SPECIES STATUS REPORT

Wolverine

(Gulo gulo)

Carcajou
Kalvik
Qavvik
Nèhtrùh
Nǫ́gha
Nógha
Nogha
Nághai

in the Northwest Territories

NORTHWEST TERRITORIES
SPECIES AT RISK
COMMITTEE

Not at Risk

December 2014

Species at Risk Committee status reports are working documents used in assigning the status of species suspected of being at risk in the Northwest Territories (NWT).

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ABOUT THE SPECIES AT RISK COMMITTEE
The Species at Risk Committee was established under the *Species at Risk (NWT) Act*. It is an independent committee of experts responsible for assessing the biological status of species at risk in the NWT. The Committee uses the assessments to make recommendations on the listing of species at risk. The Committee uses objective biological criteria in its assessments and does not consider socio-economic factors. Assessments are based on species status reports that include the best available Aboriginal traditional knowledge, community knowledge and scientific knowledge of the species. The status report is approved by the Committee before a species is assessed.

ABOUT THIS REPORT
This species status report is a comprehensive report that compiles and analyzes the best available information on the biological status of Wolverine in the NWT, as well as existing and potential threats and positive influences. Full guidelines for the preparation of species status reports, including a description of the review process, may be found at www.nwtspeciesatrisk.ca.

Northwest Territories Environment and Natural Resources

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NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

Assessment of Wolverine

The Northwest Territories Species at Risk Committee met in Fort Simpson, Northwest Territories on December 9, 2014 and assessed the biological status of Wolverine in the Northwest Territories. The assessment was based on this approved status report. The assessment process and objective biological criteria used by the Species at Risk Committee are available at www.nwtspeciesatrisk.ca.

Status: Not at Risk in the Northwest Territories

Wolverine has been evaluated and found to be not at risk of extinction given the current circumstances.

Reasons for the assessment: The species has been assessed and it does not qualify for designation as Extinct, Extirpated, Endangered, Threatened, Special Concern or Data Deficient.

- Wolverines range throughout the NWT and are well-suited to many different habitats and conditions. Habitat availability and fragmentation are currently not considered to be major issues for wolverines in the NWT.
- Wolverines naturally occur at low population density and there is evidence that the population is stable or increasing across much of the NWT; however, there is some indication that populations may be declining in the central barrens, potentially related to declines in barren-ground caribou.
- There is a general consensus that wolverines are found in the same areas they were historically found, and may even be expanding their range northward.
- Wolverines are effective predators and scavengers, capable of utilizing many alternate food sources during times of prey/carrion scarcity.
- The possibility of rescue from other northern jurisdictions is considered high, as neighbouring populations are deemed to be healthy and mobile.
- While the main threats to wolverines were identified to be harvesting, decreasing food

availability and sensitivity to noise, the individual threats were all deemed to be low to negligible at this time.

- Wolverines generally avoid areas of human activity; disturbances near denning sites have adverse effects on wolverine reproduction in the long-term.

- Increasing frequency and magnitude of threats, as well as their cumulative effects, could cause wolverines to be considered a species of Special Concern in the NWT.

Positive influences to wolverine and its habitat:

- Some types of landscape disturbance, such as wildfires, may be considered beneficial to wolverines as regeneratation attracts prey species.

- Several wolverine refugia occur in areas situated away from major communities that are hard to access.

- The Sahtú, Gwich'in and Tłı̨chǫ Land Use Plans include zoning that add to habitat protection. Six communities in the Inuvialuit Settlement Region (Inuvik, Tuktoyaktuk, Paulatuk, Ulukhaktok, Sachs Harbour and Aklavik) have adopted community conservation plans, which include recommended Wolverine conservation measures.

Recommendations:

- Hunters and trappers in some communities are interviewed annually regarding their wildlife harvest. A comprehensive harvest monitoring program is essential to assess the status of wolverine in the future.

- Comprehensive and coordinated traditional knowledge, scientific research and monitoring should be conducted in each region.

- Evaluate the effect of harvest incentives on the NWT wolverine population.

- Enhance the management of known threats using a holistic approach.

- Reassess the status of wolverine as significant new information is made available.

Executive Summary

Traditional & Community Knowledge	Scientific Knowledge
Description Wolverines are medium-sized, muscular furbearers. Their fur is mostly dark brown with lighter bands running along their lower sides, although colouration can vary regionally. Their average weight is 25 pounds (lbs) (11.3 kilograms (kg)), but they can be much heavier. They are 1.5-3.5 feet long, head to tail. Male wolverines are larger than females.	**Description** Wolverines are a medium-sized carnivore and the largest terrestrial member of the weasel family in North America, appearing more like a small bear than a weasel. They have long, glossy, coarse fur, which varies from brown to black, often with a pale facial mask and a single yellowish or tan stripe running laterally from each shoulder and meeting just above the tail. Most individuals have a white patch on the neck and chest. They have a large head, broad forehead, short stout neck, short stocky legs, and a heavy musculature. The feet are large, ears short and the tail is long and bushy. The skull structure is robust, allowing it to crush bones and eat frozen carcasses. Adult male wolverines weigh 13 to 16 kg and are generally larger than adult females, which weigh 7.5 to 11 kg.
Distribution Wolverines occur throughout the Northwest Territories (NWT) and in the Yukon Territory and Nunavut.	**Distribution** Wolverines are found across northern Eurasia and North America. In Canada they are found in northern and western ecologically intact forested areas, in alpine tundra of the western mountains, and in arctic tundra. They are found across the NWT in all habitats, although they

	are thought to be absent from most Arctic islands in the NWT except Victoria and Banks islands.
Biology and Behaviour Wolverines are good scavengers and hunters, able to traverse most terrains. Wolverines den in eskers, cliffs, rock crevices, mountains, mud banks, creek beds, and under snowdrifts or in logs and trees. Wolverines can move quickly (10-30 miles/hour according to some harvesters), cover long distances, and are described as constantly being on the move, looking for food. Females tend to have smaller home ranges than males, as they stay closer to den sites. Apart from at dens and occasionally at large kills, animals are almost always seen alone. Wolverines breed in March and April, then have kits in June or July. Litters are usually two to four kits and the young are kept in the den for the first few months of life. Young wolverines leave their mother within the first 12 months of life and have low survivorship that first year. Wolverines are known for their strength and intelligence. They can steal food from other predators and traps, and will cache and scent food for later use.	**Biology and Behaviour** Most females do not breed until they are two or three years old, and may not breed every year. Litter sizes average about two kits. Wolverines are thought to breed in the summer when females are more sedentary, with the implantation of the blastocyst (early stage of the embryo) delayed until winter. Wolverines face mortality from predation and starvation. Human-caused mortality factors (e.g., hunting and trapping) are also significant, and may increase with development of remote areas. The growth rate of kits is rapid, placing nutritional demands on the mother. They occupy home ranges that can be 50-400 km^2 for females and 230-1,580 km^2 for males. Dispersing juveniles may have even larger ranges. Home ranges may overlap within and between sexes but, overall, Wolverine densities have decreased in some study areas, but even at these reduced densitites, are considered to be moderate to high relative to other areas in North America. Wolverines are both scavengers and predators, often caching food for future use.

Their keen sense of smell, good hearing, strength, speed, endurance, and aggressive nature make them excellent predators. They have few competitors or predators, and mortality caused by other animals is thought to be low. Wolverines can avoid predators as well by climbing trees.	
Population Little to no detailed information on Wolverine abundance for the NWT was found in the sources reviewed for this report. The population status in the Mackenzie Delta was described as 'relatively few', and in the northern NWT, the Parry Peninsula was described as having 'many' wolverines. Wolverine populations in the Inuvialuit Settlement Region are thought to be stable. In the Gwich'in Settlement Area, no clear trend in Wolverine numbers was apparent. There were very few observations about population trends in the North and South Slave Regions; observations indicated that populations may be stable or decreasing in certain areas. Knowledge holders from numerous communities identified areas of refugia where relatively little Wolverine harvesting occurs and there is adequate food and habitat for Wolverine. It is thought that migration of young wolverines from these refugia sustains harvesting in other areas.	**Population** A rough estimate of the Wolverine population in the NWT is approximately 3,000-6,000. An additional 220-470 juveniles, many being transients, may be present in the fall (pre-trapping) population of the NWT based on an annual growth rate of 6.4 percent (%) found in untrapped areas in North American studies. Harvest data indicates that there is generally a fairly stable population in the NWT. Wolverines may be expanding their distribution and numbers on Victoria Island and on the northeastern and eastern mainland. However, densities declined in the central barrens between 2004/05-2011. Density declines by between approximately 39-66 percent (%). These declines were likely due to concurrent declines in the Bathurst caribou herd.

Wolverines from neighbouring areas of the Yukon Territory and Nunavut would likely be adapted to survive and reproduce, as well as find adequate habitat, in the NWT.	
Habitat Wolverines tend to be found 'where the food is' – large mammal carrion and carcasses are critical to their diet, so their presence is more often associated with food availability than a certain habitat type. Wolverines can be found in a wide variety of habitats, but seem to prefer the treeline, higher areas, or rocky and hilly areas where there are no trees. Their diet is extremely varied; however, Barren-ground Caribou are a main food source. Other ungulates, rodents, birds and bird eggs, fish, seals, berries and vegetation are also components of their diet. There were no comments about Wolverine habitat trends or loss in the sources reviewed for this report, nor was there any information on habitat availability or fragmentation. However, some areas were identified as having higher densities of wolverines – this may indicate areas of good habitat. Because of their characteristics, wolverines may have the potential to travel large distances to find good habitat,	**Habitat** Both forested and tundra vegetation associations, in ecologically intact areas where there is an adequate year-round supply of food, are used by wolverines. In the summer, food supplies consist of smaller prey species, such as rodents and Snowshoe Hares, while in winter, their diet consists of the carcasses of larger animals, like Moose, caribou and Muskox. Females den under snow-covered rocks, logs or within snow tunnels without additional structure. The snow cover, in areas where wolverines reproduce, persists at least into April or early summer at higher latitudes.

but are not likely to travel through areas of industrial activity or high population density. There are some observations that wolverines are expanding their distribution northward, having an increased presence on Victoria Island. Distribution can vary seasonally, based on access to food sources.	
Threats and Limiting Factors No actual threats were identified in the sources reviewed for this report, but several potential threats were identified that could negatively impact Wolverine populations in the NWT. These include industrial activities and human disturbances, harvesting, low food availability (e.g., if caribou populations declines), and climate change.	**Threats and Limiting Factors** The ability of Wolverine populations to recover and repopulate vacant habitats is naturally low because of low fecundity. Other factors that may limit populations include harvest, disturbance of denning areas, threats to habitats, and fluctuations in wolves, bears, caribou and Moose, as well as prey species. Forestry, hydroelectric developments, oil and gas and mineral exploration and development, and transportation corridors contribute to permanent, temporary or functional habitat losses (sensitivity to disturbance), which may destabilize populations. Current developments in the NWT affecting the Wolverine population include diamond mines; oil and gas exploration and development may present a threat in the future.
Positive Influences The available sources rarely contained information on positive influences affecting	**Positive Influences** Climate models predict increases in temperature and precipitation in Canada,

wolverines, or the relative importance or magnitude of these influences. Land use planning and protected areas that contain important Wolverine habitat will likely help to sustain populations in the north.	with the largest warming projected for northern Canada. Precipitation is likely to increase in winter and spring, but decrease in summer. Snow season length is predicted to decrease, but a net increase in snowfall should make up for the shorter snow season, resulting in increased snow accumulation. Since spring snow cover during the denning period is a critical habitat requirement of wolverines, the impact on wolverines should be negligible in the Arctic. Earlier snowmelt could actually benefit wolverines by improving primary (plant) productivity. Protected areas and community-based conservation planning can help protect habitats from development and foster Wolverine population management.

