribou herds, feeding on the remains of caribou killed by wolves.

On the tundra, fox dens are commonly found on eskers and other accumulations of glacio-fluvial materials, with few to numerous entrances. In the Central Arctic, sandy eskers are the most common terrain feature used by denning foxes (Mueller 1995). Dens are often used for years by returning animals (Macpherson 1969; Voigt 1987; Cypher 2003). Inuit Knowledge indicates that foxes like denning on little hills, in soft ground along banks of rivers, and where there are flat areas (Wolfden Resources Inc. 2006). Fox dens were located during both denning surveys and other field surveys from 2005 to 2012 (see Table 5.6) and were distributed throughout the RSA (see Figure 5.16Figure 5.16). Known dens were revisited in subsequent years to update their activity status.

Table 5.6 Active and Inactive Fox Dens Within the RSA from 2005 to 2012[1]

Year	Number of Active Dens	Number of Inactive Dens
2005	1	1
2006	0	0
2007	3	7
2008	0	0
2012	11	20

Note:
[1] Numbers reflect both newly located dens and previously located dens that were revisited.



Notes
1. Coordinate System: WGS 1984 UTM Zone 12N
2. Data Sources: Government of Canada, Stantec, Natural Resources Canada, Government of Canada (https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245)
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- Fox Den Site
- Grays Bay Port
- Grays Bay Road
- Grays Bay Winter Road
- Tibbitt to Contwoyto Winter Road
- Territorial Boundary
- Treeline
- Watercourse
- Wildlife Regional Study Area (RSA)

0 20 40 Kilometres
(At original document size of 8.5x11) 1:1,500,000

N

WEST KITIKMEOT RESOURCES CORP

EDI ENVIRONMENTAL DYNAMICS INC.

Project Location
West Kitikmeot Region
Nunavut

Prepared by OliviaLeblanc on 2026-02-20

Client/Project
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West Kitikmeot Resources Corp (WKR)
Grays Bay Road and Port

Figure No.
5.16

Title
Fox Dens Located within the Grays Bay Port and Road Project Regional Study Area, 2005–2012

6 Small Mammals

Several small mammals are expected to occur within the study area, including lemmings, voles, ground squirrels, and shrews. These small herbivores influence the trophic dynamics of the Arctic ecosystem. Lemmings and voles, in particular, undergo synchronous population fluctuations (Krebs et al. 2002) and form the basis for much of the terrestrial trophic dynamics in the Canadian Arctic (Krebs et al. 2003). Such population cycles may peak every three to four years, and may be influenced by weather patterns (Leslie 1959), predation (Myrbeget 1973; Ydenberg 1987), and/or dispersal events of juveniles. Carnivores such as weasels, foxes, wolves, wolverines, grizzly bears, and raptors depend on small mammals as prey species throughout the year. Inuit who trap benefit directly from the "run" of Arctic foxes that follows each lemming peak. Local Inuit consumed some small mammals (notably Arctic ground squirrel and Arctic hare; Priest and Usher 2004).

> *C35 "Lots of rabbits at Grays Bay. Watch out for rabbit dens, mostly on islands. (She mapped an area with lots of rabbits on the mainland west of Grays Bay)"* (NTKP 2018).

> *"The islands nearby were known to be good places to hunt Arctic hares" [Period II (1920-1955) in the Bathurst Inlet – Old Area]* (NTKP 2018).

Baseline studies have not focused on small mammals; however, small mammal trapping studies were completed in 2004 and 2006 during the High Lake project submission provided information for the northern RSA. Small mammal live-trapping surveys were completed during the summer of 2004 to document presence and relative abundance of small mammals among representative habitat types between the High Lake and Ulu areas. Additionally, small mammals were collected from six locations in July 2006 for baseline contaminants measures. Capture sites were near the proposed Grays Bay port site, at High Lake, and at reference sites between High Lake and Grays Bay.

Results from the 2004 live-trapping and 2006 baseline contaminants studies confirm the presence of northern red-backed vole, meadow vole, and masked shrew. Lemmings were not detected. Arctic hare and Arctic ground squirrels were commonly observed within the vicinity of the Project and their remains were regularly seen near or within old fox and wolf den sites, and raptor nest sites. During borrow pit surveys completed in 2012, signs and sightings of Arctic ground squirrel were frequent on eskers and glacio-fluvial deposits, often near or within old fox dens.

Lemming species that may be present in the study area include the collared lemming and brown lemming. Both species have multiple litters each year and are found in rocky, dry areas of the tundra where they feed on shoots of grasses and shrubs. Voles are commonly found in moist tundra habitats. In addition to northern red-backed vole and meadow vole, the tundra vole may inhabit the Project area. Meadow voles are the most common voles in boreal regions of Canada and were unexpectedly found in the High Lake area. Only the barren ground shrew is widely known to occur north of treeline; however, the Arctic shrew is also known to inhabit some tundra regions in the central Canadian Arctic. Other shrews, including the masked shrew and tundra shrew, are more commonly found below treeline, but may also occur in the Project area. Most shrews are found in low, wet, sedge-grass meadows and thickets of dwarf willow and birch.

The Arctic ground squirrel is found throughout the mainland Arctic. They hibernate in burrows dug in sandy ground, commencing dormancy in September or early October. Arctic ground squirrels were observed throughout the Project area. Raptors (particularly golden eagle [*kopanuakpak*; *Aquila chrysaetos*] and gyrfalcon [*kiligavikpak*; *Falco rusticolus*]) prey on Arctic ground squirrels, as the squirrels emerge from hibernation in April or early May and as juveniles emerge in early summer (Poole and Bromley 1988). Arctic hare, while not usually considered among small mammals, are ubiquitous throughout the RSA. Arctic hare are an especially important prey item for foxes, wolves, golden eagles, and gyrfalcons.

7 Eskers

Eskers are prominent terrestrial features and provide important wildlife habitat for many reasons. Barren-ground caribou use eskers for travel and relief from insects, and for feeding on south-facing slopes in the spring before green-up occurs in other areas (Banci and Spicker 2024). Grizzly bears, wolves, and foxes use eskers and other glacio-fluvial deposits for den sites, often located on well-drained sites with surrounding root mats helping to form a cohesive substrate (Heard and Williams 1992; Mueller 1995; Cluff et al. 2002; McLoughlin et al. 2002c; McLoughlin et al. 2004). Inuit have long recognized eskers as key habitat for multiple plant and wildlife species, noting the particular importance of south-facing slopes (De Beers Canada Inc. 2013, Thorpe Consulting Services Ltd. 2014a), and their value as a vantage point for hunting. Habitats with an abundance of ice-rich permafrost are generally unsuitable for den construction. Ground squirrels, an important prey for many carnivorous mammals and birds, establish their burrows in eskers.

The WKRLUP (Nunavut Planning Commission 2004) has mapped eskers throughout the region. Although eskers are found throughout the Project area, most eskers are located north of Contwoyto Lake and just outside of the RSA, near the James and Hood rivers and the Izok area. Den sites of wolves, foxes, and to a lesser extent, grizzly bears occur in esker formations and other glacio-fluvial deposits within the RSA (see above relevant species sections for further details).

> *C31 "Different kinds of animals like muskox and caribou are usually at eskers (in spring and winter). They can be seen on the eskers because it's easier for them to graze where there is less snow"* (Banci and Spicker 2024).

> *C51 "It's a lot cooler than the soil or moss so some of them lie there for most of the day when the days are long and hot, on the lee side of the eskers near the bottom. Most of these eskers have permafrost under them so they are a lot cooler than straight moss or soil. The ground is a lot cooler at the bottom of these eskers and the water is a lot colder too. At the bottom of these eskers are ponds formed from the esker springs"* (Banci and Spicker 2024).

> *C51 "Long ago the people walked using those eskers. The grizzly bears, foxes and wolves use those sites for their dens"* (NTKP 2018).

> *C22 "The eskers are the only areas we used to use for trapping, because they have wolf dens. In the spring, the wolves have dens. Long ago when the wolves had a bounty in the spring. We would look for wolf dens in the eskers when there was still snow, while we were traveling. The young wolves had a bounty on them. I don't know for how many years the wolves had a bounty on their heads. We shot even the really ugly ones in the spring. Those were the only areas where Inuit hunted wolves in the spring, at the eskers. The wolves denned at these sites… at Kingalhoak (Nose Lake)"* (NTKP 2018).

> *C51 "These are the areas at the eskers where we collected heather plants for the winter. Once in a while for some reason the old folks burn heather for a couple of hours or so to get a change of smell in their tent. They did that in their igloo too"* (NTKP 2018).

C18 “Inuit Used the area below the eskers for campsites so that they could use the high points of the eskers for lookouts” (Banci and Spicker 2024).

C203 “ The caribou go along the tops of the eskers because it’s just like a road, it's exactly like a road and it's really nice on top cause you get a breeze. So it keeps the flies down a bit more” (Banci and Spicker 2024).

C25“…The caribou and muskox use the eskers sometimes. The caribou sometimes travel using the eskers…The wolves and fixes den at these eskers so the caribou make a wide circle around these dens…” (NTKP 2018).

8 References

8.1 Literature Cited

Abrahamson, G., Gillespie, P.J., McIntosh, D.J., Usher, P.J., and Williamson, H.A. 1964. The Copper Eskimos, an Area Economic Survey, 1963. Department of Northern Affairs and National Resources, Industrial Division, Ottawa.

Abrams, M., Tsu, H., Hulley, G., Iwao, K., Pieri, D., Cudahy, T., and Kargel, J. 2015. The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) after fifteen years: Review of global products. International Journal of Applied Earth Observation and Geoinformation 38:292–301. Elsevier BV. DOI: 10.1016/j.jag.2015.01.013.

Adamczewski, J., Boulanger, J., Croft, B., Cluff, H.D., Elkin, B., Nishi, J., Kelly, A., and Nicholson, C. 2009. Decline in the Bathurst Caribou Herd 2006–2009: A technical evaluation of field data and modeling. DRAFT Technical Report. Government of Northwest Territories, Department of Resources, Wildlife and Economic Development. 105 pp.

Adamczewski, J., Boulanger, J., Croft, B., Davison, T., Sayine-Crawford, H., and Tracz, B. 2017. A Comparison of Calving and Post-calving Photo-surveys of the Bluenose-East Herd of Barrenground Caribou in Northern Canada in 2010. Canadian Wildlife Biology and Management 6(1):4–30.

Adamczewski, J., Boulanger, J., Croft, B., Elkin, B., and Cluff, H.D. 2016. Overview: Monitoring of Bathurst and Bluenose-East Caribou Herds, October 2014. Manuscript Report 263. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NWT. 76 pp.

Adamczewski, J., Boulanger, J., Sayine-Crawford, H., Nishi, J., Cluff, D., Williams, J., and LeClerc, L.-M. 2019. Estimates of Breeding Females & Adult Herd Size and Analyses of Demographics for the Bathurst Herd of Barren-Ground Caribou: 2018 Calving Ground Photographic Survey. Manuscript Report 279. Government of Northwest Territories, Environment and Natural Resources. 126 pp.

Adamczewski, J., Boulanger, J., Williams, J., Cluff, D., and Clark, K. 2023. June 2022 Calving Ground Surveys: Bathurst and Bluenose-East Barren-ground Caribou Herds. Manuscript No. 308. Government of Northwest Territories. 113 pp.

Adamczewski, J., Boulanger, J., Williams, J., Cluff, D., Clark, K., Nishi, J., Goodman, S., Chan, K., and Abernethy, R. 2022. Estimates of breeding females & adult herd size and analyses of demographics for the Bathurst herd of barren-ground caribou: 2021 calving ground photographic survey. 326.

Adamczewski, J., Gunn, A., Poole, K.G., Hall, A., Nishi, J., and Boulanger, J. 2015. What Happened to the Beverly Caribou Herd after 1994? ARCTIC 68(4):407–421. DOI: 10.14430/arctic4523.

Advisory Committee for Cooperation on Wildlife Management. 2011. Taking Care of Caribou: The Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds management plan. Advisory Committee for Cooperation on Wildlife Management, Yellowknife, NWT. 29 pp.

Advisory Committee for Cooperation on Wildlife Management. 2021. Taking Care of Caribou: the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds management plan. Yellowknife, NT. Yellowknife, NT. (https://static1.squarespace.com/static/5d24b5101204ac00011a8705/t/6604440c0c01923bbe9ca2b6/1711555603510/Taking+Care+of+Caribou+Management+Plan+2021.pdf).

Advisory Committee for Cooperation on Wildlife Management. 2024. Action Plan for the Bluenose-East Caribou Herd 2024/2025. Yellowknife, NT. 33 pp. (https://static1.squarespace.com/static/5d24b5101204ac00011a8705/t/65e8f0c1edabe20a4104762c/1709764803386/BNE+Action+Plan+2024.1+FINAL.pdf).

Aguilar, X.F., Leclerc, L.-M., Mavrot, F., Roberto-Charron, A., Tomaselli, M., Mastromonaco, G., Gunn, A., Pruvot, M., Rothenburger, J.L., Thanthrige-Don, N., Jahromi, E.Z., and Kutz, S. 2023. An integrative and multi-indicator approach for wildlife health applied to an endangered caribou herd. Scientific Reports 13(1):16524. Nature Publishing Group. DOI: 10.1038/s41598-023-41689-y.

Angerbjörn, A., Tannerfeldt, M., and Hersteinsson, P. 2008. The IUCN Red List of Threatened Species: *Alopex lagopus* (Arctic Fox). (www.iucnredlist.org). Accessed March 11, 2013.

Awan, M. 2020. Wolverine (*Gulo gulo*) Harvest Monitoring in Nunavut: Summary Report. Department of Environment, Government of Nunavut, Igloolik, Nunavut.

Awan, M. 2021. Grizzly Bear (*Ursus arctos*) Harvest Monitoring in Nunavut. Department of Environment, Nunavut.

Awan, M. 2025. Wolverine (*Gulo gulo*) Harvest Monitoring in Nunavut. Summary report. Nunavut Department of Environment.

Awan, M., Boulanger, J., Efford, M., and Poole, K.G. 2025. Grizzly bear DNA mark–recapture sampling in the western Kitikmeot region of Nunavut, 2022–2023. Government of Nunavut, Department of Environment, Igloolik, Nunavut.

Awan, M., Efford, M., and Boulanger, J. 2020. Estimates of wolverine density from mark-recapture DNA sampling. Napaktulik Lake, Kitikmeot Region, Nunavut 2018-2019. Final report. Government of Nunavut. 51 pp.

Awan, M., Efford, M., and Boulanger, J. 2023a. Grizzly bear DNA mark-–recapture sampling in the Western Kitikmeot Region of Nunavut, 2021. Department of Environment, Government of Nunavut. (https://www.nwmb.com/en/funding/nunavut-wildlife-research-trust/reports/2022-2/9916-grizzly-bear-dna-mark-recapture-sampling-in-the-kitikmeot-region-of-nunavut/file).

Awan, M., Poole, K.G., Boulanger, J., and Wierzchowski, J. 2023b. Spatial and Temporal Patterns of Wolf Harvest in Relation to Cairbou Herd Movements in Nunavut. Department of Environment, Government of Nunavut, Nunavut.

Ballard, W.B., Ayres, L.A., Krausman, P.R., Reed, D.J., and Fancy, S.G. 1997. Ecology of wolves in relation to a migratory caribou herd in Northwest Alaska. Wildlife Monographs (135):3–47.

Banci, V. 1987. Ecology and Behaviour of Wolverine in Yukon. M.Sc. Thesis. Simon Fraser University, Burnaby, British Columbia. 178 pp.

Banci, V. and Spicker, R. 2024. Kitikmiut Knowledge of the Proposed Kogloktoakyok (Grays Bay) Port and Road Project. Naonaiyaotit Inuit Knowledge Project (NTKP). Kitikmeot Inuit Association, Lands & Environment Department. West Kitikmeot Resources Corp., Kugluktuk, Nunavut. 150 pp.

Banfield, A.W.F. 1950. The Barren Ground Caribou. Report. Canadian Wildlife Service, Edmonton, Alberta.

Banfield, A.W.F. 1974. The mammals of Canada. University of Toronto Press for the National Museum of Natural Sciences, Toronto, Ontario, Canada. 438 pp.

Barr, W. 1991. Back from the brink: the road to muskox conservation in the Northwest Territories. Arctic Institute of North America, University of Calgary, Calgary, Alberta. 127 pp.

Barrier, T.A. 2011. Factors influencing the distribution of Bathurst barren-ground caribou (*Rangifertarandus groenlandicus*) during winter. Master of Science. University of Northern British Columbia. DOI: 10.24124/2011/bpgub794. (http://unbc.arcabc.ca/islandora/object/unbc%3A16160).

Barrueto, M., Jessen, T.D., Diepstraten, R., and Musiani, M. 2023. Density and genetic diversity of grizzly bears at the northern edge of their distribution. Ecosphere 14(6):e4523. DOI: 10.1002/ecs2.4523.

Bathurst Caribou Advisory Committee. 2021. Bathurst Caribou Management Plan. 66 pp. (https://www.gov.nt.ca/ecc/sites/ecc/files/resources/bathurst_caribou_management_plan_aug_2021_1.pdf).

Bathurst Caribou Advisory Committee. 2024. Annual Review of the Bathurst Caribou Herd – 2024 Action Plan. Bathurst Caribou Advisory Committee, Yellowknife, NT. 50 pp.

Bathurst Caribou Management Planning Committee. 2004. A management plan for the Bathurst caribou herd. Bathurst Caribou Management Planning Committee.

Bergerud, A.T., Luttich, S.N., and Camps, L. 2008. The Return of Caribou to Ungava. McGill-Queen’s University Press, Montreal, Quebec. 586 pp.

Beverly & Qamanirjuaq Caribou Management Board. 2025. Beverly Herd Population Increasing. (https://arctic-caribou.com/beverly-herd-population-increasing/). Accessed September 23, 2025.

BHP Billiton. 2006. EKATI Diamond Mine 2005 Wildlife Effects Monitoring Program. Prepared for BHP Billiton Diamonds Inc. by Rescan TM Environmental Services Ltd.

Bluenose East Ɂekwę́ Hearing. 2016. Final Bluenose East Ɂekwę́ (Caribou) Hearing Decision: Sahtú Renewable Resources Board reaffirms support for community conservation approach. (https://srrb.nt.ca/document-repository/public/public-hearings-registry/srrb-hearing-rules-and-guiding-documents/2016/bluenose-east-caribou-final-march-2016/supporting-documents/press-releases/1598-16-10-31-press-release-srrb-final-decisions/file#:~:text=The%20SRRB's%20hearing%20report%2C%20Ɂekwę́,not%20considered%20by%20the%20Board).

Boertje, R.D. 1984. Seasonal diets of the Denali caribou herd, Alaska. Arctic :161–165.

Boulanger, J. 2013a. An analysis of the 2012 Izok grizzly bear DNA mark-recapture data set DRAFT. Prepared by Integrated Ecological Research, Nelson, BC, for MMG's Izok Corridor Project. 10 pp.

Boulanger, J. 2013b. An analysis of the High Lake and Izok wolverine DNA mark-recapture data sets. DRAFT. Prepared by Integrated Ecological Research for MMG's Izok Corridor Project. 17 pp.

Boulanger, J., Adamczewski, J., Nishi, J., Cluff, D., Williams, J., Sayine-Crawford, H., and LeClerc, L.M. 2019. Estimates of Breeding Females & Adult Herd Size and Analyses of Demographics for the Bluenose-East Herd of Barren-Ground Caribou: 2018 Calving Ground Photographic Survey. Manuscript Report 278. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NWT. 98 pp.

Boulanger, J., Adamczewski, J., Williams, J., Clark, K., and Abernethy, R. 2024. June 2023 Calving Ground Surveys: Bluenose-East and Bathurst Barren-ground Caribou Herds. No. 319. Government of Northwest Territories. 171 pp.

Boulanger, J., Adamczewski, J., Williams, J., Cluff, D., Clark, K., Goodman, S., Chan, K., and Abernethy, R. 2022. Estimates of Breeding Females & Adult Herd Size and Analyses of Demographics for the Bluenose-East Herd of Barren-Ground Caribou: 2021 Calving Ground Photographic Survey. Manuscript Report 325. Government of Northwest Territories.