Technical Summary

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Population Trends		
Generation time (*average age of parents in the population*) **(indicate years, months, days, etc.)**	Information not available in sources.	7.5 years
Number of mature individuals in the NWT (or give a range of estimates)	Information not available in sources.	3,000-6,000
Amount of change in numbers in the recent past; *Percent change in total number of mature individuals over the* ***last*** *10 years or 3 generations, whichever is longer*	Information not available in sources.	Unknown. A recent decline (2004-2005 to 2011) of 39-66% occurred locally in three Southern Arctic Ecozone study areas over seven to eight years. Populations in other ecozones are not monitored, except by harvest, which appears stable.
Amount of change in numbers predicted in the near future; *Percent change in total number of mature individuals over the* ***next*** *10 years, or 3 generations*	Information not available in sources.	Unknown
Amount of change happening now; *Percent change in total number of mature individuals over any 10 year or 3 generation period which includes* ***both the past and the future***	Information not available in sources.	Unknown

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
If there is a decline (*in the number of mature individuals*)**, is the decline likely to continue if nothing is done?**	Not applicable.	Unknown
If there is a decline, are the causes of the decline reversible?	Not applicable.	Unknown
If there is a decline, are the causes of the decline clearly understood?	Not applicable.	No.
If there is a decline, have the causes of the decline been removed?	Not applicable.	No
If there are fluctuations or declines, are they within, or ourside of, natural cycles?	Information not available in sources; however, trends linked to supply of Snowshoe Hares and other prey species have been noted.	They are within natural cycles driven by Snowshoe Hare and caribou.
Are there 'extreme fluctuations' *(ups and downs; >1 order of magnitude)* **in the number of mature individuals?**	Information not available in sources.	No
Distribution Trends		
Where is the species found in the NWT?; *Estimated extent of occurrence in the NWT (in km2)*	Wolverines are found throughout the NWT.	1,868,289 million km^2

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
How much of its range is suitable habitat?; *Index of area of occupancy (IAO) in the NWT (in km2; based on 2 × 2 grid)*	Information not available in sources.	1,316,908 million km^2
How many populations are there? To what degree would the different populations be likely to be impacted by a single threat?; *Number of extant locations in the NWT*	Information not available in sources.	One population (Canadian; COSEWIC 2014); however, the number of 'locations' that are possible exceeds the threshold of 10.
Is the distribution, habitat or habitat quality showing a decline that is likely to continue if nothing is done?; *Is there a **continuing decline** in area, extent and/or quality of habitat?*	Information not available in sources.	No
Is the number of populations or amount of occupied area showing a decline that is likely to continue if nothing is done?; *Is there a **continuing decline** in number of locations, number of populations, extent of occupancy and/or IAO?*	Information not available in sources.	No
Are there 'extreme fluctuations' (*ups and downs)* **in the range or the number of populations?;** *Are there extreme fluctuations (>1 order of magnitude) in number of locations, extent of occupancy and/or IAO?*	Information not available in sources.	No

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Is the NWT population 'severely fragmented' *(most individuals found within small and isolated populations)***?**	The NWT population is described as widespread, with wolverines found in low numbers throughout their range.	No
Immigration from populations elsewhere		
Does the species exist elsewhere?	Wolverines are found in neighbouring areas of Yukon Territory and Nunavut. No TK/CK sources of information south of NWT were reviewed for this report.	Yes
Status of the outside population(s)	In Nunavut, the Wolverine population is described as high in the Kitikmeot region, and increasing in the Kivalliq region. In 2004, Yukon populations were described as increasing or stable.	*Special Concern* in Canada (COSEWIC 2014), general status *Sensitive* in Canada, Yukon, British Columbia and Manitoba; *Secure* in Nunavut; *May be at Risk* in Alberta; *At Risk* in Saskatchewan and Ontario.
Is immigration known or possible?	Information not directly available in sources; however, wolverines were noted to be able to travel long distances and no barriers were identified. Immigration is therefore possible.	Yes, from all neighbouring jurisdictions (three provinces and two territories).
Would immigrants be adapted to survive and reproduce in the NWT?	Information not available in sources.	Yes
Is there enough good habitat for immigrants in the NWT?	Information not available in sources.	Yes

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Is the NWT population self-sustaining or does it depend on immigration for long-term survival?	Information not available in sources.	Information not available in sources.
Threats and Limiting Factors		
Briefly summarize the threats and limiting factors. For each one, indicate how imminent it is and what the degree/scale of the impact is.	No actual threats to wolverines were identified in the sources, nor was there information on imminence and degree of threats. Potential threats and limiting factors included: Low food availability – for wolverines that rely on barren-ground caribou, reduced caribou populations could adversely impact some wolverine. Industrial development and human disturbance – wolverines are sensitive to noise, try to avoid disturbance, and are unlikely to habituate. Habitat destruction and fragmentation – seismic exploration, mining activities and roads were seen as possible threats to wolverines where they occur in their range. Climate change – likely to affect wolverines throughout their range, but impact not defined.	Habitat loss (permanent, temporary and/or functional) and fragmentation due to forestry, mining, oil and gas development, hydroelectric reservoirs, and roads. These threats are presently low in magnitude. Populations may be affected by harvest, including hunting, trapping, and nuisance control at wilderness camps. These threats are low or negligible in magnitude. Declining ungulate populations, especially Barren-ground Caribou in the NWT. This threat has the potential to initiate Wolverine population declines or fluctuations. Functional habitat loss due to disturbance caused by vehicles on roads and recreational activities such as all-terrain vehicles, snowmobiles, hiking and skiing during the denning period. Low in magnitude at present.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
	Levels of Wolverine harvesting are relatively low and were not identified as a threat.	
Positive Influences		
Briefly summarize the positive influences. For each one, indicate how imminent it is and what the degree/scale of the impact is.	Areas of refugia that receive little harvesting pressure and/or areas protected in parks help sustain Wolverine populations in nearby areas. Community conservation plans identify and promote measures to protect wolverines.	Global climate change may result in increased spring snow cover, which could benefit denning females and their litters.

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Traditional and Community Knowledge Component

Preamble

Very few comprehensive sources of published traditional or community knowledge of wolverines in the NWT were available at the time this report was prepared. As a result, the report relies extensively on Nathan Cardinal's thesis on Aboriginal traditional knowledge (TK) of Wolverine in Northern Canada (Cardinal 2004). As part of that research, interviews were conducted with 30 people in the following ten communities: (NWT) – Yellowknife, Inuvik, Tuktoyaktuk; Nunavut – Arviat, Baker Lake, Kugluktuk; Yukon Territory – Old Crow, Dawson City, Haines Junction, Teslin. Cardinal's research touched on knowledge from Inuit, Inuvialuit, Van Tat Gwich'in, Tr'ondëk Hwëch'in First Nation, Champagne and Aishihik First Nation, and Teslin Tlingit cultures. Geographic regions spanned: the Kivalliq, Kitikmeot, North Slave, Inuvialuit Settlement Region, North Yukon, Central Yukon, and South Yukon. Benson's (2014) report 'Gwich'in Traditional Knowledge: Nèhtrùh (Wolverine)' was also used extensively.

Due to the limitations of available relevant sources, the information in this report is strongest for the Inuvialuit and Gwich'in Settlement Regions and weakest for the Dehcho, North Slave, and South Slave regions.

At the time of writing, a Wolverine TK study will likely soon take place in the Sahtú Settlement Area. Wolverine TK studies are also proposed in Saskatchewan Denesuline communities. None of the results from this work were available in time to be included in this report.

Because Wolverine populations may be shared between the NWT, Yukon and Nunavut in some areas, information on neighbouring regions is included in this report when possible.

SPECIES OVERVIEW

Names and Classification

Scientific Name:	*Gulo gulo*
Common Name - English:	Wolverine
Common Name - French:	Carcajou
Inuktitut:	Kalvik (Inuinaktun; Kitikmeot region) Qavvik (Siglitun, Uummarmiutun, Inuinaktun – Kivalliq region)
Gwich'in:	Nèhtrùh (Gwich'in Settlement Area)
Sahtú:	Nǫ́gha
Dehcho:	Nógha
Denésǫłiné:	Nághai
Tłı̨chǫ:	Nogha

While 'Wolverine' is the name most often used by people across the north, alternate names can include: 'carcajou' (said to be used by First Nations people living in the treeline south of Kugluktuk); 'nanujaaqtuq' – meaning like a small Polar Bear (also from the Kivalliq region); 'qauqtuuq', which refers to the Wolverine's prominent forehead or 'qauk' (Kivalliq region); and the 'ommeethatsees' (one who likes to steal) and 'ogaymotatowagu' (one who steals fur) (Cree) (Cardinal 2004).