Boulanger, J., Croft, B., and Adamczewski, J. 2014a. An estimate of breeding females and analyses of demographic indicators from the Bathurst herd 2012 calving ground photographic survey. Environment and Natural Resources, Government of Northwest Territories.

Boulanger, J., Croft, B., and Adamczewski, J. 2014b. An Estimate of Breeding Females and Analyses of Demographics for the Bluenose-East Herd of Barren-ground Caribou: 2013 Calving Ground Photographic Survey. File Report 143. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NWT. 79 pp.

Boulanger, J., Croft, B., Adamczewski, J., Cluff, D., Campbell, M., Lee, D., and Larter, N. 2017. An Estimate of Breeding Females and Analyses of Demographics for the Bathurst Herd of Barren-Ground Caribou: 2015 Calving Ground Photographic Survey. Manuscript Report 267. Government of Northwest Territories, Environment and Natural Resources. 102 pp.

Boulanger, J., Croft, B., Adamczewski, J., Lee, D., Larter, N., and LeClerc, L.M. 2016a. An Estimate of Breeding Females and Analyses of Demographics for the Bluenose-East Herd of Barren-Ground Caribou: 2015 Calving Ground Photographic Survey. Manuscript Report 260. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NWT. 83 pp.

Boulanger, J, Croft, H.D., and Cluff, D. 2016b. Summary of the 2016 Bathurst caribou herd reconnaissance survey. Unpublished report. Integrated Ecological Research, Nelson, BC.

Boulanger, J., Gunn, A., Adamczewski, J., and Croft, B. 2011. A data-driven demographic model to explore the decline of the Bathurst caribou herd. The Journal of Wildlife Management 75(4):883–896. DOI: 10.1002/jwmg.108.

Boulanger, J. and Mulders, R. 2008. Analysis of the 2005 and 2006 wolverine DNA mark-recapture sampling at Daring Lake, Ekati, Diavik and Kennady Lake, Northwest Territories. Unpublished Report. Integrated Ecological Research, Nelson, British Columbia. 30 pp.

Boulanger, J. and Mulders, R. 2013. Analysis of wolverine DNA mark-recapture sampling at Daring Lake from 2004 to 2011. Environment and Natural Resources, Government of Northwest Territories.

Boulanger, J., Poole, K.G., Gunn, A., and Wierzchowski, J. 2012. Estimating the zone of influence of industrial developments on wildlife: a migratory caribou *Rangifer tarandus groenlandicus* and diamond mine case study. Wildlife Biology 18(2):164–179. DOI: 10.2981/11-045.

Bowler, E., Byrne, J., Leclerc, L.-M., Roberto-Charron, A., Rogers, M.S.J., Cavanagh, R.D., Harasimo, J., Lancaster, M.L., Chan, R.S.Y., Strickson, O., Wilkinson, J., Downie, R., Hosking, J.S., and Andersson, T.R. 2025. AI sea ice forecasts for Arctic conservation: A case study predicting the timing of caribou sea ice migrations. Ecological Solutions and Evidence 6(2):e70034. DOI:10.1002/2688-8319.70034.

Bowyer, R.T., Van Ballenberghe, V., and Kie, J.G. 2003. Moose. pp. 931–964. Wild mammals of NorthAmerican: biology, management, and conservation. The John Hopkins University Press, Baltimore, Maryland.

Bromley, M. and Buckland, L. 1995. Biological information for the Slave Geological Province. ManuscriptReport 83. Government of Northwest Territories Department of Renewable Resources, Yellowknife, NWT.

Brooks, M., Kristensen, K., van Benthem, K., Magnusson, A., Berg, C., Nielsen, A., Skaug, H., Maechler, M., and Bolker, B. 2017. glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modeling. The R Journal 9(2):378–400.

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D., and Thomas, L. 2001. Introduction to Distance Sampling: Estimating Abundance of Biological Populations. Oxford University Press, Oxford, England.

Burnham, K.P. and Anderson, D.R. 2002. Model selection and multimodel inference: a practical information-theoretic approach, 2nd Edition. Springer, New York. 488 pp.

Cameron, R.D., Whitten, K.R., and Smith, W.T. 1986. Summer range fidelity of radio-collared caribou in Alaska's Central Arctic herd. Rangifer 6(2):51–55.

Campbell, M. 2021. An Aerial Abundance Estimate of the Dolphin and Union Caribou (*Rangifer tarandus groenlandicus x pearyi*) Herd, Kitikmeot Region, Nunavut – Fall 2020.

Campbell, M., Boulanger, J., Lee, D.S., Dumond, M., and McPherson, J. 2012. Calving Ground Abundance Estimates of the Beverly and Ahiak Subpopulations of Barren-Ground Caribou (*Rangifer tarandus groenlandicus*). Government of Nunavut, Department of Environment. 119 pp.

Campbell, M., Boulanger, J., Ringrose, J., Danahy, J., Kite, R., and Roberto-Charron, A. 2025. Abundance and Trends of the Beverly Mainland Migratory Subpopulation of Barren-Ground Caribou (*Rangifer tarandus groenlandicus*) June 2011 - June 2023. Technical Report Series. 01–2025. Government of Nunavut.

Campbell, M., Lee, D.S., and Boulanger, J. 2019. Abundance Trends of the Beverly Mainland Migratory Subpopulation of Barren-Ground Caribou (*Rangifer tarandus groenlandicus*): June 2011 - June2018. Government of Nunavut, Department of Environment, Technical Report Series - No.01-2018.

Canadian Endangered Species Conservation Council. 2022. Wild Species 2020: The General Status of Species in Canada. Canadian Endangered Species Conservation Council National General Status Working Group. 172 pp. (www.wildspecies.ca).

Carmichael, L.E. 2007. Genetics of Northern Wolf Populations. Final Wildlife Report, No. 21. Department of Biological Sciences, University of Alberta, Edmonton, AB.

Carmichael, L.E., Nagy, J.A., Larter, N.C., and Strobeck, C. 2001. Prey specialization may influence patterns of gene flow in wolves of the Canadian Northwest. Molecular Ecology 10:2787–2798.

Carrière, S. 2012. Resident hunter surveys 1997–2009: Update and review. Manuscript Report 218. Government of Northwest Territories Department of Environment and Natural Resources. 58 pp.

Carruthers, D.R., Ferguson, S.H., Jakimchuk, R.D., and Sopuck, L.G. 1986. Distribution and habitat use of the Bluenose caribou herd in mid-winter. Rangifer, Special Issue No. 1 :57–63.

Case, R., Buckland, L., and Williams, M. 1996. The status and management of the Bathurst caribou herd, Northwest Territories, Canada. 116. Government of Northwest Territories Department of Renewable Resources, Yellowknife, NWT. 34 pp.

Case, R.L. and Buckland, L. 1998. Reproductive Characteristics of Grizzly Bears in the Kugluktuk Area, Northwest Territories, Canada. Ursus 10:41–47. International Association for Bear Research and Management.

Caslys Consulting Ltd. 2016. Barren-Ground Caribou Analysis Methods Summary Report Draft. Government of Nunavut Department of Environment, Wildlife Research Branch. 18 pp.

Chappell, D.E., Van Den Bussche, R.A., Krizan, J., and Patterson, B. 2004. Contrasting levels of genetic differentiation among populations of wolverines (Gulo gulo) from northern Canada revealed by nuclear and mitochondrial loci. Conservation Genetics 5:759–767.

Clark, D.A. and Slocombe, S. 2011a. Grizzly bear conservation in the Foothills Model Forest: appraisal of a collaborative ecosystem management effort. Policy Sciences 44:1–11.

Clark, D.A. and Slocombe, S. 2011b. Adaptive co-management and grizzly bear human conflicts in two northern Canadian Aboriginal communities. Human Ecology 39:627–640.

Clarke, H. 2012. Knowledge-based habitat suitability modeling guidelines. Yukon Fish and Wildlife Branch Report TR-12-18. Yukon Environment, Fish and Wildlife Branch, Whitehorse, Yukon, Canada. 15pp. (https://open.yukon.ca/sites/default/files/knowledge_based_habitat_suitability_modeling_guidelines_0.pdf).

Cluff, H.D. 2005. Survey of moose abundance in the boreal forest around Yellowknife, Northwest Territories. Final Report to the West Kitikmeot / Slave Study Society. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT.

Cluff, H.D., Walton, L.R., and Pacquet, P.C. 2002. Movements and habitat use of wolves denning in the central Arctic, Northwest Territories and Nunavut, Canada. Final report to the West Kitikmeot/Slave Study Society. Yellowknife, NT Canada.

Conference of Management Authorities. 2023. Progress Report on the Management of Dolphin and Union Caribou (*Rangifer tarandus groenlandicus x pearyi*) in the Northwest Territories and Nunavut (2018–2022). Conference of Management Authorities, Yellowknife, NT. Conference of Management Authorities, Yellowknife, Northwest Territories. 58 pp.

COSEWIC. 2011. Canadian wildlife species at risk. (http://www.cosewic.gc.ca/eng/sct0/rpt/rpt_csar_e.cfm).

COSEWIC. 2012. COSEWIC assessment and status report on the Grizzly Bear *Ursus arctos* in Canada. Ottawa, ON. 84 pp.

COSEWIC. 2014. COSEWIC assessment and status report on the Wolverine *Gulo gulo* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 76 pp.

COSEWIC. 2015. COSEWIC Assessment and Status Report on the Peary Caribou *Rangifer tarandus pearyi* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xii + 92pp. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports.html).

COSEWIC. 2016. COSEWIC assessment and status report on the Caribou *Rangifer tarandus*, Barren-ground population, in Canada. COSEWIC, Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 123 pp. (http://publications.gc.ca/collections/collection_2017/eccc/CW69-14-746-2017-eng.pdf).

COSEWIC. 2017. COSEWIC assessment and status report on the Caribou, Dolphin and Union population, *Rangifer tarandus*, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 50 pp.

Croft, B. and Rabesca, J.P. 2009. Caribou harvest pilot project conducted in the Tli Cho communities in the winter of 2007/2008 and 2008/2009: Preliminary results. Government of the Northwest Territories, Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT. 14 pp.

Cypher, B.L. 2003. Foxes. pp. 511–546. In G.A. Feldhamer, B. Thompson, J. Chapman (eds.) Wildanimals of North America: biology, management and conservation. The John Hopkins University Press, Baltimore, Maryland.

Danks, F.S. and Klein, D.R. 2002. Using GIS to predict potential wildlife habitat: A case study of muskoxen in northern Alaska. International Journal of Remote Sensing 23(21):4611–4632. DOI: 10.1080/01431160110113890.

Davison, T. 2016. Technical Report on the Cape Bathurst, Bluenose-West, and Bluenose-East Barren-ground Caribou Herds. File Report 150. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NWT. 81 pp.

De Beer Canada Inc. 2013. Wildlife effects monitoring program v1. Golder Associates, Yellowknife, NWT. iii + 52 pp.

De Beers Canada Inc. 2013. Gahcho Kué Project: Wildlife effects monitoring program v1. Golder Associates, Yellowknife, NWT. iii + 52 pp.

de Coccola, R. and King. 1954. The Incredible Eskimo: Life Among the Barren Land Eskimo. Hancock House Publishers, Surrey, BC. 35 pp.

Demarais, S. and Krausman, P.R. 2000. Ecology and management of large mammals in North America. Prentice Hall, Upper Saddle River, NJ.

Denryter, K.A., Cook, R.C., Cook, J.G., and Parker, K.L. 2017. Straight from the caribou's (*Rangifer tarandus*) mouth: detailed observations of tame caribou reveal new insights into summer–autumn diets. Canadian Journal of Zoology 95(2):81–94. DOI: 10.1139/cjz-2016-0114

Diavik Diamond Mines Inc. 2003. 2002 wildlife effects monitoring report. Diavik Diamond Mines Inc., Yellowknife, NWT.

Diavik Diamond Mines Inc. 2006. A comparison of methods for monitoring abundance and distribution of wolverine at the Diavik diamond mine. Prepared by Golder Associates Ltd. for Diavik Diamond Mines Inc., Yellowknife, NWT.

Dumond, M. 2006. Review of muskox population status in the Kitikmeot region of Nunavut. InterimWildlife Report. 6. Government of Nunavut Department of Environment. 29 pp.

Dumond, M. 2007a. Western Kitikmeot caribou workshop. Final Wildlife Report. 19. Government of Nunavut Department of Environment, Kugluktuk, Nunavut, Canada. 47 pp.

Dumond, M. 2007b. Muskoxen distribution and abundance in the area between Bathurst Inlet and the Coppermine River, Kitikmeot Region, Nunavut (MX19 and west of MX14). Status Report. 35. Government of Nunavut Department of Environment, Iqaluit, Nunavut. 27 pp.

Dumond, M., Boulanger, J., and Paektau, D. 2011. Grizzly bear remote monitoring in the absence of trees. Ottawa, Ontario. 2011 presentation.

Dumond, M., Boulanger, J., and Paetkau, D. 2015. The estimation of grizzly bear density through hair-snagging techniques above the tree line. Wildlife Society Bulletin 39(2):390–402. DOI:10.1002/wsb.520.

Dumond, M. and Lee, D.S. 2013. Dolphin and Union caribou herd status and trend. Arctic 66(3):329–337.

Dumond, M., Sather, S., and Harmer, R. 2013. Observation of Arctic island barren-ground caribou (*Rangifer tarandus groenlandicus*) migratory movement delay due to human induced sea-ice breaking. Rangifer 33(2):115–122. DOI: 10.7557/2.33.2.2533.

Dussault, C., Ouellet, J., Courtois, R., Huot, J., Breton, L., and Jolicoeur, H. 2005. Linking moose habitat selection to limiting factors. Ecography 28:619–628.

EBA Engineering Consultants Ltd. 2001. Tibbitt to Contwoyto winter road environmental setting report. Contwoyto Winter Road Joint Venture, Yellowknife, NWT.

Ecosystem Classification Group. 2008. Ecological regions of the Northwest Territories – Taiga Shield. Government of the Northwest Territories, Department of Environment and Natural Resources, Yellowknife, NWT. 146 pp.

Ecosystem Classification Group. 2009. Ecological regions of the Northwest Territories – Taiga Plains. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. viii + 173 pp.

Ecosystem Classification Group. 2012. Ecological Regions of the Northwest Territories – Southern Arctic. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. x + 170 pp.

Edwards, M.A., Derocher, A.E., Hobson, K.A., Branigan, M., and Nagy, J.A. 2011. Fast carnivores and slow herbivores: Differential foraging strategies among grizzly bears in the Canadian Arctic. Oecologia 165(4):877–889. DOI: 10.1007/s00442-010-1869-9.

Ehlers, L., Palm, E., Herriges, J., Bentzen, T., Suitor, M., Joly, K., Millspaugh, J., Donnelly, P., Gross, J., Wells, J., Larue, B., and Hebblewhite, M. 2024. A taste of space: Remote animal observations and discrete-choice models provide new insights into foraging and density dynamics for a large subarctic herbivore. Journal of Animal Ecology 93(7):891–905. DOI: 10.1111/1365-2656.14109.

ERM Consultants Canada Ltd. 2016. Ekati Diamond Mine: 2015 Wildlife Effects Monitoring Program. Prepared for Dominion Diamond Ekati Corporation by ERM Consultants Canada Ltd., Yellowknife, NWT.

ERM Consultants Canada Ltd. 2025. Review of the Management and Monitoring of Kokeeti Ekwo (Bathurst Caribou) Report - Prepared for Wek eezhii Renewable Resources Board. (https://wrrb.ca/sites/default/files/WRRB%20Bathurst%20Caribou%20Review_final%20report_Jan28.pdf).

ERM Consultants Canada Ltd. 2025. Etaki Diamond Mine: 2024 Wildlife Effects Monitoring Program. Prepared for Dominion Diamond Ekati Corporation by ERM Consultants Canada Ltd., Yellowknife, NWT.

ESRI. 2025. ArcGIS Pro. Environmental Systems Research Institute, Redlands, California.

Evans, J.S. and Murphy, M.A. 2023. spatialEco. (https://github.com/jeffreyevans/spatialEco).

Fennell, M., Beirne, C., and Burton, A.C. 2022. Use of object detection in camera trap image identification: Assessing a method to rapidly and accurately classify human and animal detections for research and application in recreation ecology. Global Ecology and Conservation 35:e02104. DOI: 10.1016/j.gecco.2022.e02104.

Ferguson, R.S. 1991. Detection and classification of muskox habitat on Banks Island, Northwest Territories, Canada, using Landsat Thematic Mapper data. Arctic 44(1):66–74.

Fieberg, J., Signer, J., Smith, B., and Avgar, T. 2021. A 'How to' guide for interpreting parameters in habitat-selection analyses. Journal of Animal Ecology 90(5):1027–1043. DOI: 10.1111/1365-2656.13441.

Fleck, S. and Gunn, A. 1982. Characteristics of three barren-ground caribou calving grounds in the Northwest Territories. N.W.T. Wildlife Service, Yellowknife, Northwest Territories Canada. 158 pp.

Folstad, I., Nilssen, A.C., Halvorsen, O., and Andersen, J. 1991. Parasite avoidance: the cause of post-calving migrations in *Rangifer*? Canadian Journal of Zoology 69:2423–2429.

Fournier, B. and Gunn, A. 1998. Muskox numbers and distribution in the Northwest Territories, 1997. File Report. 121. Government of the Northwest Territories, Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT.

Frame, P.F., Cluff, H.D., and Hik, D.S. 2008. Wolf reproduction in response to caribou migration and industrial development on the central barrens of mainland Canada. Arctic 61(2):134–142.

Frame, P.F., Hik, D.S., Cluff, D., and Paquet, P.C. 2004. Long foraging movement of a denning tundra wolf. Arctic 57(2):196–203.

Freeman, M.M.R. 1976. Inuit Land Use and Occupancy Project, of 3. Department of Indian and Northern Affairs, Ottawa, Ontario. 287 pp.

Garrott, R.A. and Eberhardt, L.E. 1987. Chapter 31: Arctic fox. pp. 395–406. In M. Novak, J.A. Baker, M.E. Obbard, B. Malloch (eds.) Wild Furbearer Management and Conservation in North America. Ontario Ministry of Natural Resources, Toronto, Ontario, Canada.

Gau, R.J., Case, R., Penner, D.F., and McLoughlin, P.D. 2002. Feeding Patterns of Barren-ground Grizzly Bears in the Central Canadian Arctic. Arctic 55(4):339–344.

GBEEC. 2018a. Grays Bay Road and Port Project Inuit Knowledge Workshop #1: March 2018. Report on file.

GBEEC. 2018b. Grays Bay Road and Port Project Inuit Advisory Group Workshop #2: October 2018. Report on file

Gillies, C.S., Hebblewhite, M., Nielsen, S.E., Krawchuk, M.A., Aldridge, C.L., Frair, J.L., Saher, D.J., Stevens, C.E., and Jerde, C.L. 2006. Application of random effects to the study of resource selection by animals. Journal of Animal Ecology 75(4):887–898. DOI: 10.1111/j.1365-2656.2006.01106.x.

GNWT. 2015. Dolphin and Union Caribou Core Seasonal Ranges. NWT Species and Habitat Viewer.

Golder Associates Ltd. 2003. Report on Inuit Qaujimajatuqangit literature review, gap analysis and workshop results related to the Doris North Project. Prepared for Miramar Mining Ltd.

Golder Associates Ltd. 2010. Effects of development on barren-ground caribou: Insight from Inuit Qaujimajatuqangit and an ecological model. 2010 presentation.

Gordon, B.C. 2005. 8000 years of caribou and human seasonal migration in the Canadian Barrenlands. Rangifer (Special Issue No. 16):155–162. DOI: 10.7557/2.25.4.1780.

Gould, W.A., Raynolds, M., and Walker, D.A. 2003. Vegetation, plant biomass, and net primary productivity patterns in the Canadian Arctic. Journal of Geophysical Research 108(D2). DOI: 10.1029/2001JD000948. (http://doi.wiley.com/10.1029/2001JD000948.

Government of Northwest Territories. 2020. Wolf (diga) management.