Life Form: Medium, carnivorous furbearer

Description

Wolverines stand about 30 cm high and are about 90 cm long (2.9 feet) (Gwich'in Social and Cultural Institute [GSCI] 2005) but their length can range between 1.5 to 3.5 feet long, from head to tail (Benson 2014). Their average weight is 25 lbs. (11.3 kg), but they can be much heavier (Gwich'in Social and Cultural Institute [GSCI] 2005). Some people have reported them to be as heavy as 80 lbs. (36.3 kg) (Gwich'in Elders 2001). Males are larger than females, weighing 15-40 lbs. (6.8-18.1 kg), while females are seven to ten lbs. (3.18-4.53 kg) (Gwich'in

Elders 2001; Cardinal 2004). Wolverines are described as very muscular (Cardinal 2004). Some people think that they look similar to young Black Bears or large Weasels (Gwich'in Elders 2001; Cardinal 2004).

> *… I don't know how to say in a spiritual way, but, in a way, the wolverine and the grizzly bear they look … like brothers, you see a wolverine running, it's just like watching a grizzly bear running, if you see a grizzly bear running from miles away it's like seeing a wolverine running, they both run the same …* (Aklavik participant *in* Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006:142).

Wolverines are described as being dark brown or almost black, with two whitish or golden stripes running along their sides and meeting above the tail to form a golden harp (Cardinal 2004).

> *…it's like a U-shape, from below the arms down to the bum around up again up to the other arm. Like light brown to yellowish colour. Around the neck is like white parts on it (Agnes Francis in Benson 2014: 18).*

Females have fur with white or silver patches on the back instead of the male's solid black; both have thickest fur in the winter and shed their coat in the spring (Gwich'in Elders 2001). Wolverines shed their coat in the spring (Benson 2014); during this time, their fur becomes faded and 'dirty' looking (Cardinal 2004). Their summer coat is shorter than their winter coat (Benson 2014).

Figure 1. Photograph of a Wolverine (reproduced with permission from Rob Gau, Environment and Natural Resources).

Colouration can vary both within and between certain areas though. Gwich'in trappers note that coats may be more yellow and pale, with little distinction of the markings in Wolverine living in burned areas, perhaps related to changes in the diet (Benson 2014). A particular colouration trend towards the Arctic coast has also been noted:

> *…up here [around Aklavik] they're mostly all dark I guess, [but if] you go up towards Paulatuk, you get lighter ones. ...probably just different conditions…less trees [so] harder to hide I guess (Ian McLeod in Benson 2014:19).*

Hunters in the Inuvialuit Settlement Region have reported seeing wolverines with an upper body that is mostly white. One harvester had caught an individual like this once (Cardinal 2004). During interviews conducted for Tuktut Nogait National Park, one interviewee described getting a white Wolverine in his trap:

> *One time we went to check traps, I been getting wolverine in our snow house. I had a lone trap on top of a knoll… I saw what seemed to be a head showing a little bit. When I got to it, it was a pure white wolverine, real pure white. You can see just a few colouring, brown around his whiskers* (Billy Ruben *in* Parks Canada 2009: 145).

Some knowledge holders in the Kivalliq region of Nunavut recognize two different types of wolverines: one that is larger and lighter-coloured ('greater Wolverine'), and another that is smaller and darker ('lesser Wolverine'). Some said that the greater Wolverine variety may just be older individuals and the lesser Wolverine variety younger ones. However, one knowledge holder in Arviat stated that the teeth and claws of some of the lesser variety that he had caught indicated that they were older individuals; he described finding more of the lesser variety towards Yellowknife. Without more research, it is difficult to confirm whether there are actually two different varieties, or if the differences can be attributed to other factors such as age or sex (Cardinal 2004).

Wolverines are seldom seen walking and have a very distinctive, galloping run (Gwich'in Elders 2001). Females have a different gait from males, and some harvesters can tell by the shape of a track whether it was made by a male or female Wolverine (Cardinal 2004). Wolverines have large feet, facilitating travel on top of snow, and they have very sharp claws, which differ between males and females: *"it's the size and if you look at the claws, the female are a little sharper they're…[more pointed]. And [the] male is kind of round"* (James Firth *in* Benson 2014:

19). Wolverines are known to smell strongly, which keeps other animals away and make sounds similar to a dog's growl (Benson 2014).

Distribution

All 30 knowledge holders interviewed for a previous Wolverine TK study reported finding wolverines in their respective regions throughout the NWT, Nunavut, and the Yukon Territory (Cardinal 2004).

NWT Distribution

Wolverines are found throughout the NWT in habitats that include areas of flat, open terrain, forests and mountain areas. Wolverines are described as widespread but are found in low numbers in the NWT (Nagy *et al*. 2002; Wildlife Management Advisory Council (WMAC) (North Slope) and Aklavik Hunters and Trappers Committee (HTC) 2003). Inuvialuit knowledge holders interviewed in Aklavik stressed that wolverines have a wide distribution (WMAC (North Slope) and Aklavik HTC 2003; Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006). A map of Wolverine distribution is included (Figure 2, p.6).

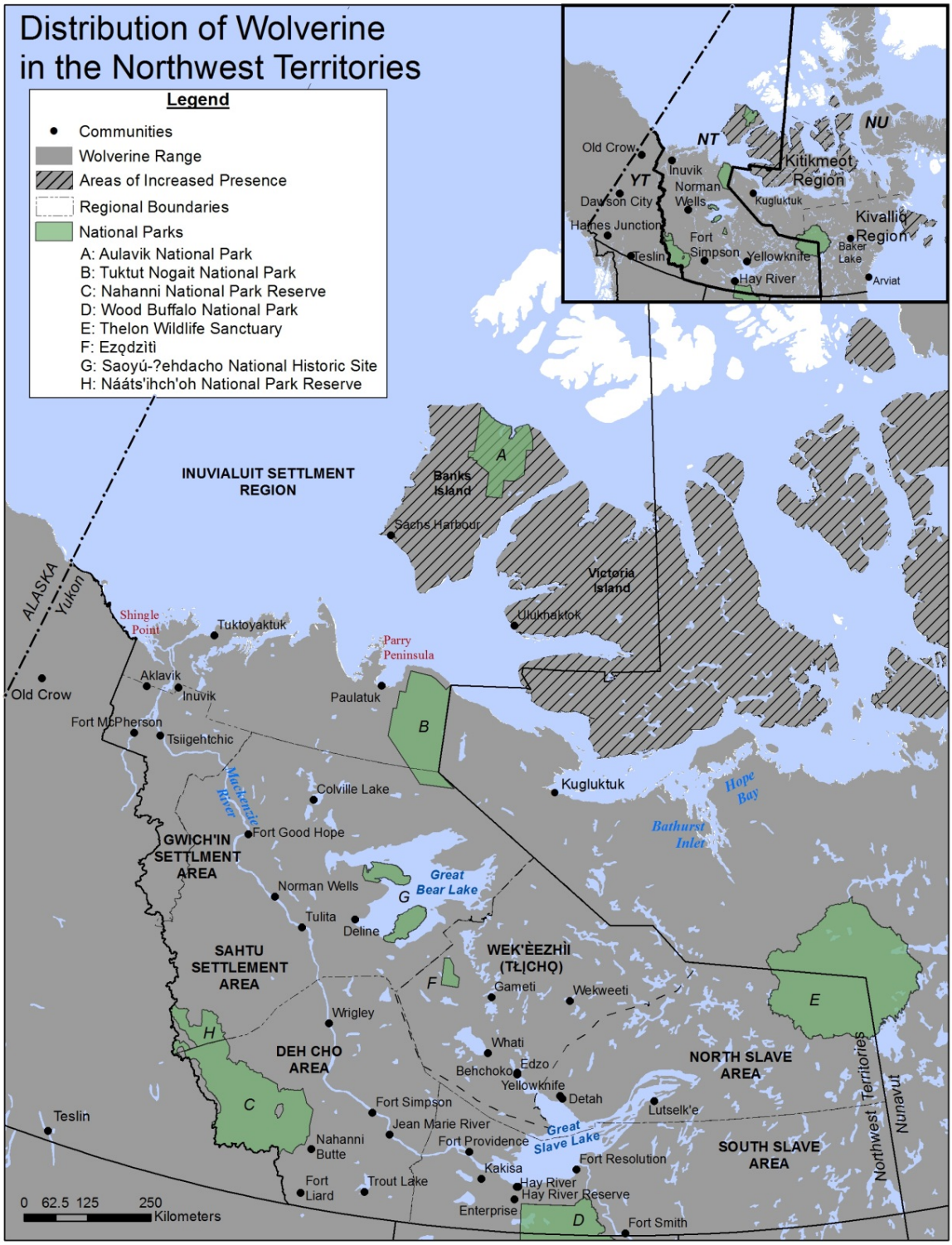

Figure 2. Map showing wolverine distribution in the NWT (map provided by NWT Species at Risk Secretariat).

Knowledge holders in Tuktoyaktuk said that wolverines were abundant east of the community, between Tuktoyaktuk and Paulatuk, and all the way to Kugluktuk. They also indicated that there might be a refugium for wolverines near Kugluktuk – described as a source of migrating wolverines (see Possibility of Rescue - *Likelihood of immigration*) (Cardinal 2004). During interviews conducted regarding Tuktut Nogait National Park, interviewees mentioned harvesting wolverines at locations such as Delesse Lake, Brock River, Clinton Point, and Fallaize Lake (Parks Canada 2009). Wolverines appear in low numbers on Banks Island (Community of Sachs Harbour *et al.* 2008); however, during recent Peary caribou consultations, it was reported that wolverines were being seen in increasing numbers on both Banks Island and Victoria Island, although they were still considered rare (Environment Canada 2013). There has also been mention of wolverines at Aulavik National Park in oral history interviews: "*I know they got two or three wolverines around here… [but they're] not from here. These all get drifted, you know, 'cause they go on the ice, they get drifted across*" (Andy Carpenter, Sr. *in* Parks Canada 1999: 5).

In addition to the areas of refugia discussed in *Possibility of Rescue* (p.30) several other areas were identified as important habitat for wolverines, or rather, areas where there were known to be lots of wolverines (i.e., likely good habitat). Inuvialuit knowledge holders interviewed in Aklavik said that while wolverines are widely distributed, more tend to be found in the foothills and mountains. Spring bear hunters said they see more tracks west of the Babbage River (WMAC (North Slope) and Aklavik HTC 2003). Wolverines are seasonally common on Hershel Island and inland from Shingle Point (WMAC (North Slope) and Aklavik HTC 2003). In the Inuvialuit Settlement Region, important Wolverine habitat, including dens, was identified around the Husky Lakes and Finger Lakes areas; in the vicinity of Ulukhaktok (Holman), coastal areas, Parry Peninsula, around the treeline, Tadenet, Tsoko, the Granet Lakes area, and the Hornady, Brock and Horton Rivers (Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006; Community of Aklavik *et al.* 2008; Community of Paulatuk *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008; Community of Ulukhaktok *et al.* 2008).