Government of British Columbia. 2021. Wildlife Habitat Mapping. (https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-habitats/wildlife-habitat-mapping).

Government of Canada. 2013. National Ecological Framework. (http://sis.agr.gc.ca/cansis/nsdb/ecostrat/index.html). Accessed January 29, 2013.

Government of Canada, P.W. and G.S.C. 2018. *Species at Risk Act*: Order amending Schedule 1: SOR/2018-112. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/orders/amend-schedule-1-volume-152-number-12-june-2018.html). Accessed June 13, 2024.

Government of Northwest Territories. 2006. Caribou Forever – Our Heritage, Our Responsibility: ABarren-ground Caribou Management Strategy for the Northwest Territories 2006 – 2010. (https://www.enr.gov.nt.ca/en/content/barren-ground-caribou-management-strategy-nwt-2006-2010).

Government of Northwest Territories. 2014. Overview: monitoring of Bathurst and Bluenose-East Caribou Herds, Sept. 2014. Department of Environment and Natural Resources, Yellowknife, NWT.

Government of Northwest Territories. 2019. Bathurst Caribou Range Plan. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NWT, Canada. 86 pp.

Government of Northwest Territories. 2024a. Species at Risk in the Northwest Territories, 2024. Environment and Climate Change, Government of the Northwest Territories, Yellowknife, NT.

Government of Northwest Territories. 2024b. Bathurst Caribou Herd Collar Data (1996 to 2024).

Government of Northwest Territories. 2024c. Beverly Caribou Herd Collar Data (2006 to 2024).

Government of Northwest Territories. 2025a. 2025 population survey results released for the Bathurst and Bluenose-East Barren-Ground Caribou herds. Government of the Northwest Territories. (https://www.gov.nt.ca/en/newsroom/2025-population-survey-results-released-bathurst-and-bluenose-east-barren-ground-caribou). Accessed November 17, 2025.

Government of Northwest Territories. 2025b. Bluenose-East Caribou Herd Collar Data (1996 to 2025).

Government of Nunavut. 2000. Muskox. Wildlife Fact Sheets.

Government of Nunavut. 2017. Bathurst Caribou Herd Total Allowable Harvest Order, Nu Reg 017-2017. CanLII. (https://www.canlii.org/en/nu/laws/regu/nu-reg-017-2017/latest/nu-reg-017-2017.html).

Government of Nunavut. 2020. Interim Total Allowable Harvest Limit Set for Dolphin and Union Caribou Herd.

Government of Nunavut. 2021a. Dolphin and Union Caribou Herd Total Allowable Harvest Order, R0052021.

Government of Nunavut. 2021b. Dolphin and Union Caribou: 2021 Collaring, Kugluktuk – April 14-26 Field Report. Department of Environment, Kugluktuk, Nunavut. 16 pp.

Government of Nunavut. 2024a. Dolphin and Union Caribou Harvest Data (2017 to 2023).

Government of Nunavut. 2024b. Summary of the Nunavut Hunting Regulations 2024|2025. 15 pp. (https://www.gov.nu.ca/sites/default/files/documents/2024-12/Nunavut_Hunting_Regulations_Guide_2024-25.pdf).

Government of Nunavut. 2025. Beverly and Ahiak Caribou Herds Collar Data (2008 to 2024).

Government of Nunavut. No date. Brucellosis - What you should know. Department of Environment.

Government of Nunavut and Government of Northwest Territories. 2018. Management plan for the Dolphin and Union Caribou (*Rangifer tarandus groenlandicus x pearyi*) in the Northwest Territories and Nunavut 2018. 107 pp. (http://publications.gc.ca/collections/collection_2018/eccc/En3-5-95-2018-eng.pdf).

Graf, R.P. 1992. Status and management of moose in the Northwest Territories, Canada. Alces Supplement 1:22–28.

Griffith, B., Gunn, A., Russell, D., Johnstone, J., Kielland, K., Wolfe, S., and Douglas, D.C. 2001. Bathurst caribou calving ground studies: Influence of nutrition and human activity on calving ground location. West Kitikmeot/Slave Study Society, Yellowknife, NWT. 118 pp.

Gunn, A. 1990. Distribution and abundance of muskoxen between Bathurst Inlet and Contwoyto Lake, NWT, 1986. File Report. 100. Government of Northwest Territories Department of Renewable Resources, Coppermite, NWT.

Gunn, A. 1991. Denning surveys for barren-ground grizzly bears, Coppermine, October 1984 and implications for a commercial quota on the Coronation Gulf mainland. Manuscript Report 46. Government of Northwest Territories Department of Resources. 29 pp.

Gunn, A. 2003. Voles, lemmings and caribou - population cycles revisited? Rangifer 23(5):105. DOI: 10.7557/2.23.5.1689.

Gunn, A., Adamczewski, J., and Nishi, J. 2008a. A review of concerns expressed by outfitters between 2003 and 2007 about the Bathurst and Ahiak herds. Manuscript Report 178. Government of Northwest Territories Department of Environment and Natural Resources, Yellowknife, NWT. 181 pp.

Gunn, A. and Adamczewski, J.Z. 2003. Muskox. pp. 1076–1091. In G.A. Feldhamer, B. Thompson, J. Chapman (eds.) Wild animals of North America: biology, management and conservation, 2ndEdition. The John Hopkins University Press, Baltimore, Maryland, USA.

Gunn, A., Buchan, A., Fournier, B.J., and Nishi, J. 1997. Victoria Island caribou migrations across Dolphin and Union Strait and Coronation Gulf from the Mainland Coast, 1976–94. Manuscript Report 94. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT. 74 pp.

Gunn, A. and Case, R. 1984. Numbers and Distribution of Muskoxen in the Queen Maud Gulf Area, July, 1982. File Report No. 39. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT.

Gunn, A. and D’Hont, A. 2002. Extent of calving for the Bathurst and Ahiak herds, June 2002. Manuscript Report 149. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT. 35 pp.

Gunn, A., D'Hont, A., Williams, J., and Boulanger, J. 2013. Satellite collaring in the Bathurst Herd of barren-ground caribou, NWT 1996–2005. Manuscript Report 225. Government of Northwest Territories Department of Environment and Natural Resources, Yellowknife, NWT. 139 pp.

Gunn, A., Dragon, J., and Boulanger, J. 2001. Seasonal movements of satellite-collared caribou from the Bathurst Herd. West Kitikmeot/Slave Study Society, Yellowknife, NWT. 72 pp.

Gunn, A. and Fournier, B.J. 2000a. Calf survival and seasonal migrations of a mainland muskox population. File Report No. 124. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT.

Gunn, A. and Fournier, B.J. 2000b. Caribou herd delimitation and seasonal movements based on satellite telemetry on Victoria Island 1987–89. File Report No. 125. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT.

Gunn, A., Fournier, B.J., and Nishi, J. 2000. Abundance and distribution of the Queen Maud Gulf caribou herd, 1986–98. File Report No. 126. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT. 75 pp.

Gunn, A. and Irvine, R.J. 2003. Subclinical Parasitism and Ruminant Foraging Strategies: A Review. Wildlife Society Bulletin (1973-2006) 31(1):117–126.

Gunn, A. and Miller, F.L. 1986. Traditional behaviour and fidelity to caribou calving grounds by barren-ground caribou. Rangifer (Special Issue No. 1):151–158.

Gunn, A. and Nishi, J. 1998. Review of information for Dolphin and Union caribou herd, Victoria Island. Conservation Breeding Specialist Group (SSC/IUCN), Population and Habitat Viability Assessment Workshop for the Peary caribou (Rangifer tarandus pearyi): Briefing Book. CBSG, Apple Valley, Minnesota.

Gunn, A. and Poole, K.G. 2010. Environmental trends across the range of the Bathurst caribou herd and timing of the arrival of cows on their calving ground 1996–2009. Government of the Northwest Territories, Department of Environment and Natural Resources. 35 pp.

Gunn, A., Poole, K.G., and Nishi, J.S. 2012. A conceptual model for migratory tundra caribou to explain and predict why shifts in spatial fidelity of breeding cows to their calving grounds are infrequent. Rangifer (20):259–267. DOI: 10.7557/2.32.2.2274.

Gunn, A., Poole, K.G., and Wierzchowski, J. 2008b. A geostatistical analysis for the patterns of caribou occupancy on the Bathurst calving grounds 1966–2007. 54 pp.

Gunn, A., Poole, K.G., and Wierzchowski, J. 2008c. A geostatistical analysis for the patterns of caribou occupancy on the Bathurst calving grounds 1966–2007. 54 pp.

Gunn, A., Russell, D., and Eamer, J. 2011. Northern caribou population trends in Canada. Canadian Biodiversity: Ecosystem Status and Trends 2010, Technical Thematic Report No. 10. Canadian Biodiversity: Ecosystem Status and Trends 2010. Canadian Councils of Resource Ministers, Ottawa, Ontario. 71 pp.

Gunn, A. and Russell, D.E. 2008. Monitoring Rangifer Herds (Population Dynamics): MANUAL. Circumarctic Rangifer Monitoring and Assessment Network. 52 pp. (www.carmanetwork.com).

Gunn, A. and Sutherland, M. 1997. Muskox diet and sex-age composition in the Central Arctic coastal mainland (Queen Maud Gulf area) 1988-1991. Manuscript Report. 95. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT. 67 pp.

Gurarie, E., Hebblewhite, M., Joly, K., Kelly, A.P., Adamczewski, J., Davidson, S.C., Davison, T., Gunn, A., Suitor, M.J., Fagan, W.F., and Boelman, N. 2019. Tactical departures and strategic arrivals: Divergent effects of climate and weather on caribou spring migrations. Ecosphere 10(12). DOI: 10.1002/ecs2.2971. (https://onlinelibrary.wiley.com/doi/abs/10.1002/ecs2.2971).

Handley, J. 2010. Diamond mine wildlife monitoring workshop report. Yellowknife, NWT.

Hayes, R.D. and Gunson, J.R. 1995. Status and management of wolves in Canada. pp. 21–33. In L.N. Carbyn, S.H. Fritts, D.R. Seip (eds.) Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, Occassional Publication No. 35.

Heard, D.C. and Williams, T.M. 1991. Caribou project summary and review part 2: Population dynamics. Unpublished Report. Government of Northwest Territories Department of Environment and Natural Resources, Yellowknife, NWT. 45 pp.

Heard, D.C. and Williams, T.M. 1992. Distribution of wolf dens on migratory caribou ranges in the Northwest Territories. Canadian Journal of Zoology 70(8):1504–1510.

Heard, D.C., Williams, T.M., and Melton, D.A. 1996. The relationship between food intake and predation risk in migratory caribou and implications to caribou and wolf population dynamics. Rangifer 16(4):37. DOI: 10.7557/2.16.4.1219.

Heard, D.C. and Zimmerman, K.L. 2021. Fall supplemental feeding increases population growth rate of an endangered caribou herd. PeerJ 9:e10708. DOI: 10.7717/peerj.10708.

Hijmans, R. 2023. terra: Spatial Data Analysis. (<https://CRAN.R-project.org/package=terra>).

Horne, J.S., Garton, E.O., Krone, S.M., and Lewis, J.S. 2007. Analyzing animal movements using Brownian bridges. Ecology 88(9):2354–2363. DOI: 10.1890/06-0957.1.

Hughes, J., Albon, S.D., Irvine, R.J., and Woodin, S. 2009. Is there a cost of parasites to caribou? Parasitology 136(2):253–265. DOI: 10.1017/S0031182008005246.

Hughes, J.R. 2006. The influence of forage and parasites on the migration of the Dolphin-Union caribou herd. PhD Thesis. University of Aberdeen.

Hundertmark, K.J. and Bowyer, R.T. 2004. Genetics, evolution, and phylogeography of moose. Alces 40:103–122.

IAG (Inuit Advisory Group). 2025a. Grays Bay Road and Port Project What We Heard Report: Inuit Advisory Group Workshop #1 Summary – Inuit Knowledge Integration Methods and Mitigation Strategies. March 2025. Report on file.

IAG (Inuit Advisory Group). 2025b. Grays Bay Road and Port Project What We Heard Report: Inuit Advisory Group Workshop #2 Summary – Understanding and Protecting Caribou. September 2025. Report on file.

Intergroup Consultants Ltd. 2008. Economic valuation and socio-cultural perspectives of the estimated harvest of the Beverly and Qamanirjuaq caribou herds. Beverlyand Qamanirjuaq Caribou Management Board, Stonewall, MB.

Inuit Advisory Group. 2025. Grays Bay Road and Port Project What We Heard Report - Inuit Advisory Group Workshop #1 Summary. Inuit Knowledge Integration Methods and Mitigation Strategies. Prepared by West Kitikmeot Resources Corp., Kugluktuk, Nunavut. 85 pp.

Inuvik Community Corporation, Tuktuyaktuk Community Corporation, and Aklarvik Community Corporation. 2006. Inuvialuit Settlement Region Traditional Knowledge Report. Mackenzie Gas Project, Inuvik, NWT.

Jenkins, D.A., Lecomte, N., Schaefer, J.A., Olsen, S.M., Swingedouw, D., Côté, S., Pellissier, L., and Yannic, G. 2016. Loss of connectivity among island-dwelling Peary caribou following sea ice decline. Biology Letters 12(9):1–5.

Johnson, C.J., Boyce, M.S., Case, R.L., Cluff, H.D., Gau, R.J., Gunn, A., and Mulders, R. 2005. Cumulative effects of human developments on arctic wildlife. Wildlife Monographs 160:1–36.

Johnson, C.J., Nielsen, S.E., Merrill, E.H., McDonald, T.L., and Boyce, M.S. 2006. Resource selection functions based on use-availability data: Theoretical motivation and evaluation methods. Journal of Wildlife Management 70(2):347–357.

Johnson, D.H. 1980. The comparison of usage and availability measurements for evaluating resource preference. Ecology 61(1):65–71. Ecological Society of America. DOI: 10.2307/1937156.

Johnson, H.E., Golden, T.S., Adams, L.G., Gustine, D.D., and Lenart, E.A. 2020. Caribou Use of Habitat Near Energy Development in Arctic Alaska. The Journal of Wildlife Management 84(3):401–412. DOI: 10.1002/jwmg.21809.

Joly, K., Couriot, O., Cameron, M.D., and Gurarie, E. 2020. Behavioral, Physiological, Demographic and Ecological Impacts of Hematophagous and Endoparasitic Insects on an Arctic Ungulate. Toxins 12(5):334. DOI: 10.3390/toxins12050334.

Karns, P.D. 1997. Population distribution, density and trends. In A.W. Franzmann, C.C. Schwartz (eds.) Ecology and management of the North American moose. Smithsonian Institute Press, Washington.

Keith, D. and Arqviq, J. 2006. Environmental Change, Polar Bears and Adaptation in the East Kitikmeot: An Initial Assessment. Final Report. World Wildlife Fund Canada.

Kelleyhouse, R.A. 2001. Calving ground habitat selection: Teshekpuk Lake and Western Arctic caribou herds. M.S. Thesis. University of Alaska Fairbanks, Fairbanks, Alaska. 140 pp.

Kelsall, J.P. 1972. The Northern Limits of Moose (*Alces alces*) in Western Canada. Journal of Mammalogy 53(1):129–138.

Klaczek, M.R., Johnson, Chris.J., and Cluff, H.D. 2015. Den site selection of wolves (*Canis lupus*) in response to declining caribou (*Rangifer tarandus groenlandicus*) density in the central Canadian Arctic. Polar Biology 38(12):2007–2019. DOI: 10.1007/s00300-015-1759-z.

Klaczek, M.R., Johnson, C.J., and Cluff, H.D. 2016. Wolf–caribou dynamics within the central Canadian Arctic. The Journal of Wildlife Management 80(5):837–849. DOI: 10.1002/jwmg.1070.

Klein, D.R. 1991. Limiting factors in caribou population ecology. Rangifer 11(4):30. DOI: 10.7557/2.11.4.990.

Klein, D.R., Yakushkin, G.D., and Pospelova, E.B. 1993. Comparative habitat selection by muskoxen introduced to northeastern Alaska and the Taimyr Peninsula, Russia. Rangifer 13(1):21–25.

Krebs, C.J., Danell, K., Angerbjörn, A., Agrell, J., Berteaux, D., Bråthen, K.A., Danell, Ö., Erlinge, S., Fedorov, V., Fredga, K., Hjältén, J., Högstedt, G., Jónsdóttir, I.S., Kenney, A.J., Kjellén, N., Nordin, T., Roininen, H., Svensson, M., Tannerfeldt, M., and Wiklund, C. 2003. Terrestrial trophic dynamics in the Canadian Arctic. Canadian Journal of Zoology 81(5):827–843.

Krebs, C.J., Kenney, A.J., Gilbert, S., Danell, K., Angerbjörn, A., Erlinge, S., Bromley, R.G., Shank, C., and Carriere, S. 2002. Synchrony in lemming and vole populations in the Canadian Arctic. Canadian Journal of Zoology 80(8):1323–1333. DOI: 10.1139/z02-120.

Krebs, J., Lofroth, E., Copeland, J., Banci, V., Cooley, D., Golden, H., Magoun, A., Mulders, R., and Shults, B. 2004. Synthesis of survival rates and causes of mortality in North American wolverines. Journal of Wildlife Management 68(3):493–502.

Kutz, S., Bollinger, T., Branigan, M., Checkley, S., Davison, T., Dumond, M., Elkin, B., Forde, T., Hutchins, W., Niptanatiak, A., and Orsel, K. 2015. *Erysipelothrix rhusiopathiae* associated with recent widespread muskox mortalities in the Canadian Arctic. The Canadian Veterinary Journal 56(6):560–563.

Kutz, S.J., Ducrocq, J., Verocai, G.G., Hoar, B.M., Colwell, D.D., Beckmen, K.B., Polley, L., Elkin, B.T., and Hoberg, E.P. 2012. Chapter 2 - Parasites in Ungulates of Arctic North America and Greenland: A View of Contemporary Diversity, Ecology, and Impact in a World Under Change. pp. 99–252. In D. Rollinson, S.I. Hay (eds.) Advances in Parasitology, Volume 79. Academic Press. DOI: 10.1016/B978-0-12-398457-9.00002-0. (http://www.sciencedirect.com/science/article/pii/B9780123984579000020).

Kuyt, E. 1969. Feeding ecology of wolves on barren-ground caribou range in the Northwest Territories. M.A. Thesis. University of Saskatchewan, Saskatoon, Saskatchewan.

Kuyt, E. 1972. Food habits and ecology of wolves on barren-ground caribou range in the Northwest Territories. Report Series. 21. Environment Canada Wildlife Service.

Kyle, C.J. and Strobeck, C. 2001. Genetic structure of North American wolverine (Gulo gulo) populations. Molecular Ecology 10(2):337–347. DOI: 10.1046/j.1365-294x.2001.01222.x.

Larter, N.C. 2013. Diet of Arctic Wolves on Banks and Northwest Victoria Islands,. Manuscript Report No. 230. Department of Environment and Natural Resources Government of the Northwest Territories.

Larter, N.C. and Nagy, J.A. 2004. Seasonal changes in the composition of the diets of Peary caribou and muskoxen on Banks Island. Polar Research . (://000226052200003).

Leclerc, L.-M. 2015. Muskox (*Ovibos moschatus*) distribution and abundance, muskox management units MX-11 subdivision, Kugluktuk, September 2013. Status Report. 2016–XX. Government of Nunavut Department of Environment, Kugluktuk, Nunavut. 16 pp.

Leclerc, L.-M. 2025a. Nunavut MX11 Moose and Muskoxen Harvest Data 2005 and 2022.

Leclerc, L.-M. 2025b. MX11 Muskoxen Harvest data 2010-2023.

Leclerc, L.-M. 2025c. Grizzly Bear Harvest Data- Kitikmeot NT 1990-2024.

Leclerc, L.-M. 2025d. Kitikmeot Wolverine reported harvest 1990-2024.

Leclerc, L.-M., Awan, M., Roberto-Charron, A., Campbell, M., and Boulanger, J. 2024. Muskox (*Ovibos moschatus*) distribution and abundance of Central Kitikmeot Group, MX-11 - March 2022. GN Technical Report. Government of Nunavut Department of Environment. 36 pp.