In the Gwich'in Settlement Area, wolverines are found in the Mackenzie Delta and along the eastern side of the Richardson Mountains (Gwich'in Elders 2001). Elders in the Gwich'in Settlement Area said that many wolverines can be seen along the Mackenzie River south of Aklavik, north of the Mackenzie River in the Travaillant Lake area, from the Arctic Circle to Fort McPherson, in the Anderson River area, up the Peel River from Fort McPherson in the Trail

River area, in the Mackenzie Mountains at the headwaters of the Arctic Red River (Benson 2014) and on the eastern side of the Richardson Mountains west of Aklavik and Fort McPherson. In Inuvik, good areas for wolverines were noted towards Aklavik, closer to the treeline and mountains (Gwich'in Elders 2001). Gwich'in knowledge holders identified the following specific areas as important habitat for wolverines: the North Slope, Cache Creek, Sheep Creek, Big Fish River, and the foothills west of Aklavik (Community of Aklavik *et al.* 2008; Community of Inuvik *et al.* 2008). Benson (2014) also notes a number of areas whose names refer specifically to wolverines: (1) a lake called Gwit'iet Van Choo that is sometimes also known as Wolverine Lake (in the Thunder River area), (2) Nèhtrùh Chì' (Wolverine-its' rock) is an area up the Arctic Red River and is associated with a Wolverine legend, and (3) Nèhtrùh Gyit (Wolverine-glacier), which is on the Blackstone River.

In the Sahtú, elders of Déljnę say that Edaiila (Caribou Point) is a very important place for all wildlife. It contains very productive wildlife habitat, and it is important to the life cycles of a wide range of wildlife species, including wolverines (Sahtú Land Use Planning Board 2010b). Délinę elders also mentioned Neregah (North Shore Great Bear Lake Heritage Zone) as a very important place for wildlife, saying that it is very productive wildlife habitat, and is important to the life cycles of a wide range of wildlife species. These species include wolverines, but also Barren-ground Caribou, Moose, Grizzly Bear, Muskox, fox, beaver, marten, mink, Muskrat, lynx, Arctic Hare, wolf and waterfowl (Great Bear Lake Working Group 2005).

Wolverines can be found throughout the Ka'a'gee Tu Candidate Protected Area, and some particularly 'abundant' areas include: Tatl'ailie Tu, Etaahdlii, Redknife Hills, Lughenia Mie east of Tatl'ailie Tu, and Nagah Zhihe (IMG-Golder 2010). Wolverines are also found within the Ts'ude Niline Tu'eyeta (Ramparts River and Wetlands) Candidate Protected Area, the Anderson River Conservation Zone, the Horton Lake Special Management Zone, and Shúhtagot'ine Néné (Mountain Dene Trail to the Mountains) Proposed Conservation Initiative (Sahtú Land Use Planning Board 2010b).

Knowledge holders in the North Slave region reported harvesting wolverines north of Yellowknife (Cardinal 2004). When staff of the Yellowknives Dene First Nation and Elders from N'Dilo and Dettah were asked about wildlife resources in the Wool Bay and Drybones Bay areas of Great Slave Lake, they reported that wolverines were observed in winter along the shore and islands of the lake and extended a few kilometers (km) inland from the shore (Cluff and Bourget

2003). The only area mentioned specifically for wolverines in the North Slave region is near Cook River:

> *This year the wolverines are abundant where we trapped - you can see them almost everywhere. Michael Sanderson killed three of them a while ago. About here on the map - I had mentioned before that we had lived there in the past along with your late grandfather Enzoe. This area here near the new proposed mine site, this is a good place for wolverines and this here is (Kezus Dez) Cook River* (Łutsël K'e Dene participant *in* LKDFN 2002: 35).

Members of the Pehdzeh Ki First Nation trap wolverines around lakes in the Tetł'eh Tí (Greasy Lake) and Dahtaeʔáa (Highland Lake) areas, around Xáa Deh (Root River) and even as far as Sah Kį (Ebbutt Hills) (Pehdzeh Ki First Nation 2005). In addition, critical Wolverine habitat that was reported for the Edehzhie is located south east of the Horn Plateau (IMG-Golder 2006).

It was reported in all regions that past generations had also found and harvested wolverines in the same areas they harvest wolverines today (Cardinal 2004). Most knowledge holders did not indicate that there were any known special groups or populations of Wolverine anywhere in the north (Cardinal 2004).

Nunavut and Yukon Distribution

Wolverines occupy almost all areas of Nunavut and are described as widespread but found in low numbers (Awan *et al.* 2012). Densities of wolverines in Nunavut are particularly high to the west and southwest of Kugluktuk towards the treeline and in the Hope Bay Belt. In contrast, no one reported catching wolverines in the northeastern portion of the Kivalliq region. Wolverines were also seen and caught near the communities of Baker Lake and Arviat and sporadic sightings have been made on the islands of the Arctic Archipelago as far north as Ellesmere Island (Cardinal 2004).

In the Yukon, wolverines were reportedly found in mountainous areas, but may use all elevations. When asked if wolverines were no longer found in areas where they occurred in the past, knowledge holders in the Yukon stated that wolverines had always been found in the same areas (Cardinal 2004).

Search Effort

As outlined in the *Preamble* (p.1), because of limited available sources of traditional and/or community knowledge for the Dehcho, North Slave and South Slave regions, little information was available on search effort for wolverines in those areas.

In other areas of the NWT and Nunavut, wolverines are described as widespread but found in low numbers (Nagy *et al*. 2002; WMAC and Aklavik HTC 2003; Awan *et al*. 2012). Gwich'in Elders said that it is so rare to see a Wolverine that some people had never seen one alive (GSCI 2005). Observations of wolverines with young are especially rare (Cardinal 2004, Benson 2014). In one study, interviewees indicated that because wolverines are not commonly seen, the majority of wolverines are caught accidentally in a trap or opportunistically when a hunter comes across a fresh track (Cardinal 2004). None of the people interviewed for that project actually targeted wolverines since they are rare to see and difficult to track (Cardinal 2004). Some hunters will hunt Grizzly bears, wolves and wolverines at the same time: "*Wolves and wolverine too, while we look for grizzly, right from Holmes Creek to Parsons Lake*" (Tuktoyaktuk participant *in* Community Corporations of Aklavik, Inuvik and Tuktoyaktuk. 2006: 146).

Nonetheless, many communities in the NWT still do hunt and trap wolverines for their fur, which is prized for its frost-resistant properties (Benson 2014). While fewer wolverines were reportedly caught in the North Slave region and Inuvialuit Settlement Region of the NWT compared to the neighbouring Kitikmeot region of Nunavut, wolverines were still considered very important for local people (Cardinal 2004). Fall and winter hunting and trapping activities strongly shape Wolverine observations. Wolverines are easier to track in the snow, and as a result, people tend to not see them in the spring/summer as much (Cardinal 2004).

Currently, some people hunt wolverines with rifles in the Gwich'in Settlement Area, but the most common harvest method is still trapping. In the past, Gwich'in harvesters would use deadfall traps to specifically catch wolverines (Heine *et al.* 2007). Trapping activities start at different times of year in different regions of the NWT. The Gwich'in begin harvesting in November and run until early March, as the quality of the fur drops in the summer (Gwich'in Elders 2001). Aklavik Inuvialuit harvest wolverines from September to April. They most often see signs of wolverines when they are traveling to their fishing and trapping camps in the winter, and when hunting in the spring. Hunters see tracks when they go into the mountains west of

Aklavik while looking for caribou and grizzly bears. People moving or staying along the coast in the summer almost never see wolverines (WMAC (North Slope) and Aklavik HTC 2003). In the Inuvialuit Settlement Region, wolverines are both hunted and trapped; however, people do not tend to report the location of their harvests, as this is sensitive information (Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006).

Trapping for wolverines also takes place in the Dehcho and Sahtú regions (Pehdzeh Ki First Nation 2005; Sahtú Land Use Planning Board 2010a; Larter pers. comm. 2014). For trappers from the Dehcho region – this includes Liidlii Kue First Nation (Fort Simpson), Sambaa K'e Dene Band (Trout Lake), Acho Dene Koe First Nation (Fort Liard) as well as Pehdzeh Ki First Nation (Wrigley) – the vast majority of wolverines are trapped from mid-November to mid-March, when ground travel with snowmachine along lines occurs (Larter pers. comm. 2014). A November through March trapping season is also the case in the Gwich'in region (Benson 2014).

In the South Slave, the Łutsël K'e Dene First Nation (LKDFN) trap wolverines in late fall and winter as they can be tracked more easily through the snow and their fur is in prime condition (LKDFN 2002). Wolverines are trapped by Łutsël K'e Dene in the barrens, and areas around Fletcher Lake and Walmsley Lake were mentioned as having a lot of wolf and Wolverine tracks at times. It is suggested that because trappers simply *"realign their traplines to coincide with areas with larger densities of furbearers"*, the location and extent of traplines used by the Denésǫłiné can be used as an indicator of the distribution of fur-bearing animals (LKDFN 2002:36). Denésǫłiné elders hunt caribou and trap wolverines in the Snap Lake region (LKDFN 2002).

BIOLOGY AND BEHAVIOUR

Habitat Requirements

The majority of knowledge holders connect locations of wolverines more to food availability than to any particular habitat type; many noted that wolverines could be found *"where the food is"* (Cardinal 2004; Benson 2014). It is large mammal carrion or carcasses that are critically important for wolverines, rather than habitat type.

Knowledge holders noted wolverines on various types of terrain, including hilly, forested areas

to areas of open ice (Cardinal 2004). While wolverines could be found in a variety of habitats, some knowledge holders did note that they have habitat preferences in certain regions. In Nunavut and the NWT, knowledge holders report finding and catching the majority of wolverines in or near the tree line, which some ascribe to increased security, denning sites, and/or food availability. Gwich'in knowledge, compiled in Benson (2014) agrees with this but adds that wolverines prefer higher elevations, creeks and lakes.