Leclerc, L.-M. and Boulanger, J. 2018. Fall Population Estimate of the Dolphin and Union Caribou herd (*Rangifer tarandus groenlandicus x pearyi*) Victoria Island, October 2015 and Demographic Population Indicators 2015–2017. Status Report 2018-xx. Government of Nunavut, Department of Environment, Kugluktuk, Nunavut. 49 pp.

Leclerc, L.-M. and Boulanger, J. 2019. Population Estimate of the Dolphin and Union Caribou herd (*Rangifer tarandus groenlandicus x pearyi*) Coastal Survey, October 2018 and Demographic Indicators. Nunavut Department of Environment, Kugluktuk, Nunavut. 53 pp.

Leclerc, L.-M., Milton, T., and Davison, T. 2025. Abundance estimates for the Dolphin and Union caribou herd (*Rangifer tarandus groenlandicus x pearyi*) – Fall 2023. Department of Environment, Government of Nunavut, Kugluktuk, Nunavut. 41 pp.

Leclerc, L.-M., Tomaselli, S., Checkley, S., Kugluktuk Angoniatit Hunters and Trappers Organization, and Ekaluktutiak Hunters and Trappers Organization. 2016. Dolphin and Union (*Rangifer tarandus groenlandicus x pearyi*) caribou herd abundance and trends, Kitikmeot Region, Nunavut. Winnipeg, MB. 2016 presentation.

Lee, J. and Niptanatiak, A. 1996. Observation of repeated use of a wolverine, *Gulu gulo*, den on the tundra of the Northwest Territories. Canadian Field Naturalist 110(2):349–350.

Legat, A., Chocolate, G., Gon, B., Zoe, S.A., and Chocolate, M. 2001. Caribou Migration and the State of Their Habitat. Dogrib Treaty 11 Council and West Kitikmeot Slave Study Society, Yellowknife, NWT.

Lele, S.R., Merrill, E.H., Keim, J., and Boyce, M.S. 2013. Selection, use, choice and occupancy: clarifying concepts in resource selection studies. Journal of Animal Ecology 82(6):1183–1191. DOI: 10.1111/1365-2656.12141.

Leorna, S. and Brinkman, T. 2024. Camera trap sampling protocols for open landscapes: The value of time-lapse imagery. Conservation Science and Practice 6(3):e13094. DOI: 10.1111/csp2.13094.

Leslie, P.H. 1959. The properties of a certain lag type of population growth and the influence of an external random factor on the number of such populations. Physiologic Zoology 32:151–159.

Lofroth, E.C., Krebs, J.A., Harrower, W.L., and Lewis, D. 2007. Food habits of wolverine *Gulo gulo* in montane ecosystems of British Columbia, Canada. Wildlife Biology 13(2):31–37.

Macpherson, A.H. 1969. The dynamics of Canadian arctic fox populations. Canadian Wildlife Service Report Series Number 8. Ottawa, Ontario, Canada. 52 pp.

Magoun, A.J. and Copeland, J.P. 1998. Characteristics of Wolverine Reproductive Den Sites. The Journal of Wildlife Management 62(4):1313–1320. [Wiley, Wildlife Society]. DOI: 10.2307/3801996.

Manly, B.F., McDonald, L., Thomas, D.L., McDonald, T.L., and Erickson, W.P. 2002. Resource Selection by Animals: Statistical Design and Analysis for Field Studies. Springer. (https://books.google.com/books?hl=en&lr=&id=rBXnBwAAQBAJ&pgis=1).

Manning, T.H. 1960. The relationship of the Peary and barren-ground caribou. Technical Paper. 4. Arctic Institute North America. 52 pp.

Mattson, I.J., Johnson, C.J., and Cluff, H.D. 2009. Winter survey of the Bathurst caribou and associated wolf distribution and abundance. Manuscript Report. 185. Government of the Northwest Territories, Department of Environment and Natural Resources, Yellowknife, NWT. 41 pp.

McCune, B. and Keon, D. 2002. Equations for potential annual direct incident radiation and heat load. Journal of Vegetation Science 13(4):603–606. DOI: 10.1111/j.1654-1103.2002.tb02087.x.

McFarlane, K., Gunn, A., and Strobeck, C. 2009. Proceedings from the caribou genetics and relationships workshop. Edmonton, Alberta, March 8-9, 2003. Manuscript Report. 183. Government of the Northwest Territories, Department of Natural Resources and Environment. 171 pp.

McLennan, D., Brown, K., Scharien, R., Else, R., Wilson, K., Humpheries, E., Marsh, P., Ullulaq, J., Park, B., Cockney-Goose, T., Aipellie, G., and Qillaq, N. 2022. Environmental change in the Kitikmeot Region of western Nunavut and Ulukhaktok region of eastern Northwest Territories. Aqhaliat Report. Polar Knowledge 4. (https://www.canada.ca/content/dam/polar-polaire/documents/publications/aqhaliat/volume-4/aqhaliat-volume-4-english.pdf).

McLoughlin, P.D., Case, R.L., Gau, R.J., Cluff, D.H., Mulders, R., and Messier, F. 2002a. Hierarchical habitat selection by barren-ground grizzly bears in the central Canadian Arctic. Oecologia 132(1):102–108. DOI: 10.1007/s00442-002-0941-5.

McLoughlin, P.D., Cluff, H.D., Gau, R.J., Mulders, R., Case, R.L., and Messier, F. 2002b. Population delineation of barren-ground grizzly bears in the central Canadian Arctic. Wildlife Society Bulletin 30(3):728–737.

McLoughlin, Philip D., Cluff, H.D., Gau, R.J., Mulders, R.J., Case, R.Y., and Messier, F. 2003a. Effect of spatial differences in habitat on home ranges of grizzly bears. Écoscience 10(1):11–16. DOI: 10.1080/11956860.2003.11682744.

McLoughlin, P.D., Cluff, H.D., and Messier, F. 2002c. Denning Ecology of Barren-Ground Grizzly Bears in the Central Arctic. Journal of Mammalogy 83(1):188–198.

McLoughlin, P.D., Ferguson, S.H., and Messier, F. 2000. Intraspecific Variation in Home Range Overlap with Habitat Quality: A Comparison among Brown Bear Populations. Evolutionary Ecology 14(1):39–60.

McLoughlin, Philip D, Taylor, M.K., Cluff, H.D., Gau, R.J., and Mulders, R. 2003. Demography of barren-ground grizzly bears. 81:8.

McLoughlin, Philip D., Taylor, M.K., Cluff, H.D., Gau, R.J., Mulders, R., Case, R.L., and Messier, F. 2003b. Population viability of barren-ground grizzly bears in Nunavut and the Northwest Territories. Arctic :185–190.

McLoughlin, P.D., Walton, L.R., Cluff, H.D., Paquet, P.C., and Ramsay, M.A. 2004. Hierarchical Habitat Selection by Tundra Wolves. Journal of Mammalogy 85(3):576–580. DOI: 10.1644/BJK-119.

McNeil, P., Russell, D.E., Griffith, B., Gunn, A., and Kofinas, G.P. 2004. Where the wild things are: Seasonal variation in caribou distribution in relation to climate change. Rangifer Special Issue (16):51–63.

Mennell, R. 2021. Spatial and temporal trends in range-use by the Bathurst Caribou during a population decline, 1997-2019. Masters. Queens University, Kingston, ON.

Merkle, J.A., Gage, J., Sawyer, H., Lowrey, B., and Kauffman, M.J. 2022. Migration Mapper: Identifying movement corridors and seasonal ranges for large mammal conservation. Methods in Ecology and Evolution 13(11):2397–2403. Wiley. DOI: 10.1111/2041-210x.13976.

Miller, F.L., Barry, S.J., and Calvert, W.A. 2005. Sea-ice crossings by caribou in the south-central Canadian Arctic Archipelago and their ecological importance. Rangifer 25(4):77–88. DOI: 10.7557/2.25.4.1773.

Miramar Hope Bay Ltd. 2005. Final report, proposed wildlife mitigation and monitoring program for the Doris North Gold Mine Project. Miramar Hope Bay Ltd., North Vancouver, BC.

Mitchell, B. 1980. Bathurst caribou collaring project: Contwoyto Lake July 26–August 3 1979. File Report. 9. Government of the Northwest Territories Wildlife Service. 23 pp.

Mowat, G. and Heard, D.C. 2006. Major components of grizzly bear diet across North America. Canadian Journal of Zoology 84(3):473–489. DOI: 10.1139/z06-016.

Mueller, F.P. 1995. Tundra esker systems and denning by grizzly bears, wolves, foxes, and ground squirrels in the Central Arctic, Northwest Territories. Northwest Territories Department of Renewable Resources, Yellowknife, Northwest Territories. 68 pp. (https://www.enr.gov.nt.ca/sites/enr/files/115.pdf).

Muff, S., Signer, J., and Fieberg, J. 2020. Accounting for individual-specific variation in habitat-selection studies: Efficient estimation of mixed-effects models using Bayesian or frequentist computation. Journal of Animal Ecology 89(1):80–92. DOI: 10.1111/1365-2656.13087.

Mulders, R. 2000. Wolverine ecology, distribution, and productivity in the Slave Geological Province. Final Report. West Kitikmeot/Slave Study Society, Yellowknife, NWT.

Mulders, R., Boulanger, J., and Paetkau, D. 2007. Estimation of population size for wolverines Gulo gulo at Daring Lake, Northwest Territories, using DNA based mark-recapture methods. Wildlife Biology 13(2):38–51.

Musiani, M., Leonard, J.A., Cluff, H.D., Gates, C.C., Mariani, S., Paquet, P.C., Vilà, C., and Wayne, R.K. 2007. Differentiation of tundra/taiga and boreal coniferous forest wolves: genetics, coat color and association with migratory caribou. Molecular Ecology 16:4149–4170.

Myrbeget, S. 1973. Geographical synchronism of cycles of small rodents in Norway. Oikos 24:220–224.

Nagy, J.A. and Johnson, D. 2006. Estimates of the Number of Barren-ground Caribou in the Cape Bathurst and Bluenose-West Herds and Reindeer/Caribou on the Upper Tuktoyaktuk Peninsula Derived Using Post Calving Photography, July 2006. No. 171. Department of Environment and Natural Resources, Government of the Northwest Territories, Inuvik, Northwest Territories. 56 pp.

Nagy, J.A., Johnson, D.L., Larter, N.C., Campbell, M.W., Derocher, A.E., Kelly, A., Dumond, M., Allaire, D., and Croft, B. 2011. Subpopulation structure of caribou (*Rangifer tarandus* L.) in arctic and subarctic Canada. Ecological Applications 21(6):2334–2348.

Nagy, J.A., Wright, W.H., Slack, T.M., and Veitch, A.M. 2005. Seasonal Ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East Barren-Ground Caribou Herds. Manuscript Report 167. Environment and Natural Resources, Government of the Northwest Territories, Inuvik, NWT. 43 pp.

Nagy, J.A.S. 2011. Use of Space by Caribou in Northern Canada. PhD Thesis. University of Alberta, Edmonton, Alberta. 184 pp.

Natural Resources Canada. 2017. Canadian Digital Elevation Model, 1945-2011 - Open Government Portal. (https://open.canada.ca/data/en/dataset/7f245e4d-76c2-4caa-951a-45d1d2051333).

Natural Resources Canada. 2019. Land Cover of Canada - Cartographic Product Collection. (https://app.geo.ca/en-ca/map-browser/record/11990a35-912e-4002-b197-d57dd88836d7).

Nault, R., Mathieu, C., and Crete, M. 1993. Vegetation biomass and habitat selection by a newly introduced population of muskoxen in northern Quebec. Rangifer 13(2):71–77.

Nicholson, K.L., Arthur, S.M., Horne, J.S., Garton, E.O., and Del Vecchio, P.A. 2016. Modeling Caribou Movements: Seasonal Ranges and Migration Routes of the Central Arctic Herd. PLOS ONE 11(4):e0150333. DOI: 10.1371/journal.pone.0150333.

Nick Wilson [GNWT]. 2024. RE: Bathurst Seasonal Ranges Metadata – email to EDI from GNWT with information on the methodology used for Bathurst caribou herd seasonal ranges. July 25, 2024 email.

Nielson, R., N., Sawyer, H., and McDonald, T.L. 2019. bbmm: Brownian Bridge Movement Model.

Nishi, J.S. 2000. Calving and rutting distribution of the Dolphin and Union caribou herd based on radio-telemetry, Victoria Island (1994–1997). Manuscript Report. 127. Government of the Northwest Territories, Department of Resources, Wildlife, and Economic Development, Kugluktuk, Nunavut.

Nishi, J.S., Croft, B., Boulanger, J., and Adamczewski, J. 2010. An estimate of breeding females in the Bathurst herd of barren-ground caribou, June 2009. File Report. Yellowknife, NWT. 98 pp.

Nishi, J.S., Croft, B., Boulanger, J., and Johnson, D. 2007. An estimate of breeding females in the Bathurst herd of barren-ground caribou, June 2006. File Report. 137. Government of the Northwest Territories, Department of Environment and Natural Resources, Yellowknife, NWT. 99 pp.

Nishi, J.S. and Gunn, A. 2004. An estimate of the herd size for the migratory Dolphin and Union caribou herd during the rut (17–22 October 1997). File Report. 131. Government of the Northwest Territories, Department of Resources, Wildlife, and Economic Development, Yellowknife, NWT. 52 pp.

NTKP. 2018. Naonaiyaotit Traditional Knowledge Project. Cartographic material, transcripts, quotes, placenames and photos. Proprietary ArcGIS 10.5 Geodatabase and associated textual and photographic databases. Kitikmeot Inuit Association, Kugluktuk NU. (https://www.ntkp.ca).

Nunavut Impact Review Board. 2024a. Back River Energy Cetnre Project Proposal. Hearing Transcripts-Vol 01. Cambridge Bay, Nunavut, February 27, 2024.

Nunavut Impact Review Board. 2024b. Back River Energy Centre Project Proposal. Hearing Volume 2. Cambridge Bay, Nunavut: February 28. (https://www.nirb.ca/portal/dms/script/dms_download.php?fileid=349112&applicationid=125740&sessionid=i39d16tnqcc0ltouqf96fqvos3).

Nunavut Planning Commission. 2004. Draft West Kitikmeot Regional Land Use Plan.

Nunavut Wildlife Management Board. 2023. Government of Nunavut's Proposal to increase the total allowable harvest for Muskoxen in teh MX-11 Management Unit from 225 to 300. (https://www.nwmb.com/en/list-all-site-files/decision-documents/terrestrial-mammals/muskox-2). 2023 email.

Olthof, I., Latifovic, R., and Pouliot, D. 2009. Development of a circa 2000 land cover map of northern Canada at 30 m resolution from Landsat. Canadian Journal of Remote Sensing 35(2):152–165. DOI: 10.5589/m09-007.

Olthof, I., Latifovic, R., and Pouliot, D. 2015. Northern Land Cover of Canada – Circa 2000. (Accessed March 17, 2017.

Paquette, E., Ljubicic, G., Johnson, C.A., Okpakok, S., Mueller, D., and Montpetit, B. 2023. Seasonal Sea Ice Conditions Affect Caribou Crossing Areas Around Qikiqtaq, Nunavut: Uqsuqtuurmiut Knowledge Guides Ice Chart Analysis. ARCTIC 76(1):83–101. DOI: 10.14430/arctic77149.

Patterson, B.R., Olsen, B.T., and Joly, D.O. 2004. Population estimate for the Bluenose-East caribou herd using post-calving photography. Arctic 57(1):47–58.

Pearce, J.L. and Boyce, M.S. 2006. Modelling distribution and abundance with presence-only data. Journal of Applied Ecology 43(3):405–412. DOI: 10.1111/j.1365-2664.2005.01112.x.

Pebesma, E. 2018. Simple Features for R: Standardized Support for Spatial Vector Data. The R Journal 10(1):439. DOI: 10.32614/RJ-2018-009.

Peek, K.M. 1997. Habitat relationships. pp. 371–375. Ecology and management of the North American Moose. Smithsonian Institute Press, Washington.

Poole, K.G. and Bromley, R.G. 1988. Interrelationships within a raptor guild in the central Canadian arctic. Canadian Journal of Zoology 66(10):2275–2282.

Poole, K.G., Gunn, A., Patterson, B.R., and Dumond, M. 2010. Sea ice and migration of the Dolphin and Union caribou herd in the Canadian Arctic: an uncertain future. Arctic 63(4):414–428.

Priest, H. and Usher, P.J. 2004. Nunavut Wildlife Harvest Study. Nunavut Wildlife Management Board, Iqaluit, Nunavut. 822 pp. (http://www.nwmb.com/inu/publications/harvest-study/1824-156-nwhs-report-2004-156-0003/file).

Prno, J., Bradshaw, B., Wandel, J., Pearce, T., Smit, B., and Tozer, L. 2011. Community vulnerability to climate change in the context of other exposure-sensitivities in Kugluktuk, Nunavut. Polar Research 30(1):7363. Norwegian Polar Institute. DOI: 10.3402/polar.v30i0.7363.

R Core Team. 2025. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Rescan. 2012. Doris North Gold Mine Project: Final grizzly bear DNA Report. Hope Bay Mining Limited.

Rescan Environmental Services Ltd. 2005. Ekati Diamond Mine 2004 Wildlife Effects Monitoring Program. Prepared for BHP Billiton Diamonds Inc. by Rescan Environmental Services Ltd.

Riewe, R. 1992. Nunavut atlas. Canadian Circumpolar Institute and Tungavik Federation of Nunavut, Edmonton, Alberta. 259 pp.

Russell, D.E., Kofinas, G.P., and Griffith, B. 2002. Barren-Ground Caribou Calving Ground Workshop: report of proceedings. Technical Report Series Number 390. Canadian Wildlife Service, Ottawa, Ontario Canada.

Russell, D.E., Martell, A.M., and Nixon, W.A. 1993. Range ecology of the Porcupine caribou herd in Canada. Rangifer 13(5):1–168.

Sappington, J.M., Longshore, K.M., and Thompson, D.B. 2007. Quantifying Landscape Ruggedness for Animal Habitat Analysis: A Case Study Using Bighorn Sheep in the Mojave Desert. Journal of Wildlife Management 71(5):1419–1426. DOI: 10.2193/2005-723.

Saul, G. 2022. Timelapse Reference Guide. Greenberg Consulting Inc. / University of Calgary. (https://saul.cpsc.ucalgary.ca/timelapse/uploads/Guides/TimelapseReferenceGuide.pdf).

Sawyer, H., Kauffman, M.J., Nielson, R.M., and Horne, J.S. 2009. Identifying and prioritizing ungulate migration routes for landscape-level conservation. Ecological Applications 19(8):2016–2025. DOI: 10.1890/08-2034.1.

SENES Consultants Ltd. 2012. A way of life: Bridging science and Aboriginal knowledge in caribou monitoring at Diavik Diamond Mine. Technical Report. March 14-15, 2012 TK/IQ Panel Session. The Traditional Knowledge and Inuit Qaujimajatuqangit Panel Environmental Monitoring Advisory Board (EMAB), Yellowknife, NWT.

Serreze, M.C., Holland, M.M., and Stroeve, J. 2007. Perspectives on the Arctic's shrinking sea-ice cover. Science 315:1533–1536.

Slavik, D. 2010. Inuvialuit Knowledge of Nanuq: Community and Traditional Knowledge of Polar Bears in the Inuvialuit Settlement Region. Wildlife Management Advisory Council (NWT), Wildlife Management Advisory Council North Slope, and Inuvialuit Game Council. 68 pp.

Species at Risk Committee. 2012. Species Status Report for Peary Caribou (Rangifer tarandus pearyi) in the Northwest Territories. Species at Risk Committee, Yellowknife, NWT.

Species at Risk Committee. 2013. Species status report for Dolphin and Union caribou (Rangifer tarandus groenlandicus pearyi) in the Northwest Territories. Species at Risk Committee, Yellowknife, NWT.

Species at Risk Committee. 2014. Species Status Report for Wolverine (*Gulo gulo*) in the Northwest Territories. Species at Risk Committee, Yellowknife, NT. 146 pp.

Species at Risk Committee. 2023a. Species Status Report: Dolphin and Union Caribou. Government of Northwest Territories.

Species at Risk Committee. 2023b. Species Status Report for Dolphin and Union Caribou (*Rangifer tarandus groenlandicus x pearyi*) in the Northwest Territories. Species at Risk Committee, Yellowknife, NT.

Superbie, C., Stewart, K.M., Regan, C.E., Johnstone, J.F., and McLoughlin, P.D. 2022. Northern boreal caribou conservation should focus on anthropogenic disturbance, not disturbance-mediated apparent competition. Biological Conservation 265:109426. DOI: 10.1016/j.biocon.2021.109426.

Sutherland, M. and Gunn, A. 1996. Bathurst calving grounds surveys: 1965–1996. File Report No. 118. 118. Government of Northwest Territories Department of Resources, Wildlife, and Economic Development, Yellowknife, Northwest Territories. 97 pp.

Tarroux, A., Berteaux, D., and Bêty, J. 2010. Northern nomads: ability for extensive movements in adult Arctic foxes. Polar Biology 33(8):1021–1026.

Thorpe Consulting Services Ltd. 2014a. We are Saying Something Everybody can Understand: Marine and Land Inuit Qaujimajatuqangit Report for the Izok Corridor Project (Inuit Version). Results from a Workshop carried out with Inuit and Inuvialuit in Iqaluktuuttiaq (Cambridge Bay) in March 2013. Prepared by N. Thorpe and K. Scott with contributions from M. Kakkianiun and G. Angulalik for MMG Ltd. Vancouver, BC.

Thorpe Consulting Services Ltd. 2014b. The Caribou is the Boss of the Mine: Izok Corridor Project Caribou Inuit Qaujimajatuqangit Report. Results from Interviews and a Workshop carried out in Qurluqtuq (Kugluktuk) in 2012. Prepared by N. Thorpe and K. Scott with contributions from M. Kakkianiun and G. Angulalik for MMG Ltd. Vancouver, BC.

Thorpe, N., Hakongak, N., Eyegetok, S., and Elders, Q. 2001a. The Tuktu and Nogak Project: a caribou chronicle. Final Report. West Kitikmeot/Slave Study Society, Yellowknife, NWT.

Thorpe, N., Hakongak, N., Eyegetok, S., and Kitikmeot Elders. 2001b. Thunder on the Tundra: Inuit Qaujimajatuqangit of the Bathurst Caribou. Tuktu and Nogak Project, Vancouver, British Columbia. 208 pp.

Thorpe, N.L. 2000. Contributions of Inuit Ecological Knowledge to Understanding the Impacts of Climate Change on the Bathurst Caribou Herd in the Kitimeot Region, Nunavut. M.RM. Thesis. Simon Fraser University, Burnaby, British Columbia. 113 pp.

Toupin, B., Huot, J., and Manseau, M. 1996. Effect of Insect Harassment on the Behaviour of the Rivière George Caribou. Arctic 49(4):375–382. DOI: 10.14430/arctic1213.

Trailmark Systems Inc. 2015. Review of post-2010 Literature on Human Effects on Barren-Ground Caribou: Focus on Traditional Knowledge, Western Science and Caribou Protection Measures. Prepared for the Nunavut Wildlife Management Board. 92 pp.

Treseder, L. and Graf, R. 1985. Moose in the Northwest Territories - A Discussion Paper. Manuscript Report 13. NWT Wildlife Service, Renewable Resources, Government of Northwest Territories, Yellowknife, NWT. 39 pp.

van Dijk, J., Gustavsen, L., Mysterud, A., May, R., Flagstad, Ø., Brøseth, H., Andersen, Roy, Andersen, Reidar, Steen, H., and Landa, A. 2008. Diet shift of a facultative scavenger, the wolverine, following recolonization of wolves. Journal of Animal Ecology 77(6):1183–1190. DOI: 10.1111/j.1365-2656.2008.01445.x.

Voigt, D.R. 1987. Red fox. pp. 379–392. In M. Novak, J.A. Baker, M.E. Obbard, B. Malloch (eds.) Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario.

Vors, L.S. and Boyce, M.S. 2009. Global declines of caribou and reindeer. Global Change Biology 15(11):2626–2633. DOI: 10.1111/j.1365-2486.2009.01974.x.

Walton, L.R., Cluff, H.D., Paquet, P.C., and Ramsay, M.A. 2001. Movement patterns of barren-ground wolves in the central Canadian Arctic. Journal of Mammalogy 83(3):867–876.

Warton, D.I., Duursma, R.A., Falster, D.S., and Taskinen, S. 2012. smatr 3 – an R package for estimation and inference about allometric lines. Methods in Ecology and Evolution 3(2):257–259. DOI: 10.1111/j.2041-210X.2011.00153.x.

Webber, Q.M.R., Ferraro, K.M., Hendrix, J.G., and Vander Wal, E. 2022. What do caribou eat? A review of the literature on caribou diet. Canadian Journal of Zoology 100(3):197–207. DOI: 10.1139/cjz-2021-0162.

Wek'èezhìı Renewable Resources Board. 2016a. Report on a Public Hearing Held by the Wek'èezhìı Renewable Resources Board 23-24 February 2016 Yellowknife, NT & Reasons for Decisions Related to a Joint Proposal for the Management of the Bathurst ʔekwo (Barren-ground caribou) Herd Part A. Wek'èezhìi Renewable Resource Board, Behchokö, NWT. 81 pp.

Wek'èezhìı Renewable Resources Board. 2016b. Report on a Public Hearing Held by the Wek'èezhìı Renewable Resources Board 6-8 April 2016, Behchokǫ, NT & Reasons for Decisions Related to a Joint Proposal for the Management of the Bluenose-East ʔekwo (Barren-ground caribou) Herd Part A. Wek'èezhìi Renewable Resource Board, Behchokö, NWT. 81 pp.

Wek'èezhìı Renewable Resources Board. 2016c. Summary of the Wek'èezhìı Renewable Resources Board's report, entitled "Report on a Public Hearing Held by the Wek'èezhìı Renewable Resources Board, 6-8 April 2016, Behchok , NT & Reasons for Decisions Related to a Joint Proposal for the Management of Bluenose-East ekwo (Barren-ground caribou) Herd – PART A." Wek'èezhìı Renewable Resources Board.

Wek'èezhìı Renewable Resources Board. 2019. Report on a Public Hearing Held by the Wek'èezhìı Renewable Resources Board 9-11 April 2019 Behchokǫ̀, NT & Reasons for Decisions Related to a Joint Proposal for the Management of the Sahtì Ekwǫ̀ (Bluenose-East Caribou) herd. (https://www.wrrb.ca/sites/default/files/WRRB%20to%20ENR-TG%20-%202024%20BNE%20RFD%20Report%20FINAL%2015jan2025.pdf).

Wek'èezhìı Renewable Resources Board. 2025. WRRB Reasons for Decision Report - 2024 Sahtì Ekwǫ̀ Management Proceeding. (https://www.wrrb.ca/sites/default/files/WRRB%20to%20ENR-TG%20-%202024%20BNE%20RFD%20Report%20FINAL%2015jan2025.pdf).

Wiebe, N., Samlius, G., Alisauskas, R.T., Bantle, J.L., Bergman, C., De Carle, R., Hendrickson, C.J., Lusignan, A., Phipps, K.J., and Pitt, J. 2009. Foraging behaviours and diets of wolves in the Queen Maud Gulf Bird Sanctuary Nunavut, Canada. Arctic 62(4):399–404.

Wildlife Management Advisory Council (North Slope). 2008. Aklavik local and traditional knowledge about grizzly bears of the Yukon North Slope: Final Report. Wildlife Management Advisory Council (North Slope), Whitehorse Yukon.

Wildlife Research Section. 2007. Recommendations of total allowable harvest (TAH) rates for the terrestrial wildlife populations in Nunavut. Final Wildlife Report. 4. Government of Nunavut Department of Environment, Iqaluit, Nunavut. 84 pp.

Williams, T.M. 1990. Summer diet and behaviour of wolves denning on barren-ground caribou range in the Northwest Territories, Canada. M.Sc. Thesis. University of Alberta, Edmonton, Alberta.

Wilson, A., Hodson, J., Abernethy, R., Jutha, N., Nishi, J., and Woodworth, B. 2025. Technical report wolf (dìga) management program January – October 2024. 335. Government of Northwest Territories.

Wilson, G., Van Den Bussche, R.A., Kennedy, P.K., Gunn, A., and Poole, K.G. 2000. Genetic variability of wolverines (Gulo gulo) from the Northwest Territories, Canada: conservation implications. Journal of Mammalogy 81(1):186–196.

Witter, L.A., Johnson, C.J., Croft, B., Gunn, A., and Gillingham, M.P. 2012. Behavioural trade-offs in response to external stimuli: time allocation of an Arctic ungulate during varying intensities of harassment by parasitic flies. Journal of Animal Ecology 81(1):284–295.

Wolfden Resources Inc. 2006. High Lake Draft Environmental Impact Statement Volume 3, Section 4: Inuit Qaujimajatuqangit. 061127-06MN082. Thunder Bay, Ontario. 59 pp.

Wood, J.E., Gillis, M.D., Goodenough, D.G., Hall, R.J., Leckie, D.G., Luther, J.E., and Wulder, M.A. 2002. Earth Observation for Sustainable Development of Forests (EOSD): project overview, IEEE International Geoscience and Remote Sensing Symposium, IEEE International Geoscience and Remote Sensing Symposium. IGARSS 2002, Volume 3, 1299–1302 pp. IEEE, Toronto, Ont., Canada. DOI: 10.1109/IGARSS.2002.1026097. (http://ieeexplore.ieee.org/document/1026097).

Woods, J.G., Paetkau, D., Lewis, D., McLellan, B.N., Proctor, M., and Strobeck, C. 1999. Genetic tagging of free-ranging black and brown bears. Wildlife Society Bulletin 27(3):616–627.

Worton, B.J. 1989. Kernel Methods for Estimating the Utilization Distribution in Home-Range Studies. Ecology 70(1):164–168. DOI: 10.2307/1938423.

Yamaguchi, Y., Kahle, A.B., Tsu, H., Kawakami, T., and Pniel, M. 1998. Overview of Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). IEEE Transactions on Geoscience and Remote Sensing 36(4):1062–1071. Institute of Electrical and Electronics Engineers (IEEE). DOI: 10.1109/36.700991.

Ydenberg, R.C. 1987. Nomadic predators and geographical synchrony in microtine population cycles. Oikos 50(2):270–272.

Zalatan, R., Gunn, A., and Henry, G.H.R. 2006. Long-term abundance patterns of barren-ground caribou using trampling scars on roots of *Picea mariana* in the Northwest Territories, Canada. Arctic, Antarctic, and Alpine Research 38(4):624–630. DOI: 10.1657/1523-0430(2006)38[624:LAPOBC]2.0.CO;2.

8.2 Personal Communications

Awan, M. 2013. Carnivore Biologist, Government of Nunavut Department of Environment, Kugluktuk, Nunavut. Email to Kim Poole, Aurora Wildlife Research, 9 April 2013.

Cluff, D. 2012. Regional Biologist, Government of the Northwest Territories, Environment and Natural Resources, Yellowknife, Northwest Territories. Telephone discussion with Kim Poole, Aurora Wildlife Research, 15 March 2012.

Dumond, M. 2006. Kitikmeot Regional Biologist, Government of Nunavut Department of Environment, Kugluktuk, Nunavut. Email to Kim Poole, Aurora Wildlife Research, 27 March 2006.

Dumond, M. 2012. Kitikmeot Regional Biologist, Government of Nunavut Department of Environment, Kugluktuk, Nunavut. Email to Kim Poole, Aurora Wildlife Research, 20 January 2012.

Johnson, C. 2006. Assistant Professor, University of Northern British Columbia, Prince George, British Columbia. Email to Kim Poole, Aurora Wildlife Research, 27 March 2006.

Klengenberg, K. 2013. Kugluktuk Hunters and Trappers Organization, Kugluktuk, Nunavut. Meeting with Kim Poole, Aurora Wildlife Research, 14 March 2013.

Leclerc, L. 2013. Kitikmeot Regional Biologist, Government of Nunavut Department of Environment, Kugluktuk, Nunavut. Meeting with Kim Poole, Aurora Wildlife Research, 7 March 2013.

Leclerc, L. 2016. Kitikmeot Regional Biologist, Government of Nunavut Department of Environment, Kugluktuk, Nunavut. Email communication, Aurora Wildlife Research, 15 December 2016.

McLoughlin, P.D. 2006. Assistant Professor, University of Saskatchewan, Saskatoon, Saskatchewan. Email to Kim Poole, Aurora Wildlife Research, 7 April 2006.

Milakovic, B. 2013. Wildlife biologist, Rescan Environmental Services Ltd., Vancouver, BC. Meeting with Kim Poole, Aurora Wildlife Research, 6 March 2013.

Paetkau, D. 2012. Wildlife Genetics International, Nelson, British Columbia. Telephone discussion with Kim Poole, Aurora Wildlife Research, 7 May 2012.

Ray, J. 2016. Wildlife Conservation Society. Telephone discussion with Kim Poole, Aurora Wildlife Research, 23 November 2016.

Appendix A Habitat Modelling — Resource Selection Functions

A.1 Methods

A.1.1 Overview

A resource selection function (RSF) is a statistical tool that helps describe the environmental variables selected and avoided by animals (Manly et al. 2002). These functions compare use data (e.g., global positioning system [GPS] fixes of a known location) against availability data (i.e., randomly sampled locations). If a population uses a resource more than it is available, that resource is *selected*. In contrast, if a resource is used less than it is available, that resource is *avoided*. The RSF predicts the *relative* probability of selecting a given resource type (Lele et al. 2013). Furthermore, the RSF can be used to make spatial predictions of resource selection in a heterogeneous landscape composed of multiple resource types.

RSFs were developed using GPS collar data for the following caribou herds and seasons:

<u>Bathurst Caribou (2009 to 2024)</u>

1. Calving/Post-calving (June 2 to June 28)
2. Summer (June 29 to September 6)
3. Fall (September 7 to November 30)

<u>Dolphin and Union Caribou (2015 to 2023)</u>

1. Pre-Spring Migration Staging and Post-Fall Migration (April 15 to May 28, November 9 to 30)

   Notes: The objective in assessing these combined seasons was to describe habitat selection when space use is concentrated along the mainland ocean shoreline. Spring migration typically occurs from April 15 to May 28, but most caribou began staging near the mainland shoreline around April 25 according to GPS collars with 50 percent (%) seasonal coverage. Fall migration onto mainland Nunavut typically occurs from November 9 to 30, but most do not reach mainland Nunavut until approximately November 23 according to GPS-collared Dolphin and Union caribou with 50% seasonal coverage.
2. Winter (December 1 to April 14)

The seasonal date ranges used for RSFs were retrieved from the *Bathurst Caribou Range Plan* (Government of Northwest Territories 2019) and the *Species Status Report for Dolphin and Union Caribou* (Species at Risk Committee 2023b). Seasonal RSFs were developed within 95% utilization distribution (UD) seasonal ranges developed for each herd (see Caribou Collar Data and Seasonal Ranges in Section 4.1.2).

A.1.2 Study Design

Resource selection occurs at multiple spatial scales (Johnson 1980). The scale of analysis used depends on the study's objective and the type of data available. Collar data can provide a robust assessment of the seasonal ranges of individual animals, which is best characterized as 2nd order selection. In this study, an analysis of 2nd order selection is proposed to adequately sample the seasonal ranges of Bathurst caribou and Dolphin and Union caribou while still accounting for individual-level heterogeneity in resource selection. Second (2nd) order RSFs were developed to compare the distribution of habitat components within used versus available (random) locations in each herd's seasonal ranges, and for each caribou in each year (i.e., caribou-year combination). Caribou-years were chosen as the individual-level unit for resource selection because individuals may experience different seasonal conditions over time.

A used-available study design was necessary because GPS telemetry data consist only of 'presences', and true 'absences' are not directly observed. In such cases, random locations must be sampled to identify 'pseudo-absences' or available locations (Pearce and Boyce 2006). To minimize biased estimates, 20-times as many available locations were generated for every used location. A minimum spacing of 30 metres (m) between available locations was implemented to minimize sampling the same pixel multiple times. Used and available locations were then overlaid on spatial environmental layers, and environmental values were extracted to associate each used and available sample location with each habitat component.

A.1.3 GPS Collar Data

Bathurst caribou collar data (1996 to 2024) were provided by the Government of Northwest Territories and Dolphin and Union caribou collar data (1999 to 2024) were provided by the Government of Nunavut. Several data cleaning and preparation procedures were completed on the acquired collar data. First, the analysis was restricted to years of data composed mostly of GPS collars: 2009 to 2024 for the Bathurst caribou herd and 2015 to 2023 for the Dolphin and Union caribou herd. Second, all erroneous and duplicate locations were removed from the datasets. Finally, to reduce bias from dropped or malfunctioning collars, or occasional users of a seasonal range, any collared caribou that primarily occurred outside of seasonal range boundaries or had incomplete temporal coverage during a season were removed from the analysis. Thus, for a caribou to be retained for analysis, its GPS locations in a given season and year needed to cover at least 50% of that seasonal period within the 95% UD seasonal range (see Caribou Collar Data and Seasonal Ranges in Section 4.1.2). The collar data used to develop RSFs are summarized in Table A.1 for Bathurst caribou and Table A.2 for Dolphin and Union caribou.

Table A.1 Bathurst Caribou GPS Collars and Locations Used to Develop Seasonal Resource Selection Functions

Year	Number of GPS Collars per Year		
	Calving/ Post-calving	Summer	Fall
2009	11	11	8
2010	19	14	8
2011	18	5	7
2012	19	9	10
2013	12	11	5
2014	18	15	13
2015	32	28	25
2016	27	24	23
2017	30	28	23
2018	16	17	16
2019	22	23	22
2020	39	38	37
2021	35	34	27
2022	38	37	33
2023	29	28	26
2024	18	–	–
Total Number of Caribou in All Years	196	172	156
Total Number of GPS Locations	25,212	20,633	22,000
Number of GPS Locations per Animal per Year	11–84	36–70	43–87

Table A.2 Dolphin and Union Caribou GPS Collars and Locations Used to Develop Seasonal Resource Selection Functions

Year	Number of GPS Collars per Year	
	Pre-Spring and Post-Fall Migration Staging	Winter
2015	4	5
2016	–	3
2017	1	–
2018	25	25
2019	14	12
2020	4	–
2021	22	26
2022	20	23
2023	1	17
Total Number of Caribou in All Years	61	62
Total Number of GPS Locations	1,134	14,063
Number of GPS Locations per Animal per Year	5–39	80–145

A.1.4 Environmental Variables

Environmental variables were chosen based on knowledge of Bathurst and Dolphin-Union caribou ecology and was limited by the availability of data for this region. Final habitat data included remote-sensed layers such as landcover classification (Land Cover of Canada; Natural Resources Canada 2019), heat load index, elevation, terrain ruggedness, and Normalized Difference Vegetation Index (NDVI). All environmental variables were acquired and developed as raster layers with a 30 m cell size.

Caribou consumption of vascular plants (e.g., deciduous shrubs) is greatest during spring, summer, and fall, whereas terrestrial lichens are the primary winter forage (Webber et al. 2022, Ehlers et al. 2024). Graminoids (i.e., grasses) are commonly consumed by caribou year-round, including when senescent during winter (Webber et al. 2022). Given the importance of forage and vegetation cover in caribou habitat selection, both landcover and NDVI layers were used in RSFs. Landcover variables were treated as continuous rather than discrete (categorical) variables by calculating the percentage of each landcover class within a certain radius of every raster cell on the landscape. Key land cover variables included percent barren-lichen-moss, grass-lichen-moss, and shrub-lichen-moss. The use of NDVI was meant to refine predictions of habitat selection that would otherwise be missed by the coarse-resolution landcover layers (e.g., differences in vegetation growth between the same landcover types).