> *Wolverine tend to like hilly countries, where there's lots of hills and creeks. Especially in the mountains, there's more wolverine. But the flat areas…they don't really go [there]. They'll stay by the creeks, for the fish maybe, or hilly country for…the birds, and the lemmings and [the other animals] that hang around there* (Willard Hagen *in* Benson 2014: 26).

Habitat use observations recorded in Cardinal's (2004) study are presented in Table 1.

Table 1. Instances of wolverine sightings in various habitat types, as reported by participants in Cardinal's (2004) study. The total number of participants contributing information in each area is included in brackets following the name of the region.

Habitat	NWT total (9)	Yukon total (6)	Kivalliq region (9)	Kitikmeot region (4)	Nunavut total (13)	Total
Mountains, hills	**1**	6	0	1	1	8
Forested areas, thick bush	**6**	2	2	3	5	13
Rocks, rocky outcrop	**0**	1	8	2	10	11
Creeks, rivers	**5**	4	1	2	3	12
Tundra, flat	**1**	n/a	1	0	1	2
"Where the food is"	**2**	4	1	1	2	8
Follow caribou	**3**	1	2	1	3	7
Follow wolves	**2**	3	3	2	5	10

In the relatively treeless areas of the Kivalliq and Kitikmeot regions (Nunavut), most knowledge holders described wolverines preferring areas that are hilly and rocky. One knowledge holder in the Kivalliq region noted that wolverines occur more in rocky habitat rather than related to specific food sources such as caribou. It is thought that rocky outcrops offer increased security, denning sites, and food availability. Few people in these regions reported finding wolverines on the open tundra; large areas of flat, open terrain are thought to be poor habitat for wolverines. Wolverines that people did track on the open tundra would often run to the closest set of hills or

boulders, indicating that such habitat acted as important safety cover (Cardinal 2004).

In the mountainous areas of the Yukon and NWT, knowledge holders associated wolverines with higher elevations, but noticed that they use all elevation levels. Some knowledge holders in the Yukon said that female wolverines prefer higher elevation areas, which provide increased safety for their offspring. One knowledge holder reported that males are found more in lower elevation areas, where larger prey species are often available (Cardinal 2004). A knowledge holder in Haines Junction (Yukon) described the wolverine's use of different elevations as follows:

> *They come down off the high mountains, in the summer, they're way up high, that's where the wolverine go up there, that's where the wolves concentrate up high. Then of course they're down in the timber areas, on the rivers and down in the lake, where the moose goes* (A. van Bibber *in* Cardinal 2004: 106).

Food Requirements/Diet

Knowledge holders across the north report that wolverines are mainly scavengers, but still good hunters. They are opportunistic feeders, said to eat anything, and always appear to be looking for food (Gwich'in Elders 2001; Cardinal 2004; Benson 2014). They have a tendency to leave an area where food availability is poor (Cardinal 2004), but they have also been observed to cache food (GSCI 2005).

In the NWT and Nunavut, the majority of knowledge holders reported that the wolverine's main food source was barren-ground caribou and wolverines are found most frequently around caribou (Cardinal 2004). Caribou are hunted by wolverines, and there is also caribou carrion made available from wolf and bear kills. Barren-ground caribou are the wolverine's main carrion species (Cardinal 2004). While wolverines do hunt and catch large prey, this was not described as their main method of obtaining food. Their abundance is often connected to the presence of caribou and the carrion made available from wolf and bear kills (Johnson and Ruttan 1993; Gwich'in Elders 2001; Cardinal 2004; Community of Aklavik *et al.* 2008; Community of Inuvik *et al.* 2008; Community of Paulatuk *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008; Community of Ulukhaktok *et al.* 2008). Knowledge holders across the north also reported wolverines scavenging off the kills of polar bears and grizzly bears in the summer (Cardinal 2004). As a result, wolverines are known to follow caribou and/or wolves (Cardinal 2004). This

topic is covered in more detail in *Interactions*, p.21.

In areas where there are few or no barren-ground caribou (Kluane, Dakh Ka and Dawson regions), moose, mountain woodland caribou, muskoxen, and mountain sheep are both prey and a source of carrion for wolverines (Cardinal 2004).

Wolverines in the Northern Mountain ecological area (Yukon and part of the Western NWT) have a more varied diet, but are also dependent on larger animals such as prey or carrion. Rabbits and ptarmigan are also identified as other important food sources in the Northern Mountain and Boreal ecological areas. In some parts of the Yukon, people feel that wolverine abundance may be affected by the availability of snowshoe hares (Cardinal 2004).

Overall, the wolverine diet is extremely varied and can include caribou, moose, mountain sheep, muskox, rabbit, ptarmigan, mice, lemmings, birds, gull eggs, ducks, muskrat, beaver, ground squirrel, porcupine, fish, seals, weasel, lynx, mink, carrion, berries, and vegetation (Gwich'in Elders 2001; Golder Associates 2003; Cardinal 2004; GSCI 2005; Community of Aklavik *et al.* 2008; Community of Inuvik *et al.* 2008; Community of Paulatuk *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008; Community of Ulukhaktok *et al.* 2008; Benson 2014). They are often seen feeding on antlers, bones and skulls (Cardinal 2004). Wolverines are also said to have a strong appetite for porcupines; they kill porcupines by smothering them with snow and then turning them over on their backs to get at their soft underbelly (Gwich'in Elders 2001; Benson 2014). In the NWT, wolverine tracks have also been seen following Dolly Varden spawning creeks (Byers 2010).

Several knowledge holders noted that wolverines will cache food – returning periodically to check on the cache and/or add more food:

> *They always go back to some of their old caches to try to surprise foxes or something that's there. I've tracked them before where they've caught a fox or ptarmigan enroute to where they are going, and, at one of their caches, they'll look at it, and a fox may have been at it, so they'll scent it up again so other animals don't try to eat it* (A. Niptanatiak *in* Cardinal 2004: 104).

Wolverines can survive irregular food supplies while still remaining healthy: *"I think it's an animal that don't eat very much. He's just the kind of animal he is. But when there's something to eat, boy he eat lots too. He's good for long time I think"* (Abraham Peterson *in* Benson 2014:

20).

Denning – NWT

Wolverine mothers give birth and raise the young in a den that they've dug (Benson 2014), although one knowledge holder says that the young ones can also be born on ice:

> *When [s]he have young one, they claim they have yound ones on the ice…because it's a tough animal. Because you want to make then little things tough. So most of the time the little young ones are born on the ice* (Jim Vittrekwa *in* Benson 2014: 28).

Wolverines den in the sides of cliffs, mud banks, rocks, mountains and under snowdrifts or trees (Gwich'in Elders 2001; GSCI 2005; Benson 2014). Caves, rock crevices, fallen logs and trees, stumps, bushes, holes in snow and burrows are used for denning (WMAC (North Slope) and Aklavik HTC 2003; Cardinal 2004; Community of Aklavik *et al.* 2008; Community of Inuvik *et al.* 2008; Community of Paulatuk *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008; Community of Ulukhaktok *et al*. 2008).

In the Inuvialuit Settlement Region, wolverines tend to have their young under a pile of bushes or logs, where other animals cannot get at them. Wolverines will also go up into rocks in the hills to have their young (Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006). Some knowledge holders in the Inuvialuit Settlement Region commented that wolverines will den in the snow and snow banks, and others stated that wolverines den in banks along creeks and riverbeds (Cardinal 2004).

Eskers are used as denning habitat by wolverines, as well as wolf and white fox. Eskers make popular denning sites for wolverines because of the substrate and the availability of food in the way of wolf and white fox pups as well as caribou and muskox (Golder Associates 2003). Elders of the Łutsęl K'e Dene First Nation call Aylmer Lake, (Tła Gai Tué) Thai T'ath Tué, which means "lake where there are lots of eskers". The many eskers at Aylmer Lake (Tła Gai Tué) have always been important to the Denésǫłiné for trapping, indicative of their value as wolverine habitat (LKDFN 2001b).

> *The wolverines have their dens just about anywhere - inside cracks of cliffs, anywhere where there is rough terrain. I went after one wolverine because I had wounded him. At the time I*

> *was a young man and I was good at walking around. I kept on going after him and he stopped at some moss-covered marsh with small labrador tea plants… You can see that he had paused there because he had been eating these small labrador tea…* (Łutsęl K'e Dene participant *in* LKDFN 2001a: 27).

Knowledge holders in Nunavut additionally identified sandy areas (i.e., riverbanks) and cracks in boulders as good sites for wolverine denning (Golder Associates 2003). There was also some evidence from Inuit hunters that dens could remain active for multiple years (Lee and Niptanatiak 1996). In the Yukon and Kitikmeot region, wolverines were known to prefer south-facing hills as denning sites in the winter, because of the increased warmth from the sun. Yukon knowledge holders also noted that wolverines were thought to give birth higher up in the mountains. All natal dens featured safety, warmth, and isolation as important characteristics (Cardinal 2004).

Ultimately though, few people ever see the places where female wolverines give birth and raise their young. Such sites are very well hidden (Benson 2014).

Seasonal Habitat Use

Wolverine range is thought to be similar for all months of the year, though some knowledge holders did report slight seasonal differences (Cardinal 2004; Benson 2014). For example, carrion is said to be eaten in winter, while rabbits, ducks, and vegetation are eaten more in the summer months.

In the spring, wolverines are seen traveling in the foothills and mountains near Aklavik in April (WMAC (North Slope) and Aklavik HTC 2003). It was also noted in April that roughly half of the wolverine trails followed went into burrows in gullies that had willows and creeks present (WMAC (North Slope) and Aklavik HTC 2003). Wolverines are also seen inland from Shingle Point and Herschel Island, Yukon, in the spring (WMAC (North Slope) and Aklavik HTC 2003). One knowledge holder said he sees the most tracks in April and May along the coast, and that wolverines reportedly hunt sunning seals in April after their breathing holes have collapsed and the seals come up on the ice (WMAC (North Slope) and Aklavik HTC 2003). In the Inuvialuit Settlement Region, it was reported by one individual that in the spring and summer more wolverines are found near water bodies and the coast (Cardinal 2004). Wolverines feed on gulls

and gull eggs on the coast in the spring (Cardinal 2004).

Feeding at gull colonies and hunting seals continues into the summer months (Cardinal 2004). Also in summer, wolverines are thought to move around the Mackenzie Delta and live in the bush (Gwich'in Elders 2001). They are not typically seen on the coast at this time of year, but are reportedly common on Herschel Island during summer months (WMAC (North Slope) and Aklavik HTC 2003). They are seen feeding on berries and vegetation in the summer months, and lemmings are an important summer food source. In the Kivalliq region, wolverines are thought to prefer flatter areas in the summer to catch lemmings (Cardinal 2004). One person reported that wolverines tend to eat more in the summer, as they are not as heavily dependent on scavenging from wolf kills because there are more animals available, and there are also bears around who leave carrion behind (Cardinal 2004).

Movements

Knowledge holders commented that wolverines were never resting but were constantly on the move, following various scents looking for food (Cardinal 2004; Benson 2014). Knowledge holders noted the Wolverine's keen sense of smell, which could detect faint smells from far away. Many knowledge holders commented on how fast wolverines could run, and four hunters noted that wolverines could reach speeds of between 10-30 miles per hour (Cardinal 2004) and can travel long distances in a day (WMAC (North Slope) and Aklavik HTC 2003; Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006); up to 75-80 miles according to one Gwich'in Elder (Walter Alexie *in* Benson 2014: 26).

While the majority of those interviewed in Cardinal's (2004) study think that wolverines have home ranges, some disagree, saying that the area travelled would be too large to discern any relevant home range or that some wolverines are 'transients'; that is, young wolverines dispersing from their natal areas looking to establish their own home range. They will migrate to an area of high food availability, sometimes following wolves and caribou, until they encounter an unoccupied area where they can establish a home range:

> *We found that [wolverine] are always moving in. When there's no dominant males or females, other young would move in and start, 'hey this is my home now.' And with the caribou moving in that area when they're traveling through, I think that is a way of them just following them and saying, oh there is nobody here, we'll just build a home,* (A. Niptanatiak *in* Cardinal

2004:98).

All those interviewed recognize that a wolverine home range would have to be extremely large, as they are constantly on the move looking for food, and do not seem to stay in the same area for very long (Cardinal 2004). In addition, one hunter noted that wolverines move across their trap line every two to three weeks – indicating regular travel within a home range (Cardinal 2004). Indeed, Benson (2014) noted that wolverines may use the same trails repeatedly or stay in the same area providing that a good food source is available:

> *Whenever they find a good place they could feed, they just stay in that trail. Like they find a good creek than is running with…little fishes and stuff, where they could live, they stay there for a while* (Abraham Peterson *in* Benson 2014: 21).

When such a territory has been established, wolverines will mark it with urine and defend it (Benson 2014).

Male wolverines are thought to travel more than females and have larger home ranges. This is supported by the fact that the majority of harvests are of males. In addition, females tend to stay closer to their den site. It is possible that the lower productivity characteristic of the central barrens will make wolverine home ranges bigger than in the boreal zone (Mulders pers. comm. 2012).

Although wolverines are capable of traversing most terrains (they are able to swim, climb trees, move through mountain routes, and, on account of their large feet, travel across deep snow), they do also make use of trails and natural travel corridors such as rivers and creeks (Benson 2014).

Life Cycle and Reproduction

Wolverines are most often observed alone, but are sometimes seen in groups of two or three animals during the mating season or when they find a large source of food (Gwich'in Elders 2001; GSCI 2005; Larter and Allaire 2013). Wolverines can be seen in groups or families at their dens (GSCI 2005), but are otherwise shy and solitary (Gwich'in Elders 2001). Some Gwich'in Elders note that wolverine are primarily nocturnal: *"In the day time, most of the time, he sleeps…I think that is why you don't see them around. At night he travels around. …there is very*

few times you could see them in the day" (Gabe Andre *in* Benson 2014: 21).

Observations across the NWT are similar – Wolverine breeding occurs for a few weeks between March and April (Cardinal 2004; Dehcho Land Use Planning Committee 2006; Benson 2014); perhaps as early as February, which appears to be based on observations of when individuals are seen to be travelling together (Benson 2014). They will scent-mark during this time in order to attract a mate and are also more active, travelling around their home ranges more and tracking each other (Cardinal 2004). Gwich'in hunters and trappers start to see two sets of tracks together around late March. They also observe that wolverines tend to move around a lot in April, so it is likely that the mating season occurs in these two months (Gwich'in Elders 2001).

Some knowledge holders report seeing two to four males tracking a single female, and that one male's home range may overlap with four to five female home ranges. Males may fight for access to females during the breeding season (Cardinal 2004). One hunter had seen an area where males had been fighting – likely over breeding opportunities with a female. He described their breeding behaviour as follows:

> *The only time [you see them together] is breeding season... If you have a couple of females and two males, just on the outside or in their home range, you start seeing them together, you know, wrestling or biting... during February* (A. Niptanatiak *in* Cardinal 2004: 95).

Wolverines will give birth in June or July and keep the young in the den for the first few months of life (Gwich'in Elders 2001). They usually have a litter of two to four young, but litters as low as one and as high as six have been reported (Cardinal 2004; GSCI 2005). Sightings of very young wolverines are rare (Gwich'in Elders 2001; Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006) although one Gwich'in elder reported seeing inside a wolverine den. He said it was in a snowdrift and likely had three beds (Gwich'in Elders 2001). Another Gwich'in knowledge holder noted the following:

> *I've never seen [a young wolverine], but I heard them. …Not far from my cabin, I noticed when we first moved there, there's always wolverine. Usually, you look at the tracks, [and] you could tell a female and male. And I followed this one and [the tracks] took me to the den. I could hear them in there, but I didn't go any further than that. But I heard them and there's probably, I don't know, maybe two or three in there. [They sounded like a] little animal, like a cat or a little…animal. [It was] just a hole in the ground on the side of the hill…it was pretty*

> *small. Just enough to get in there. If I never heard the noise I would never have seen it, never even have been there because…everything's just covered naturally* (James Firth *in* Benson 2014: 28).

Eight participants in Cardinal's (2004) study had personally seen wolverines with young; these sightings were all in spring and/or summer (April, July and August). Females are thought to raise the young on their own during these months, allowing the male to interact briefly with the young during the fall months, after they had reached a larger size (Cardinal 2004). The mother wolverine is extremely shy and protective of her young, keeping them away from people until the young have matured. She is aggressive toward people who approach her young. The kits do not stay with the mother for very long and usually separate before they are 12 months old (Cardinal 2004; GSCI 2005). Benson (2014) notes that young wolverine can become independent as early as three months of age. The newly independent young tend to stick together into the fall:

"In the fall time when you first start going out there, you might see two travelling together. And that's more because they're [from a] litter so they're out on their own now, so they kind of hang around together. For the first…I don't know I'm not sure, but may for the first year they hang around together but after that they all [split up]" (James Firth *in* Benson 2014: 29).

Survival of young wolverines in their first year is thought to be low, but survival rates increase in subsequent years (Cardinal 2004).

Physiology and Adaptability

Most knowledge holders commented on the wolverine's strength, toughness, and intelligence; it is represented in stories as a trickster, thief, and intelligent animal (Gwich'in Elders 2001; Cardinal 2004; Benson 2014). Wolverines are reportedly ingenious at getting food, including robbing meat caches, destroying traps, stealing bait, and eating animals caught in traps (Gwich'in Elders 2001; Cardinal 2004; Benson 2014). They have a keen sense of smell, good vision and good hearing, which enables them to find a trapped animal from far away. In the Gwich'in language the name for wolverine (Nèhtrùh) means something or someone who is sly or crooked; they are respected by the Gwich'in for their intelligence, power, craftiness, and aggressive nature. It is said that only the best hunters and trappers can catch wolverines. They are described

as a vicious and fast predator, with sharp claws, that would not hesitate to steal food away from larger animals, including grizzly bears, polar bears, and packs of wolves (Gwich'in Elders 2001; Benson 2014). Females are said to be faster than males because they are the more dominant hunter (Cardinal 2004).

Wolverines can live in a lot of different types of habitat and eat lots of different types of food. (Gwich'in Elders 2001). They are reportedly very strong and able to carry heavy things. Gwich'in hunters have seen wolverines pack food like humans do – they will pack it on their shoulder and walk on three legs with their fourth leg holding the load (Gwich'in Elders 2001; Benson 2014). Other hunters reported seeing a wolverine carrying a whole caribou: "*one time in Aklavik, we seen one packing a whole caribou. A frozen one*" (G. Kasook *in* Cardinal 2004: 81). These factors, combined with their ability to cache food and roam for long distances, as well as large feet permitting them to traverse snow (Benson 2014), likely make wolverines well-suited to survival in many locations and types of conditions.

Wolverines were generally described as being in good health with a good layer of fat on them (WMAC (North Slope) and Aklavik HTC 2003; Cardinal 2004).

Wolverines do not hibernate; in fact, some knowledge holders indicate that wolverines thrive in even the coldest weather: "*And they're out in all kinds of weather, the colder the better, because they know that other animals are trying to find a place to sleep and be comfortable. He know it, that's when wolverine is happy*" (Sarah McLeod-Firth *in* Benson 2014: 30).

Interactions

Wolverines have few predators or competitors. Even packs of wolves are said to avoid wolverines. It is said that it would take more than one wolf to kill a wolverine (Benson 2014). People report seeing wolverines harassing and attempting to take kills away from grizzly bears, polar bears and wolves; several knowledge holders in the Boreal and Arctic ecological areas also described wolverines fighting with wolves, and three people had seen sites where wolves had killed wolverines (Cardinal 2004). However, wolverines will often climb trees to avoid being caught, and may do this to avoid predators such as wolves (Cardinal 2004). Mortality caused by other animals is likely low (Cardinal 2004).

Wolverines tend to be found wherever there are many barren-ground caribou (Gwich'in Elders

2001, Benson 2014), and are impacted by increases or decreases in caribou abundance.

> *…recently these past few years there has been some caribou coming back down to our area, and because of that I've seen wildlife other than foxes, like wolverines and wolves, coming down following the herd* (Randy Pokiak *in* Berger 1976: 4218).

It is noted in numerous places in the literature (e.g., Auriat *et al.* 2002; Nagy *et al.* 2002; Zimmer *et al.* 2002; Gunn 2009) that Boreal Woodland Caribou and wolverines share the same habitat. However, no participants in Gunn's TK study (2009) reported wolverines preying on boreal woodland caribou.