Furthermore, given the diversity of topography in the caribou seasonal ranges, and the understanding of how certain landscape features can influence caribou behaviour (i.e. windswept ridges for insect avoidance), topographical-based layers (elevation, terrain ruggedness, slope) were also developed to inform habitat selection. The Canadian digital elevation model (Natural Resources Canada 2017) at a 1:250,000 scale was used to develop measures of absolute elevation (metres), slope, and a terrain ruggedness index (TRI; Sappington et al. 2007). Heat load index was assessed as a potential variable to explain the seeking of thermal refugia on the landscape during summer (Bathurst caribou); it was calculated using R package 'spatialEco' (Evans and Murphy 2023), following the methods of McCune and Keon (2002).

Human disturbance features, including roads, mining infrastructure, and camps in the region are mostly limited to several features located in the Bathurst winter range (NT). Given the limited geographical extent of these features, data related to human disturbances (e.g., distance to polygonal disturbance or linear features) were excluded from seasonal RSFs.

In summary, the following environmental variables were fit to seasonal RSFs for each caribou herd:

Bathurst Caribou

1. Calving/Post-calving: elevation, terrain ruggedness, percent grass-lichen-moss land cover, percent barren-lichen-moss land cover, and NDVI.
2. Summer: elevation, terrain ruggedness, percent grass-lichen-moss land cover, percent shrub-lichen-moss land cover, and NDVI.
3. Fall: elevation, terrain ruggedness, percent grass-lichen-moss land cover, percent shrub-lichen-moss land cover, and NDVI.

Dolphin and Union Caribou

1. Pre-Spring and Post-Fall Migration Staging: elevation, terrain ruggedness, percent shrub-lichen-moss land cover, and percent barren-lichen-moss land cover. *Note: NDVI was excluded from this model due to its varied values in spring versus fall, resulting in uninformative mean NDVI values and no selection.*
2. Winter: elevation, terrain ruggedness, percent grass-lichen-moss land cover, and NDVI.

A.1.5 Resource Selection Functions

RSFs were developed using the R package 'glmmTMB' (Brooks et al. 2017) to fit generalized linear mixed models (logistic regressions) of the following form:

$$\text{logit}(P_s) = \beta_0 + \mu_{i,0} + (\beta_1 + \mu_{i,1})x_1 \ldots (\beta_k + \mu_{i,k})x_k$$

where the probability of selection (P_s) is dependent on the linear predictor (right-hand side) through a logit-link function, x_k represents the *k*-th environmental variable, β_k represents its associated coefficient (fixed-effect estimates).

Two additional terms were included to account for interindividual variation in habitat selection among caribou and between years: $\mu_{i,0}$, the random intercept associated with the locations from each *i*-th caribou-year, and $\mu_{i,k}$, the random slope associated with each *k*-th variable (x_k). In other words, a random slope was fit for each environmental variable included in the RSF. The random slopes allow the strength and direction of selection to vary by caribou-year combination, making it possible to model the variation in resource selection among individuals. The random intercept accounts for the correlated observations in caribou-years by employing a compound symmetric correlation structure, which assumes that observations within each caribou-year are equally correlated (Gillies et al. 2006). In summary, including random effects allows for the estimation of population-level responses by controlling for interindividual variation, unequal sample sizes, and autocorrelation (Gillies et al. 2006, Muff et al. 2020).

Several additional model parameterizations were considered when developing RSFs. Fieberg et al. (2021) recommend that RSFs be developed by (1) maximizing the number of available locations to the extent possible and (2) assigning large weights to those locations when fitting logistic regression models. The first recommendation was implemented using the 1:20 used-vs-available sampling ratio. The second recommendation was implemented by assigning large weights to all available locations ($w_{\text{available}}$ = 1,000) relative to used locations (w_{used} = 1) (Muff et al. 2020). Finally, rather than directly estimating the random intercepts for each caribou-year (which is not of interest, nor does it contribute to interpreting RSF parameters), a large, fixed variance (σ^2 = 10^6) was applied to the random intercept to avoid 'shrinkage' (see Muff et al. 2020 for details).

A.1.6 Model Fitting

To avoid biased estimates of coefficients and inflated standard errors, multicollinearity among variables was assessed using two methods. The first was via a correlation matrix using Pearson's product moment correlation in which $|r| > 0.60$ were dropped from consideration. The second was using the variance inflation factor scores, in which variables with $VIF > 3$ were dropped from consideration.

Environmental variables were selected for inclusion in models using two methods: (1) visual comparison of used versus available density plots, and (2) univariate logistic regression. Density plots depicted the frequency distribution of locations across the gradient of environmental values (e.g., range of elevation). Density functions were estimated using a Gaussian smoothing kernel and helped clarify the strength and shapes of selection. For example, unimodal selection (i.e., a quadratic function) is evident when the used distribution is higher at moderate environmental-variable values, and the available distribution is higher at low and high (extreme) environmental-variable values. Furthermore, univariate regressions were used to determine whether the appropriate functional form (or shape) of selection was linear or quadratic.

When caribou select a particular resource type on the landscape, it may select that resource for its quantity and distribution beyond the immediate vicinity. For example, a caribou may select a landcover type (e.g., grass-lichen-moss) based on its abundance within a 100 m or 250 m radius buffer from the caribou's location. This buffer can be interpreted as the 'patch size' of a given resource type. The habitat values for variable patch sizes were calculated using a moving window algorithm, computing the mean value of a given habitat component within a buffer with the respective radius. To develop an RSF with the appropriate patch sizes, univariate logistic regressions were fit using different patch sizes for TRI (60 m and 120 m), and NDVI and land cover percentages (100 m, 250 m, 500 m, or 1,000 m). The best functional forms and patch sizes of environmental variables were identified using a standard information theoretic approach, corrected Akaike Information Criterion (AICc; Burnham and Anderson 2002), which balances the trade-off between the amount of variance explained (model log-likelihood) and the number of variables fit. The univariate model with the lowest AICc score was identified as the best model (Burnham and Anderson 2002) describing the best functional forms and patch sizes of environmental variables.

Based on the results of data exploration, environmental variables used in RSFs were selected based on knowledge of Bathurst caribou and Dolphin and Union caribou seasonal ecology, shape and form of density plots, and the diagnostics from the univariate regression analysis. Some variables were not included in any seasonal models due to limited representation of certain landcover class within the seasonal range, which resulted in an inflated proportion of values at, or near zero which might affect model convergence (e.g., conifer forest land cover percent was excluded due to its minimal occurrence within caribou seasonal ranges). All variables were standardized to a mean of 0 and a standard deviation of 1 to compare relative importance between variables.

A.1.7 Model Validation

All RSFs were evaluated by their predictive performance (e.g., Johnson et al. 2020, Superbie et al. 2022). Model predictions were evaluated by implementing 5-fold cross-validation to compare *observed* versus *expected* used locations in decile (10) bins of mapped RSF predictions, as per Johnson et al. (2006). Below, each step of the model validation procedure is described in detail.

1. The location data were partitioned into five groups. Four of those groups were combined for each iteration of the cross-validation to produce the ‘training’ dataset; the remaining group was retained as the ‘testing’ dataset. Note: because the used-available location dataset was very large, it posed computational challenges to complete cross-validation procedures with the entire dataset; therefore, only 50% of used-available locations were resampled for each caribou-year combination. Each data fold included an equal number of different caribou-year combinations; this approach tested whether the population-level RSF could make consistent predictions regardless of interindividual variation.
2. The RSF was estimated using the ‘training’ dataset, and the predictions were mapped across the landscape at a 30 m resolution (i.e., the same resolution as environmental spatial layers). Those mapped predictions were then assigned a bin value from 1–10 to correspond with deciles for those predictions (i.e., 10-percentile intervals).
3. Midpoint (median) values of raw RSF (probabilities) were calculated for each decile bin. Those midpoints were used to calculate the expected utilization within each decile bin, as per Johnson et al. (2006):

$$U(x_i) = \frac{w(x_i)A(x_i)}{\sum_{i=1}^{n} w(x_i)A(x_i)}$$

where $U(x_i)$ is the expected utilization, $w(x_i)$ is the midpoint, and $A(x_i)$ is the area of the *i*-th decile bin. I.e., the expected utilization in each bin is calculated as the product of the midpoint and area in that bin, divided by the sum of the midpoint-area products in every bin.

4. The mapped RSF decile values were extracted to caribou locations in the 'testing' dataset — the *observed* counts in each decile bin.
5. The *expected* counts in each decile bin were calculated based on the expected utilization and the total number of used locations in the 'testing' dataset, as per Johnson et al. (2006):

   $$N_i = N \times U(x_i)$$

   where N_i is the expected count, N is the total number of observations in the 'testing' dataset, and $U(x_i)$ is the expected utilization (see previous equation) of the *i*-th decile bin.
6. The observed and expected counts were also recalculated as proportions, i.e., the number of counts in each decile divided by the sum of all counts. The relationships between observed versus expected proportions in each fold (or cross-validation iteration) were tested using major axis regression, spearman's rank sum correlation (r_s), and chi-square tests of proportions in every decile bin. Observed versus expected counts in all bins were compared using a chi-square goodness-of-fit test.

Major axis regressions with intercepts close to zero and slopes close to one indicate a strong fit between observed versus expected proportions. Slopes <1 indicate that fewer observed locations occur in areas with higher RSF values; in other words, the RSF predicts higher selection probabilities in areas with a less-than-expected number of caribou. Therefore, slopes <1 indicate that the RSF overestimates resource selection (or relative habitat quality). Conversely, slopes >1 indicate that the RSF underestimates resource selection (or relative habitat quality).

Steps (1) through (6) were repeated five times with five folds in each iteration. R packages 'sf' (Pebesma 2018) and 'terra' (Hijmans 2023) were used to facilitate prediction, mapping of the RSF, and extraction of RSF (decile) values to point locations. If issues with prediction accuracy were identified, then the global model structures were adjusted, and the validation process was repeated, using the new model structure. Model validation results are presented separately for each of the five iterations and summarized by combining all iterations.

A.1.8 Relative Habitat Quality and Distribution

A *post-hoc* selection ratio test was conducted between caribou locations and RSF values to define relative habitat quality ratings. Mapped RSF values were partitioned into 50 quantile bins (2-percentile intervals) and associated with *used* and *available* locations to calculate a ratio. The ratio was negative if the proportion of available locations in a 2-percentile interval was greater than that of used locations. The ratio was positive when the proportion of used locations was greater. The purpose of this approach was to identify the point within the RSF-value range where values switched from being *avoided* (negative ratio) to *selected* (positive ratio). Identifying this selection ratio switch-point prevents arbitrarily choosing a threshold to define *selected* (or high value) habitat, and it accounts for the combined effect of all habitat components on the landscape.

The selection ratio for each quantile bin was calculated as follows:

$$SR_i = \frac{UP_i - AP_i}{AP_i}$$

where the selection ratio SR_i for each *i*-th quantile bin is dependent on the proportion of used (UP_i) and available (AP_i) locations in that bin.

Six (6) habitat ratings were established to further describe the gradation in resource selection: Nil, Very Low, Low, Moderate, Moderately High, and High. These ratings were chosen to be consistent with common habitat suitability rating schemes (e.g., Clarke 2012). The portion of the *selected* RSF-value range (positive selection ratios) was divided into three equal parts to define Moderate, Moderately High, and High ratings. The portion of the *avoided* RSF-value range (negative selection ratios) was divided into three equal parts to define Nil, Very Low, and Low ratings. Note that the distinction between habitat ratings within the *selected* (Moderate versus Moderately High versus High) and *avoided* (Nil versus Very Low versus Low) RSF-value ranges is somewhat subjective, but it does reflect differences in the degree of selection. More important from an ecological perspective is the difference between *selected* and *avoided* regions on the landscape. Each pixel in the RSF map was assigned a habitat rating based on its RSF value to demonstrate those differences.

A.2 Results

A.2.1 Bathurst – Calving/ Post-calving

During calving/ post-calving, Bathurst caribou selected 0–300 m elevations, relatively flat terrain in a 60 m radius (TRI_60 < 10), >50% Grass-Lichen-Moss landcover within a 1,000 m radius, 10–40% Barren-Lichen-Moss landcover within a 1,000 m radius, and moderate (0.4–0.6) NDVI values. NDVI and elevation had the largest marginal effect on calving/ post-calving resource selection, as demonstrated by standardized regression coefficients (see Table A.3). The calving/ post-calving RSF had high prediction accuracy across the combined cross-validation tests (correlation: r_s = 0.97; regression: intercept = -0.01, slope = 1.06, R^2 = 0.90; see Figure A.1 for tests from each iteration). Following the development of habitat ratings (see Figure A.2), RSF predictions across the calving/ post-calving range demonstrated approximately 46% of the range is considered ‘selected’ habitat (moderate-to-high relative quality) by Bathurst caribou (see Figure 4.26).

Table A.3 Model Coefficients and 95% Confidence Intervals for Calving/ Post-calving Resource Selection by Bathurst Caribou

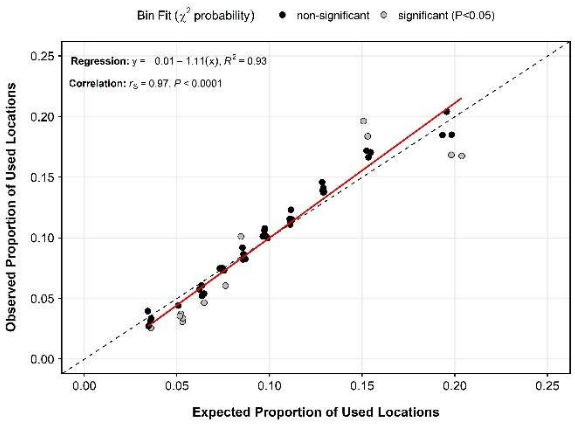
Model Term	Estimate	95% LL	95% UL	*z*-statistic	*P*-value
Intercept	-18.48	-118.63	81.67	-0.36	0.72
Land Cover Percent					
Grass-Lichen-Moss_1000m	0.31	0.21	0.41	6.30	<0.0001
(Grass-Lichen-Moss_1000m)^2	-0.11	-0.20	-0.01	-2.18	0.029
Barren-Lichen-Moss_1000m	0.50	0.41	0.58	11.14	<0.0001
(Barren-Lichen-Moss_1000m)^2	-0.75	-0.85	-0.65	-14.12	<0.0001
Vegetation Density					
NDVI_100m	11.50	10.25	12.75	18.01	<0.0001
(NDVI_100m)^2	-10.75	-11.80	-9.71	-20.16	<0.0001
Terrain Characteristics					
Elevation	5.01	4.46	5.56	17.74	<0.0001
(Elevation)^2	-5.25	-5.76	-4.73	-19.98	<0.0001
Ruggedness_60m	0.16	0.10	0.22	5.00	<0.0001
(Ruggedness_60m)^2	-0.78	-0.88	-0.68	-15.62	<0.0001

Notes:

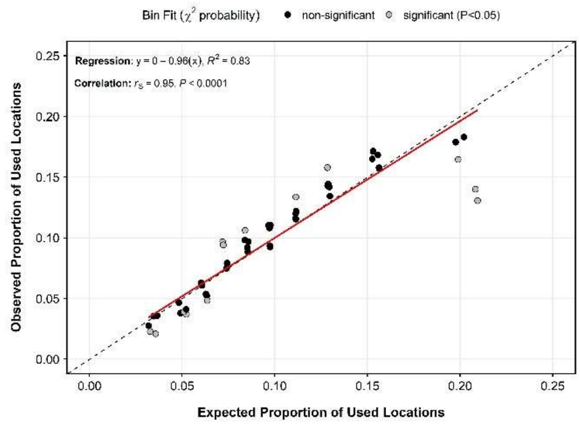
- Covariates were standardized before model fitting to allow relative comparison of fixed-effect coefficient magnitudes. Quadratic terms are identified as follows: $(x)^2$.
- Patch sizes are provided for the relevant covariate terms, e.g., 1000 m. Bolded coefficients identify terms with confidence intervals that do not overlap zero.
- 95% LL = lower confidence interval; 95% UL = upper confidence interval.
- Estimates of random slopes and intercepts are not provided because they are not of direct interest for interpreting results.

Figure A.1 Cross-Validation Results Comparing Expected Versus Observed Proportions of Used Locations by Bathurst Caribou During Calving/ Post-calving

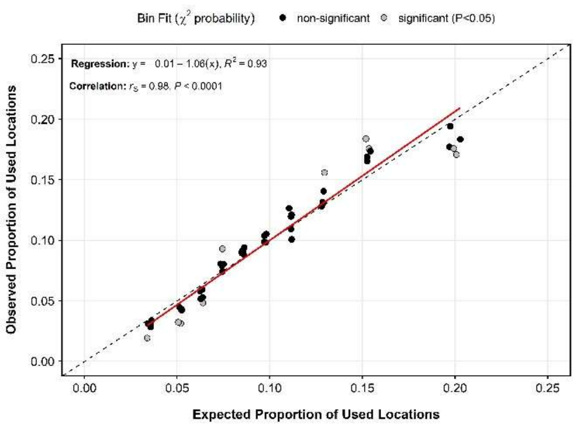
Iteration #1



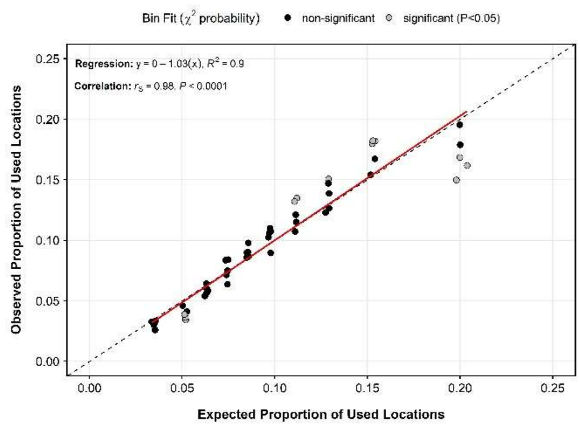
Iteration #2



Iteration #3



Iteration #4



Iteration #5

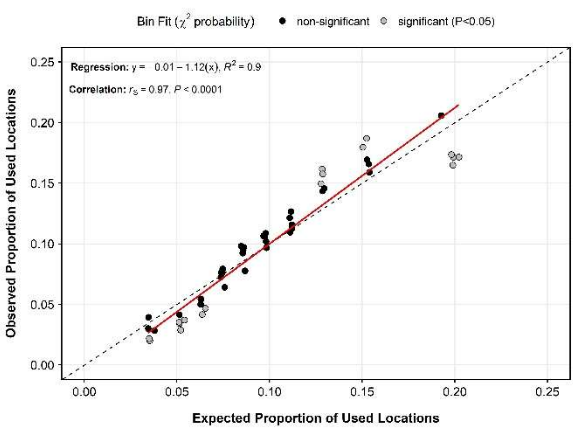
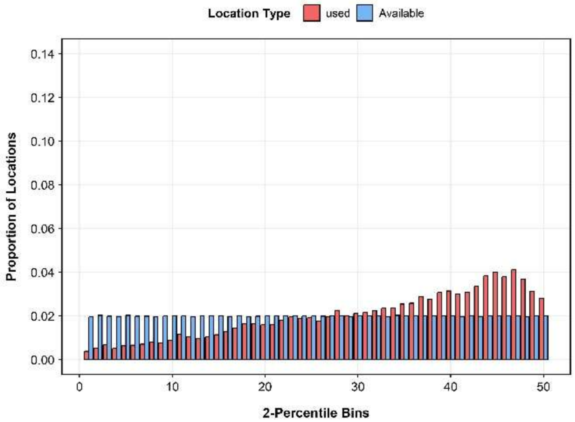
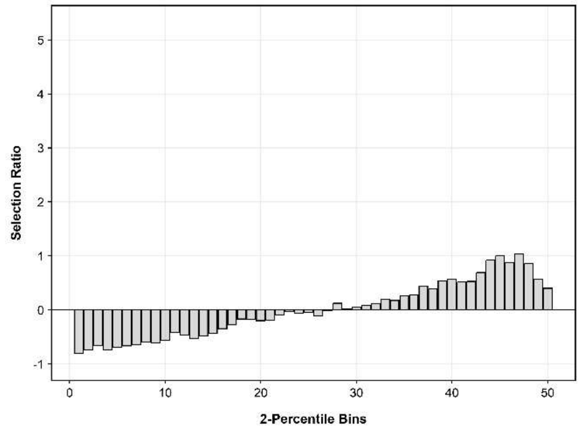