Wolverines prey on caribou, and take caribou that have been injured by other predators; "*if there's a wounded caribou, the wolverine will kill it right away*" (Johnson and Ruttan 1993:115). Chipewyan Dene in northern Saskatchewan noted that wolverines occasionally run down and kill healthy caribou (Johnson and Ruttan 1993). The same information was recorded in Nunavut, where wolverines have been observed to kill caribou by chasing them for a long time, including an observation of a wolverine chasing a caribou for over 80 km (Dumond 2007). Wolverines can also catch larger animals by charging or ambushing them (Benson 2014) and ripping their necks, or harassing them until they succumb (Cardinal 2004). They have also been described 'tackling' caribou (Thorpe *et al.* 2001). One Inuvialuit harvester mentioned that wolverines have learned how to hunt reindeer in the Inuvialuit Settlement Region (Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006).

Wolverines are also known to scavenge large carcasses killed by other animals in many areas, possibly learning to follow other predators to find food (Benson 2011).

> *As for the wolverines, they always follow behind the wolves to scavenge. They follow the wolf tracks. After the wolves kill, they come in and steal the kill. They are scavengers. The wolves do the hunting for the wolverines* (Joseph Niptanatiak *in* Golder Associates 2003: 44).

In Nunavut, wolverines are thought to mainly feed on wolf kills and bear kills, but as they are opportunistic, they are sometimes seen taking food from other animals as well: "*Sometimes wolverine would come in and steal food from foxes too. They would also steal seal pups*" (Clarence Klengenberg *in* Golder Associates 2003: 44).

Knowledge holders in the Kivalliq region reported that wolverines started to increase when wolf

control stopped. They stressed that the control of a species has consequences for other species (Cardinal 2004; Dumond 2007).

Knowledge holders respect wolverines for their place in the environment and their ability to survive (Cardinal 2004). Wolverines are seen as important for maintaining balance in nature (Community of Inuvik *et al.* 2008; Community of Paulatuk *et al.* 2008). Several harvesters commented on the biological importance of wolverines, in particular for their role in maintaining healthy muskrat populations (Benson 2014):

> *That is how come…you can shoot [muskrats] all spring…you can shoot all kinds of rats. [wolverines] keep the population down, it keeps them healthy. So the next year, fall like, they [are] nice healthy rats. Otherwise, [if wolverines] don't do that, [muskrats will] get sick and they die off* (Charlie Stewart *in* Benson 2014: 32).

They are important to all things and all species: "*it is part of our animal species structure.... And all of our elders always said you have to look after everything, you know, because they'd all link together*" (A. Niptanatiak *in* Cardinal 2004: 85).

Wolverines do not appear to harbour large numbers of lice or other external parasites as would commonly be found on animals like lynx. Gwich'in knowledge holders attribute this to lynx's high consumption of rabbits, which are known to carry large numbers of lice in the spring (Benson 2014). Wolverine are also thought to be less likely than other mammals to succumb to rabies: "*Never did [find a dead wolverine]. I found foxes and I find them dead, but they're just from rabies. Wolverine I never heard of them dying*" (Charlie Stewart *in* Benson 2014: 42).

STATE AND TRENDS

Population

Abundance

Wolverines are described as widespread by Inuvialuit knowledge holders in Aklavik; however, they are not numerous (WMAC (North Slope) and Aklavik HTC 2003). This is echoed in the Gwich'in area, where wolverines are seen to be 'scarce' (Benson 2014). Fresh tracks are seen

about every 40-80 km in April and May (WMAC (North Slope) and Aklavik HTC 2003) but the relative scarcity of wolverines makes it difficult to discern trends (Benson 2014). Wolverine don't seem to present the same dramatic population cycles as other species (although, as noted above, their scarcity makes determination of trends difficult), but their abundance does seem to be somewhat related to trends in rabbit populations and those of other prey species too:

> *Like the last three years there's been quite a bit more [than] there was [before], a lot of marten in the last three years because of food supply. A lot of lynx, a lot of foxes…It just goes with the food cycle. You know if there's lots of food then there's lots of wolverine, lots of animals. But if there's no food, then there nothing, or very little* (James Firth *in* Benson 2014: 39).

During interviews conducted in the Inuvialuit Settlement Region in 2005, there were no observations regarding population size or health (Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006). The population status in the Mackenzie Delta is described as "relatively few" (Community of Inuvik *et al.* 2008; Community of Paulatuk *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008). In 2004, Cardinal summarized that wolverines were at high population levels along forested areas in the northern portions of the mainland Inuvialuit Settlement Region.

In the northern NWT, the Parry Peninsula was described as having 'many' wolverines (Nagy *et al*. 2002). Prime areas with high wolverine abundance are said to be to the west and southwest of Kugluktuk towards the treeline (Cardinal 2004). Information on areas known to be good wolverine habitat is included in *Habitat*, p.32.

Cardinal (2004) produced a map of the relative density of wolverines in the north based on information provided by 30 knowledge holders in the NWT, using a map by COSEWIC (2003) as a starting point. The result is shown in Figure 3, p.25. Based on information provided by 30 knowledge holders in the NWT, Yukon and Nunavut, the general abundance map for wolverines (COSEWIC 2003) can be adjusted to reflect the new information provided about wolverine harvest and trends (see Figure 3; reproduced with permission from Nathan Cardinal). This is especially true for the Kivalliq, Kitikmeot, and Inuvialuit Settlement regions.

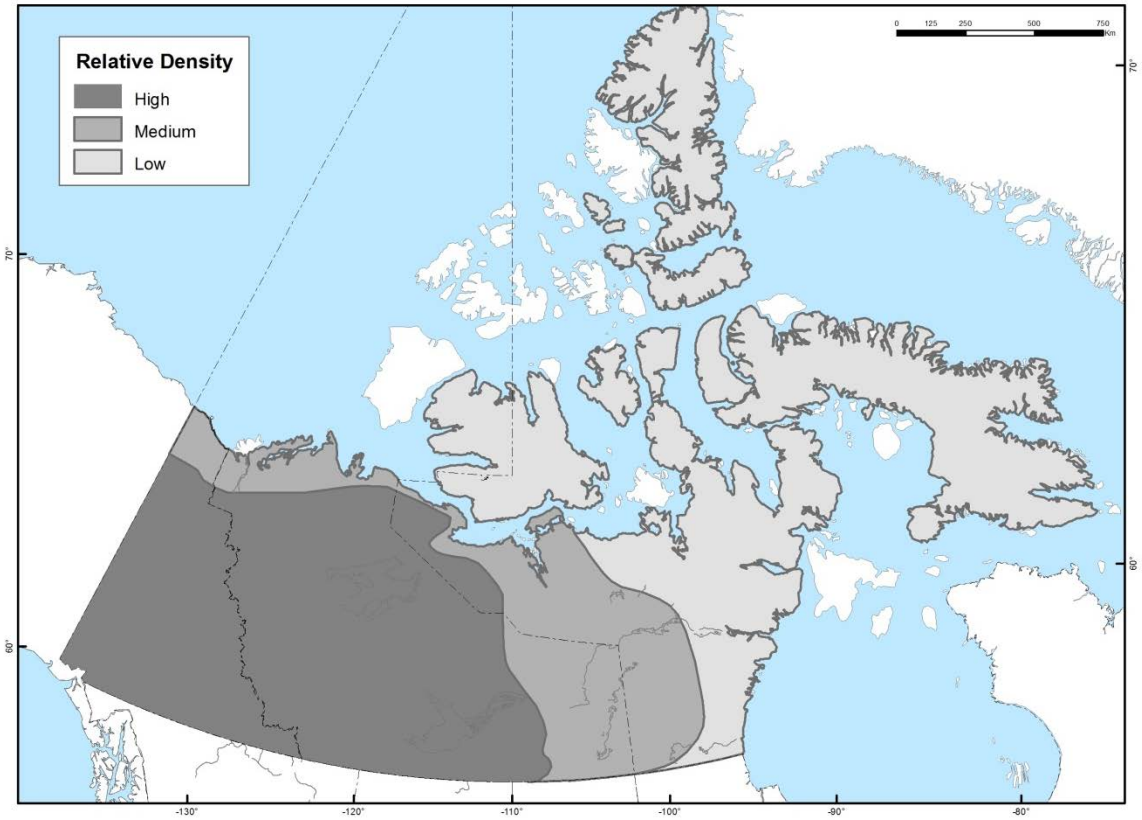

Figure 3. Adjusted abundance based on (COSEWIC 2003) and amended with information from participants in Cardinal's (2004) study (Map reproduction by B. Fournier, ENR, based on Cardinal (2004), with permission).

Other than information from the Inuvialuit Settlement Region, the Gwich'in Settlement Area and communities in the Yukon and Nunavut, little to no detailed information on Wolverine abundance for the NWT was found in the literature reviewed for this report. It was noted by Benson (2014) however, that Wolverine density is known to vary somewhat within the Gwich'in area. As a result of abundant food resources, Wolverine populations are observed to be more dense in the mountains, around Old Crow, on the Arctic coast, in the Anderson River area, and the area between Thunder River and Travaillant River, as well as in other areas where caribou and Moose were present in high numbers.

Trends and Fluctuations

Cardinal's research was conducted with 30 people across 10 northern communities (2004). The information from these interviews was compiled, and trends in the relative abundance of

wolverines in the NWT, Nunavut and Yukon Territory at that time were mapped (Figure 4, below).