Figure A.2 Bathurst Caribou Calving/ Post-calving Habitat Rating Development

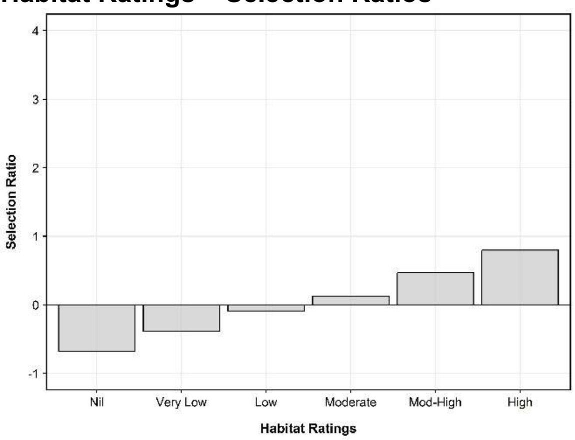
Bins – Used-Available Proportions



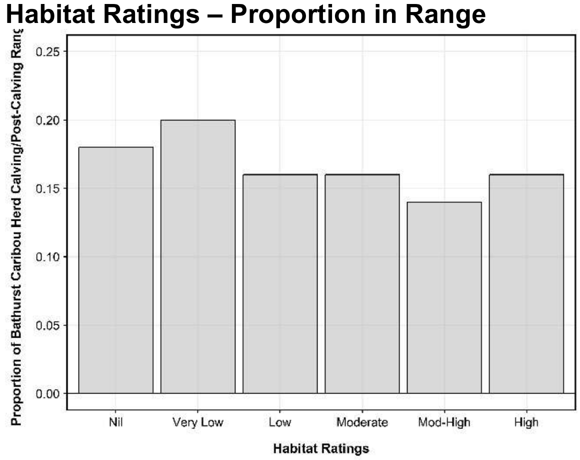
Bins – Selection Ratios



Habitat Ratings – Selection Ratios



Habitat Ratings – Proportion in Range



A.2.2 Bathurst – Summer

During summer, Bathurst caribou selected >500 m elevations, relatively flat terrain in a 120 m radius (TRI_120 < 10), >50% Grass-Lichen-Moss landcover within a 1,000 m radius, >60% Shrub-Lichen-Moss landcover within a 250 m radius, and high (>0.6) NDVI values. NDVI and elevation had the largest marginal effect on summer resource selection, as demonstrated by standardized regression coefficients (see Table A.4). The summer RSF had very high prediction accuracy across the combined cross-validation tests (correlation: r_s = 0.99; regression: intercept = -0.01, slope = 1.05, R^2 = 0.98; see Figure A.3 for tests from each iteration). Following the development of habitat ratings (see Figure A.4), RSF predictions across the summer range demonstrated approximately 46% of the range is considered 'selected' habitat (moderate-to-high relative quality) by Bathurst caribou (see Figure 4.27).

Table A.4 Model Coefficients and 95% Confidence Intervals for Summer Resource Selection by Bathurst Caribou

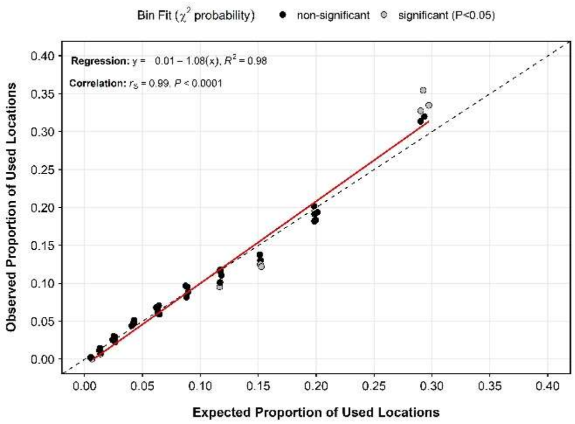
Model Term	Estimate	95% LL	95% UL	*z*-statistic	*P*-value
Intercept	-14.95	-124.17	94.27	-0.27	0.79
Land Cover Percent					
Grass-Lichen-Moss_1000m	-0.32	-0.40	-0.23	-7.14	<0.0001
$(\text{Grass-Lichen-Moss\_1000m})^2$	0.25	0.17	0.34	5.62	0.029
Shrub-Lichen-Moss_250m	1.71	1.59	1.83	27.93	<0.0001
$(\text{Shrub-Lichen-Moss\_250m})^2$	-0.65	-0.74	-0.56	-14.12	<0.0001
Vegetation Density					
NDVI_500m	9.11	8.28	9.93	21.66	<0.0001
$(\text{NDVI\_500m})^2$	-4.98	-5.39	-4.56	-23.27	<0.0001
Terrain Characteristics					
Elevation	4.55	4.20	4.90	25.46	<0.0001
$(\text{Elevation})^2$	-3.95	-4.29	-3.61	-22.86	<0.0001
Ruggedness_120m	-0.01	-0.06	0.04	-0.38	0.70
$(\text{Ruggedness\_120m})^2$	-0.19	-0.25	-0.12	-5.57	<0.0001

Notes:

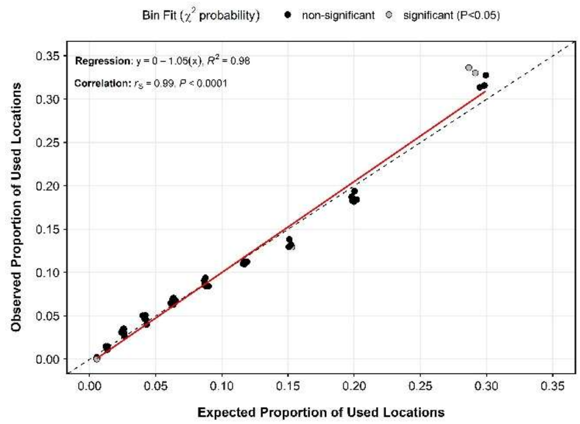
- Covariates were standardized before model fitting to allow relative comparison of fixed-effect coefficient magnitudes. Quadratic terms are identified as follows: $(x)^2$.
- Patch sizes are provided for the relevant covariate terms, e.g., 1000 m. Bolded coefficients identify terms with confidence intervals that do not overlap zero.
- 95% LL = lower confidence interval; 95% UL = upper confidence interval.
- Estimates of random slopes and intercepts are not provided because they are not of direct interest for interpreting results.

Figure A.3 Cross-Validation Results Comparing Expected Versus Observed Proportions of Used Locations by Bathurst Caribou During Summer

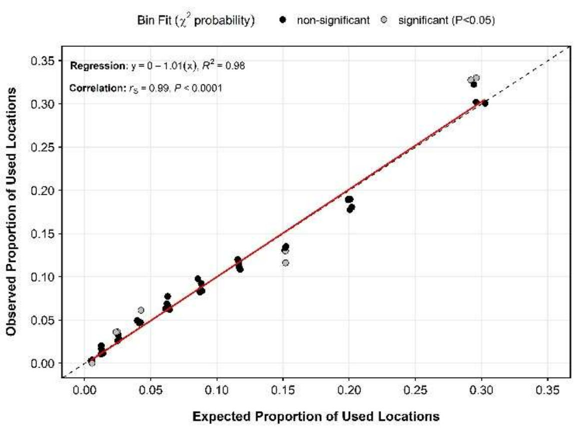
Iteration #1



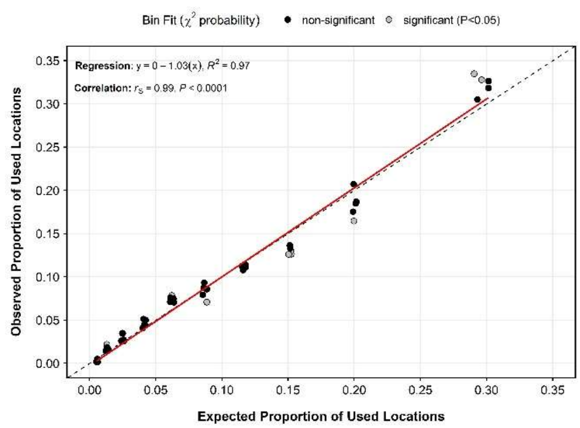
Iteration #2



Iteration #3



Iteration #4



Iteration #5

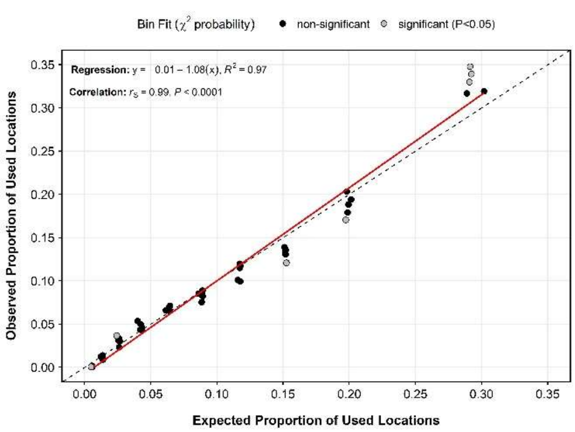
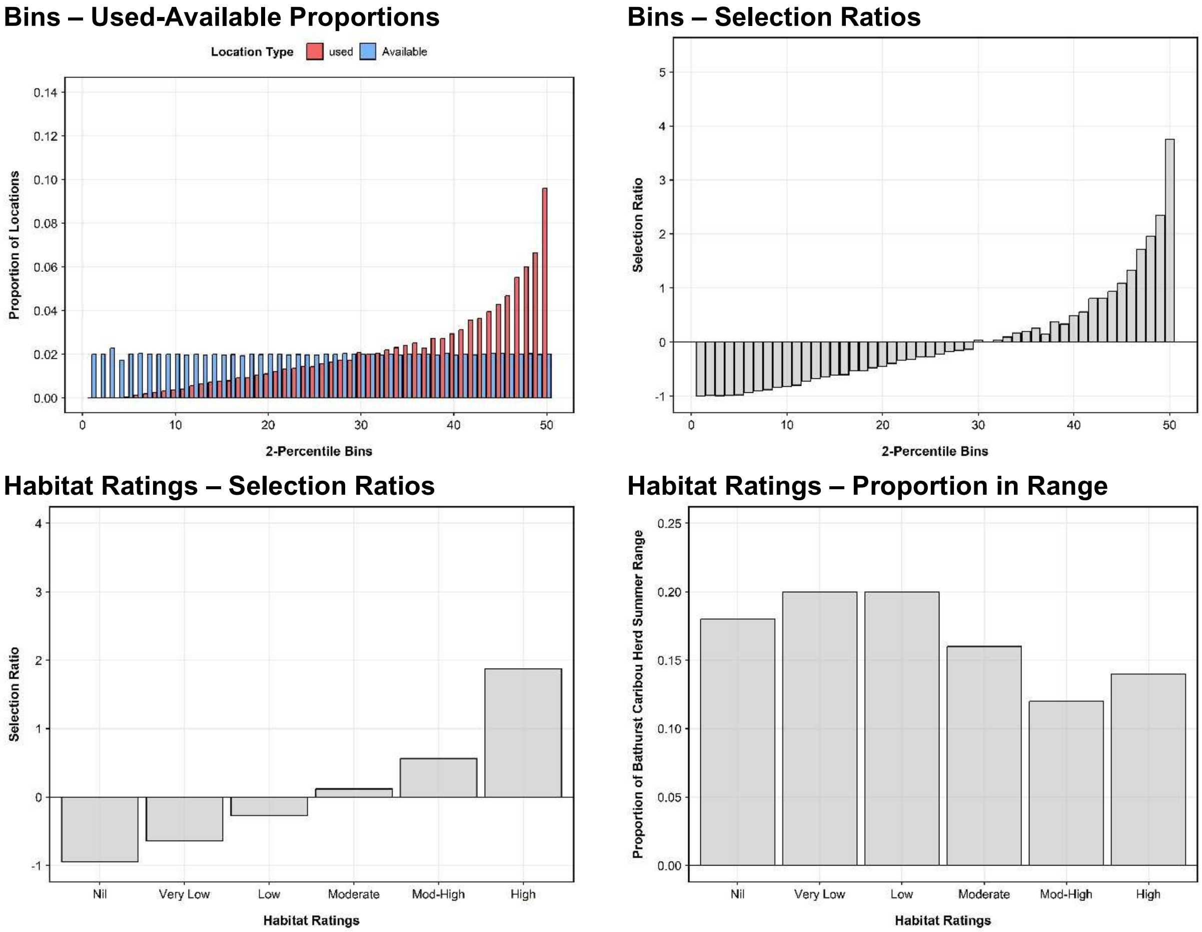


Figure A.4 Bathurst Caribou Summer Habitat Rating Development



A.2.3 Bathurst – Fall

During fall, Bathurst caribou selected >500 m elevations, <20% Grass-Lichen-Moss landcover within a 1,000 m radius, 40–80% Shrub-Lichen-Moss landcover within a 100 m radius, and high (>0.6) NDVI values. NDVI and elevation had the largest marginal effect on summer resource selection, as demonstrated by standardized regression coefficients (see Table A.5). The fall RSF had high prediction accuracy across the combined cross-validation tests (correlation: r_s = 0.98; regression: intercept = -0.01, slope = 1.06, R^2 = 0.96; see Figure A.5 for tests from each iteration). Following the development of habitat ratings (see Figure A.6), RSF predictions across the summer range demonstrated approximately 46% of the range is considered ‘selected’ habitat (moderate-to-high relative quality) by Bathurst caribou (see Figure 4.28).

Table A.5 Model Coefficients and 95% Confidence Intervals for Fall Resource Selection by Bathurst Caribou

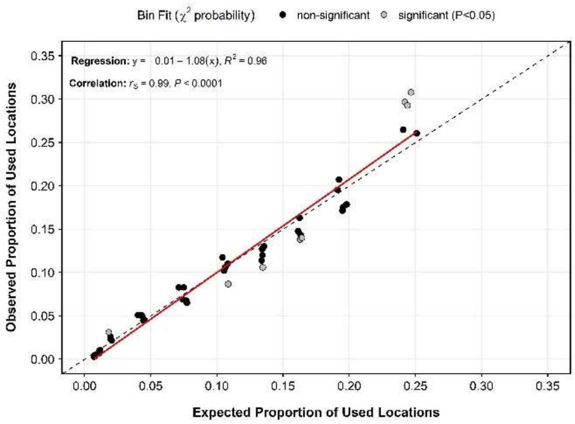
Model Term	**Estimate**	**95% LL**	**95% UL**	***z*-statistic**	***P*-value**
Intercept	-15.36	-131.87	101.15	-0.26	0.80
Land Cover Percent					
Grass-Lichen-Moss_1000m	0.15	0.07	0.23	3.67	0.0002
$(\text{Grass-Lichen-Moss\_1000m})^2$	-0.55	-0.65	-0.46	-11.20	<0.0001
Shrub-Lichen-Moss_100m	1.66	1.55	1.76	30.62	<0.0001
$(\text{Shrub-Lichen-Moss\_100m})^2$	-0.68	-0.76	-0.60	-16.26	<0.0001
Vegetation Density					
NDVI_1000m	12.10	10.85	13.35	18.98	<0.0001
$(\text{NDVI\_1000m})^2$	-6.51	-7.18	-5.84	-18.94	<0.0001
Terrain Characteristics					
Elevation	7.06	6.08	8.03	14.20	<0.0001
$(\text{Elevation})^2$	-6.62	-7.58	-5.66	-13.50	<0.0001

Notes:

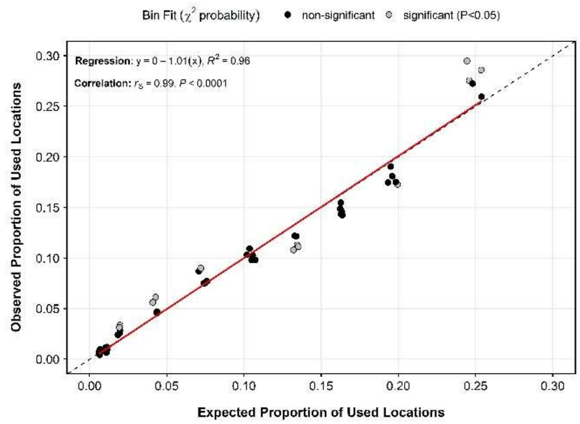
- Covariates were standardized before model fitting to allow relative comparison of fixed-effect coefficient magnitudes. Quadratic terms are identified as follows: $(x)^2$.
- Patch sizes are provided for the relevant covariate terms, e.g., 1000 m. Bolded coefficients identify terms with confidence intervals that do not overlap zero.
- 95% LL = lower confidence interval; 95% UL = upper confidence interval.
- Estimates of random slopes and intercepts are not provided because they are not of direct interest for interpreting results.

Figure A.5 Cross-Validation Results Comparing Expected Versus Observed Proportions of Used Locations by Bathurst Caribou During Fall

Iteration #1



Iteration #2



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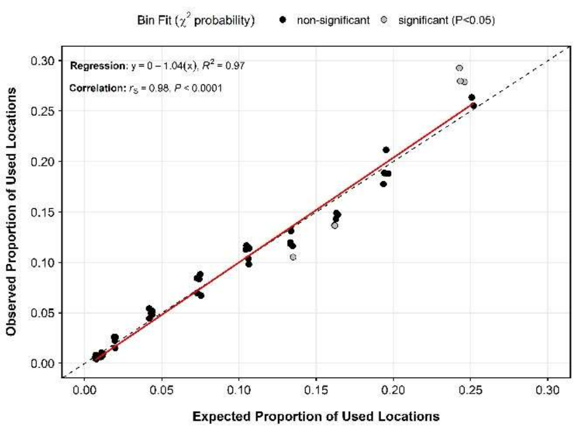
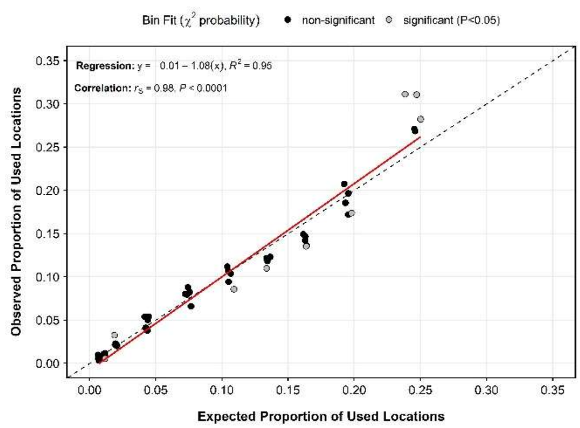


Iteration #4



Iteration #5

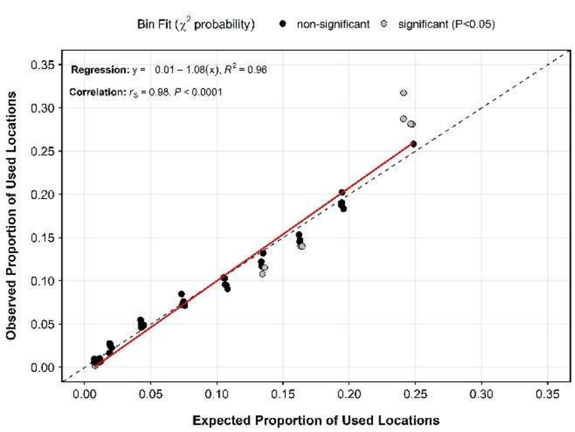
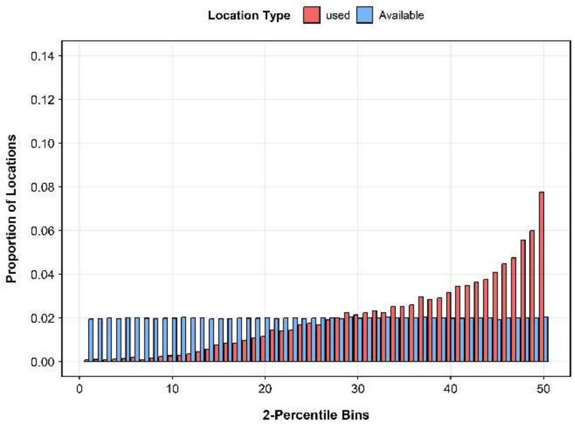
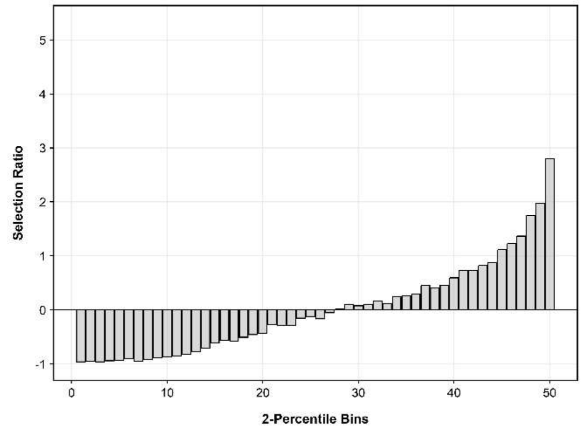


Figure A.6 Bathurst Caribou Fall Habitat Rating Development

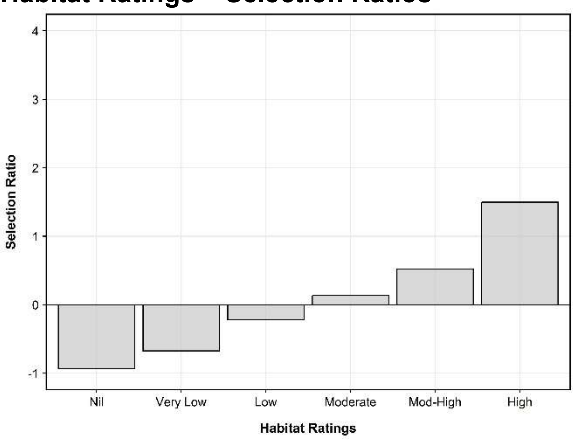
Bins – Used-Available Proportions



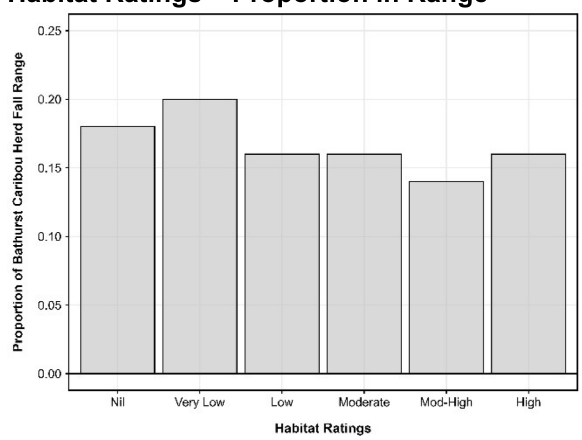
Bins – Selection Ratios



Habitat Ratings – Selection Ratios



Habitat Ratings – Proportion in Range



A.2.4 Dolphin and Union – Pre-Spring and Post-Fall Migration Staging

During pre-spring and post-fall migration staging, Dolphin and Union caribou selected <200 m elevations, relatively flat terrain in a 60 m radius (TRI_60 < 10), and 20–40% Shrub-Lichen-Moss landcover within a 100 m radius. Elevation and Shrub-Lichen-Moss landcover had the largest marginal effect on resource selection, as demonstrated by standardized regression coefficients (see Table A.6). The pre-spring and post-fall migration staging RSF had moderate prediction accuracy across the combined cross-validation tests (correlation: r_s = 0.88; regression: intercept = -0.01, slope = 1.11, R^2 = 0.86; see Figure A.7 for tests from each iteration). Following the development of habitat ratings (see Figure A.8), RSF predictions during pre-spring and post-fall migration staging demonstrated approximately 38% of the herd's mainland range is considered 'selected' habitat (moderate-to-high relative quality) by Dolphin and Union caribou (see Figure 4.39).

Table A.6 Model Coefficients and 95% Confidence Intervals for Pre-Spring and Post-Fall Migration Staging Resource Selection by Dolphin and Union Caribou

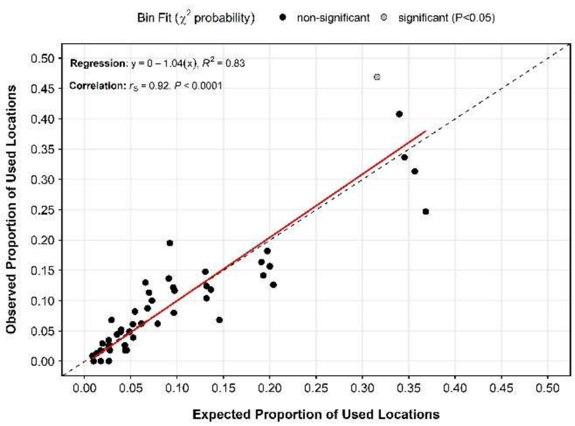
Model Term	Estimate	95% LL	95% UL	*z*-statistic	*P*-value
Intercept	-17.15	-222.61	188.31	-0.16	0.87
Land Cover Percent					
Shrub-Lichen-Moss_100m	1.76	1.51	2.00	14.04	<0.0001
(Shrub-Lichen-Moss_100m)^2	-1.63	-1.85	-1.40	-14.16	<0.0001
Terrain Characteristics					
Elevation	2.53	1.23	3.84	3.81	0.0001
(Elevation)^2	-6.50	-8.25	-4.74	-7.26	0.0000
Ruggedness_60m	-0.04	-0.22	0.13	-0.50	0.6187
(Ruggedness_60m)^2	-0.22	-0.46	0.01	-1.87	0.0609

Notes:

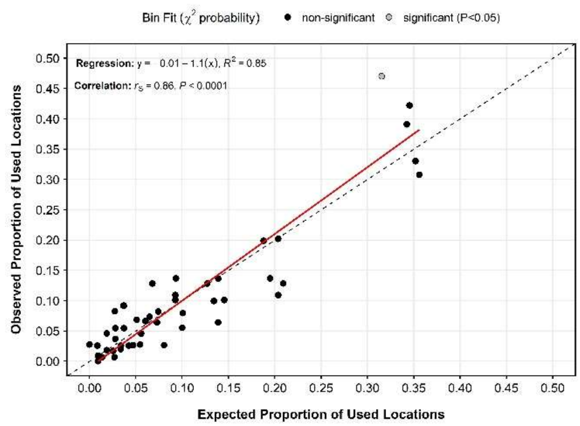
- Covariates were standardized before model fitting to allow relative comparison of fixed-effect coefficient magnitudes. Quadratic terms are identified as follows: $(x)^2$.
- Patch sizes are provided for the relevant covariate terms, e.g., 1000 m. Bolded coefficients identify terms with confidence intervals that do not overlap zero.
- 95% LL = lower confidence interval; 95% UL = upper confidence interval.
- Estimates of random slopes and intercepts are not provided because they are not of direct interest for interpreting results.

Figure A.7 Cross-Validation Results Comparing Expected Versus Observed Proportions of Used Locations by Dolphin and Union Caribou During Pre-Spring and Post-Fall Migration Staging

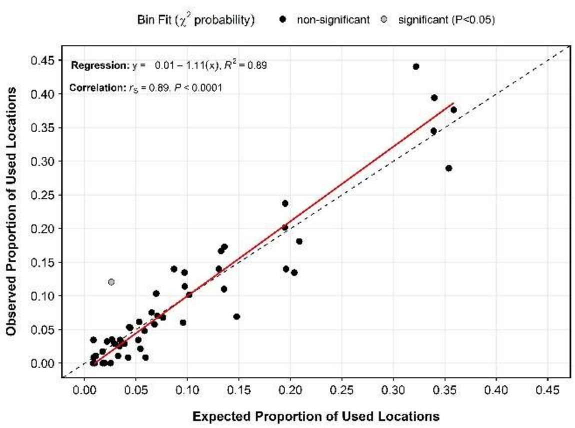
Iteration #1



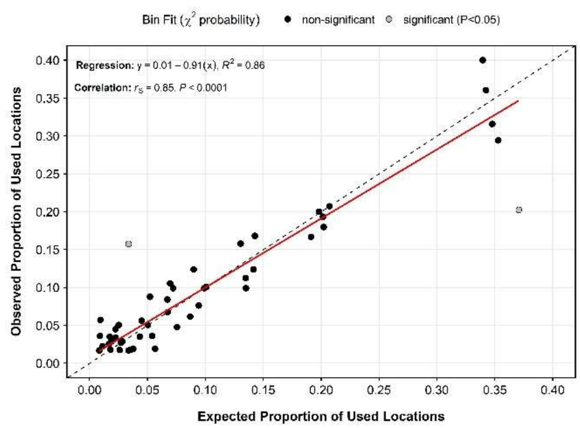
Iteration #2



Iteration #3



Iteration #4



Iteration #5

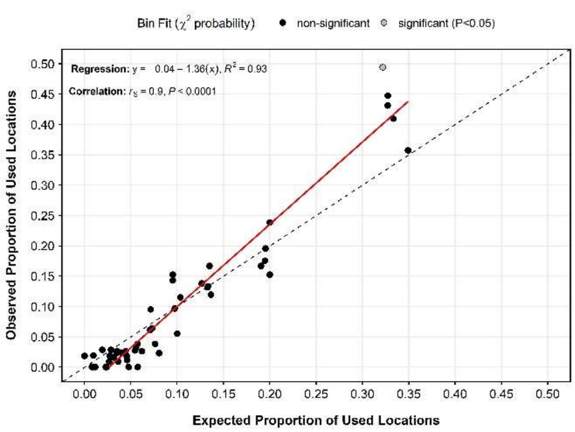
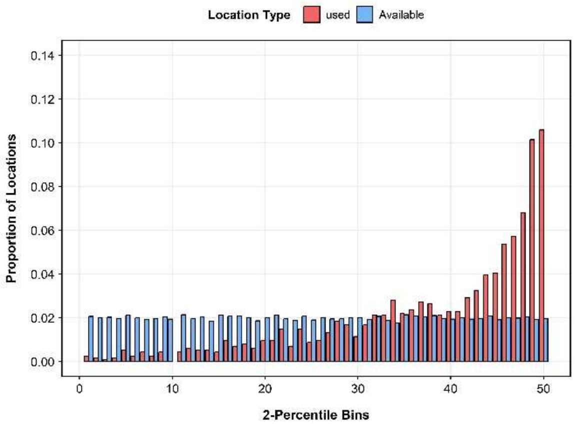
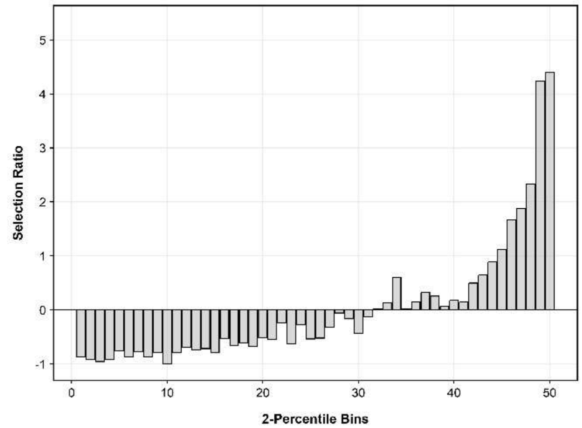


Figure A.8 Dolphin and Union Caribou Pre-Spring and Post-Fall Migration Staging Habitat Rating Development

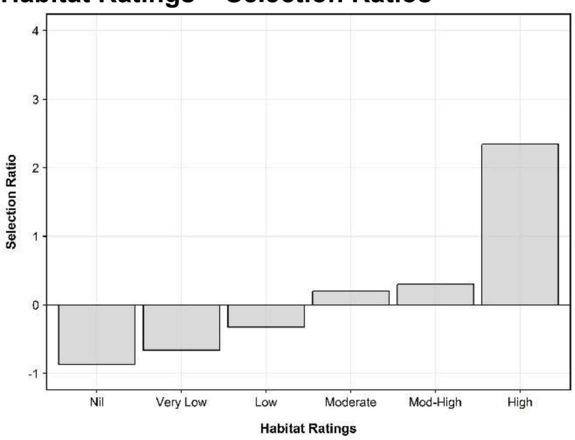
Bins – Used-Available Proportions



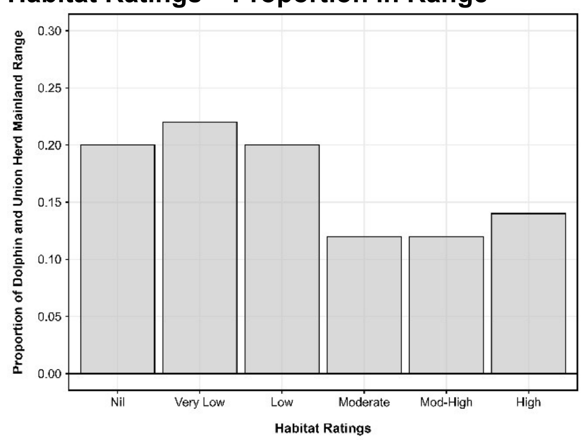
Bins – Selection Ratios



Habitat Ratings – Selection Ratios



Habitat Ratings – Proportion in Range



A.2.5 Dolphin and Union – Winter

During winter, Dolphin and Union caribou selected a range of elevations (100–400 m), relatively flat terrain in a 120 m radius (TRI_60 < 10), 10–30% Grass-Lichen-Moss landcover within a 250 m radius, and moderate (0.4–0.6) NDVI values. NDVI and elevation had the largest marginal effect on winter resource selection, as demonstrated by standardized regression coefficients (see Table A.7). The winter RSF had high prediction accuracy across the combined cross-validation tests (correlation: r_s = 0.94; regression: intercept = 0.00, slope = 1.01, R^2 = 0.90; see Figure A.9 for tests from each iteration). Following the development of habitat ratings (see Figure A.10), RSF predictions during winter demonstrated approximately 50% of the herd's mainland range is considered 'selected' habitat (moderate-to-high relative quality) by Dolphin and Union caribou (see Figure 4.40).

Table A.7 Model Coefficients and 95% Confidence Intervals for Winter Resource Selection by Dolphin and Union Caribou

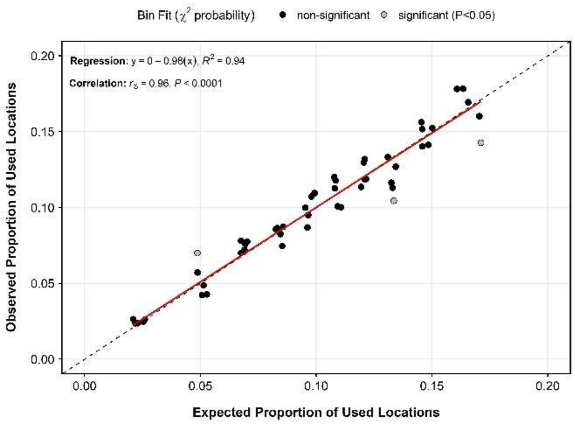
Model Term	Estimate	95% LL	95% UL	*z*-statistic	*P*-value
Intercept	-15.79	-201.82	170.24	-0.17	0.87
Land Cover Percent					
Grass-Lichen-Moss_250m	0.70	0.54	0.87	8.40	<0.0001
$(\text{Grass-Lichen-Moss\_250m})^2$	-0.92	-1.06	-0.79	-13.15	<0.0001
Vegetation Density					
NDVI_1000m	6.36	5.28	7.44	11.54	<0.0001
$(\text{NDVI\_1000m})^2$	-5.82	-6.76	-4.88	-12.08	<0.0001
Terrain Characteristics					
Elevation	7.46	6.13	8.79	10.96	<0.0001
$(\text{Elevation})^2$	-7.11	-8.15	-6.07	-13.43	<0.0001
Ruggedness_120m	0.29	0.15	0.43	3.98	0.0001
$(\text{Ruggedness\_120m})^2$	-1.44	-1.66	-1.21	-12.78	<0.0001

Notes:

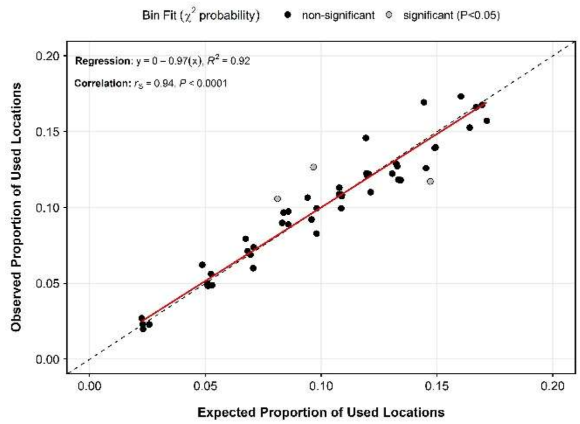
- Covariates were standardized before model fitting to allow relative comparison of fixed-effect coefficient magnitudes. Quadratic terms are identified as follows: $(x)^2$.
- Patch sizes are provided for the relevant covariate terms, e.g., 1000 m. Bolded coefficients identify terms with confidence intervals that do not overlap zero.
- 95% LL = lower confidence interval; 95% UL = upper confidence interval.
- Estimates of random slopes and intercepts are not provided because they are not of direct interest for interpreting results.

Figure A.9 Cross-Validation Results Comparing Expected Versus Observed Proportions of Used Locations by Dolphin and Union Caribou During Winter

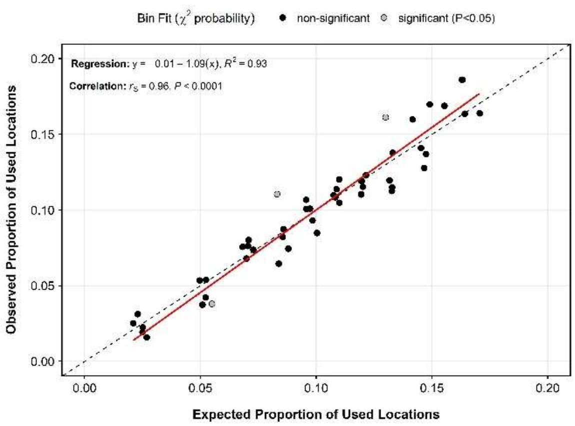
Iteration #1



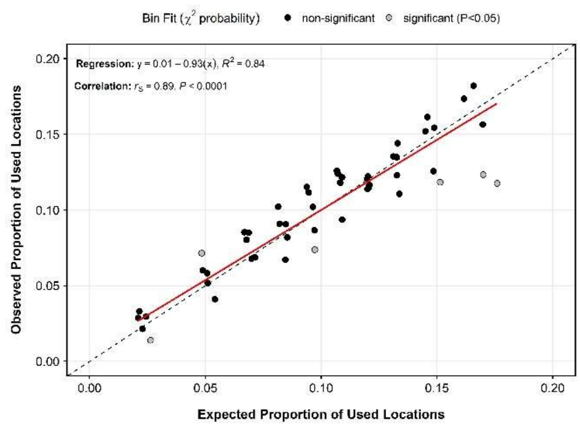
Iteration #2



Iteration #3



Iteration #4



Iteration #5

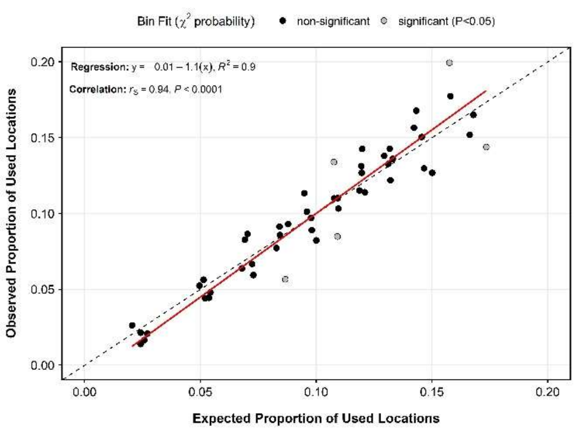


Figure A.10 Dolphin and Union Caribou Winter Habitat Rating Development