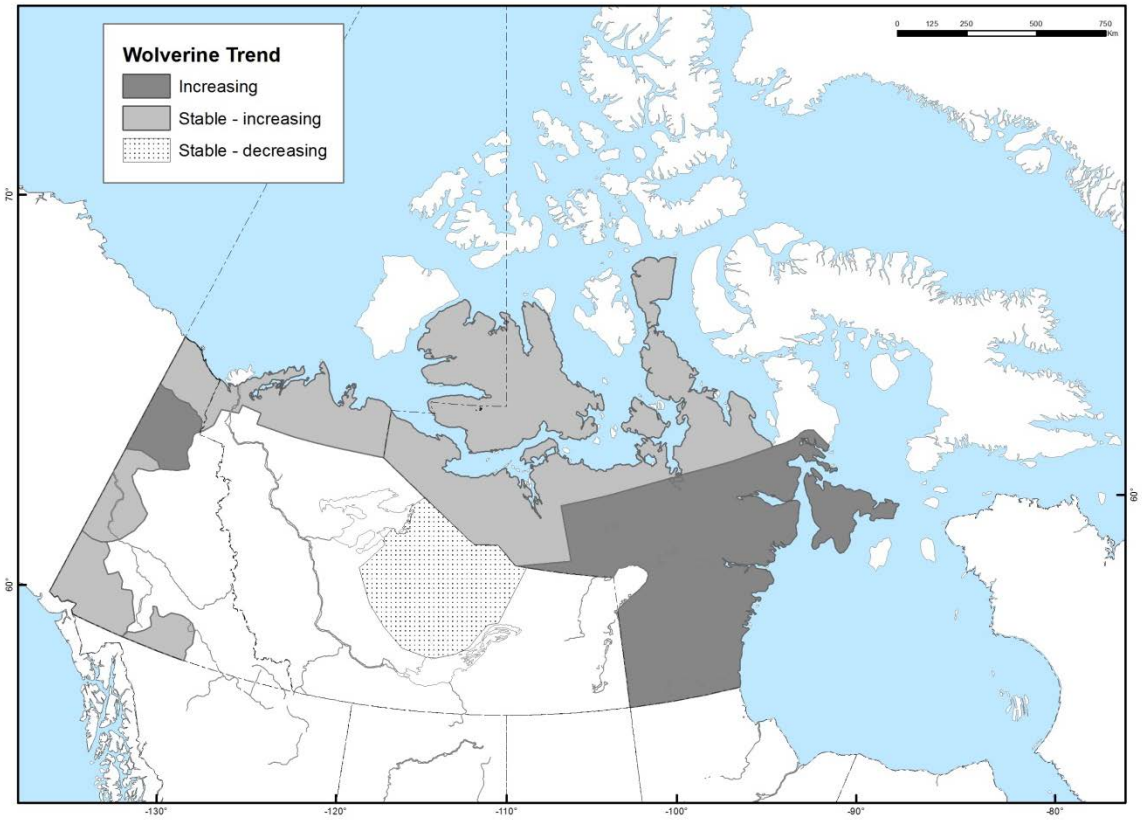

Figure 4. Map of wolverine trends in northern Canada by B. Fournier, ENR (based on information from participants in Cardinal's (2004) study and reproduced with permission from Nathan Cardinal). Note: although wolverine sightings have been recorded on some of the Arctic Islands, no populations are included except for Victoria Island, since no knowledge holders interviewed by Cardinal (2004) mentioned any island other than Victoria Island in their discussions of wolverines. Figure is representative of Cardinal's (2004) study and not of the full range of wolverine in the NWT.

Despite wolverine sightings being relatively rare, Cardinal (2004) found that knowledge holders were able to comment on general trends in wolverine abundance because of their many years spent hunting and trapping the animals; the majority of knowledge holders described wolverine populations as either stable or increasing at the time of the study (Cardinal 2004; Benson 2014). These trends are discussed in more detail throughout the rest of this section by region, along with more recent information resulting from other studies.

Inuvialuit Settlement Region

In a 2002 Boreal Woodland Caribou study in the Inuvialuit Settlement Region, the majority of interviewees thought that wolverine numbers were either stable or increasing in the region; people described the number of wolverines found in boreal woodland caribou habitat in many areas as 'many to few' (Nagy *et al*. 2002).

In work conducted in Aklavik in 2003, TK participants had differing opinions on trends in wolverine abundance. Some said numbers had declined since snow machines replaced dog teams; others said there weren't many, but their numbers were stable. One participant said wolverine numbers were increasing in the Mackenzie Delta. There was also a note that there were more wolverines west of Babbage River since there has been less hunting. One participant said he didn't know if their numbers were changing or not (WMAC (North Slope) and Aklavik HTC 2003).

In Cardinal's (2004) study in the Inuvialuit Settlement Region, five people interviewed indicated that the wolverine population was stable, and one person said it fluctuates up and down with food availability. Two knowledge holders said the population was increasing, possibly due to an increase in caribou. Others said that while the population was stable, wolverine harvests may be rising due to the use of snow machines (Cardinal 2004).

Since Cardinal's 2004 study, Inuvialuit harvesters interviewed in 2005 reported that wolverines were getting harder to find (Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006). However, there was no distinct trend of decline noted over the years.

The most current wolverine population trend in the Inuvialuit Settlement Region was described as "stable", noted in a letter from the Inuvialuit Game Council from October 2012 (Lam pers. comm. 2012).

Gwich'in Settlement Area

In the Gwich'in Settlement Area, no clear trend in wolverine numbers was apparent. Participants in the Arctic Borderlands Ecological Knowledge Co-op (ABEKC) program in Fort McPherson

said that wolverine numbers appeared to be the same, and in Aklavik people said that while there were some wolverines, you *"really have to work hard to get them,"* (ABEKC 2004:52). The same year, participants in Inuvik had conflicting reports of wolverine numbers; Gwich'in participants said they were seeing more tracks, but Inuvialuit participants in the same area felt that wolverines were declining and there were very few sightings (ABEKC 2004). Similarly, Russell Andre commented in 2004 that, "*Wolverines, they're all in a big incline…because there are not many harvesters out there anymore, there's more wolves, there's wolverines, there's more foxes, there's more marten*" (Benson 2014: 39). Overall, Gwich'in Elders said that wolverine populations vary yearly, and this is possibly related to cycles in rabbit populations (GSCI 2005; Benson 2014), or, more generally, prey populations (Benson 2014).

In 2006/2007, participants in the ABEKC study (2004) said there seemed to be a lot of wolverines in the Aklavik area; trappers had been successful in catching them and they were being spotted in the foothills. The same year, participants in Fort McPherson reported that there were hardly any wolverines around while Inuvik participants reported their numbers as normal (ABEKC 2007).

In the Gwich'in Settlement Area, one of the most recent observations comes from 2011. Here, a Gwich'in participant in a boreal woodland caribou TK study said that he thought wolverine populations may be on the rise in the area: "*Wolverine too is getting more all the time. I see it and I caught a few too. Usually it would be hard to get them*" (Ernest Vittrekwa *in* Benson 2011:24). Even more recently, Benson (2014) concluded that the wolverine population in the Gwich'in Settlement Area and surrounding regions is stable but low.

North Slave Region

Two knowledge holders in the North Slave region reported the wolverine population to be either stable or decreasing in Cardinal's work (2004). Only in Yellowknife did people report that wolverine might be decreasing (Cardinal 2004). No additional or more recent traditional or community knowedge was available with respect to trends in wolverine abundance in the North Slave Region.

Dehcho Region

One knowledge holder in the Dehcho Region reported the wolverine population, as well as those of other carnivores (e.g., wolves, foxes) to be increasing recently (Horesay pers. comm. 2014).

South Slave Region

Some Denésǫłiné (South Slave) trappers reported a decline in some fur-bearing animals, including wolverines, during the 2001-2002 trapping season compared to previous years; this decline was only reported in certain areas (LKDFN 2002). Pelt quality was reported to generally be good or normal. All the following observations are from trappers from the Łutsël K'e Dene First Nation:

> *The fur-bearing animal population was high in the sixties, though sometimes it was hard to catch fur-bearing animals. You'd be lucky if you caught five to ten pelts. I remember some people caught enough fur for Christmas. Now today I think there are more fur-bearing animals towards the barren lands compared to the forest, there are lots of white foxes, wolves and wolverines. People have just stopped trapping or hunting them as much – around Łutsël K'e too* (Łutsël K'e Dene participant *in* LKDFN 2002: 36).
>
> *I trapped for wolverines but they're really sly around the traps. Trapping was very promising because there was lots of fur-bearing animals. I caught between 100 and 150 martens and minks. Now it's not the same; now I don't catch much fur-bearing animals like before. Before there were lots of snow and now there's not as much* (P. Lockhart *in* LKDFN 2002: 37).
>
> *I harvested martens, minks, wolverines, and foxes [in the past]. Before each day I used to visit 50-60 traps but now it went down to 20-30. I do not really profit anything because I have to buy gas, food, ski-doo parts, and equipment supplies so it costs a lot to check your traps. The best time to trap is in October through mid February. I usually trap all over and it really depends on how far you go. The amount of animals this year was pretty low this year for me. There were no signs of tracks I am not sure why of this. The fur quality this year was the same as before* (Łutsël K'e Dene participant *in* LKDFN 2002: 59).

Nunavut and Yukon Territory

In Nunavut, Golder Associate's (2003) report noted that both wolf and wolverine populations were observed to be increasing in Bay Chimo and the Doris North area. In the Kivalliq region, wolverine populations increased significantly between 1980 and 1995, representing a recovery from 1970-1980 levels, when the population crashed and was virtually extirpated from the

region. Some people attributed this population crash to a wolf control program in the 1950s-1960s, while others attributed the subsequent increase to less hunting and trapping pressure. By 2004, people in the region were seeing many tracks and catching significantly more wolverine than they were 25 years ago, but they were still not considered as numerous as they were before the wolf control program was implemented. In the Kitikmeot region, wolverine numbers were reportedly stable, and large enough to support strong harvest pressure. Wolverines were considered least abundant in the northeastern corner of Nunavut and the Arctic Islands. Wolverine populations are known to fluctuate somewhat, based on food availability (Cardinal 2004).

More recently, according to the opinions of 65 hunters from across Nunavut, 58% believed that the wolverine population in their area is increasing, 40% stated that it was stable, and < 2% believed it was decreasing (Awan *et al.* 2012).

In the Yukon Territory, knowledge holders interviewed by Cardinal (2004) reported wolverine populations to be increasing or stable, perhaps because there are fewer active trappers in the area now. Small fluctuations in the population are known to occur, depending on total food availability (Cardinal 2004). No clear trend was seen in Old Crow, where a decline in wolverines was reported in 2002 and 2004, while signs of wolverine presense increased in Crow Flats by 2007 (ABEKC 2003, 2004 and 2007). No additional or more recent traditional or community knowedge was available with respect to trends in wolverine abundance in the Yukon.

Population Dynamics

The sources reviewed for this report did not contain specific information on birth rates, death rates, immigration rates, or changes in body size or condition.

Possibility of Rescue

Likelihood of Immigration

With respect to the immigration of wolverines into the central barrens of the NWT, it is necessary to look at the Kitikmeot region, as this is a shared population (Mulders pers. comm. 2012). Considering populations in the Kivalliq region of Nunavut may also be relevant, where

wolverines were caught closer to the treeline in the western portion near the NWT/Nunavut border, and also in the northwestern portion (Cardinal 2004).

Knowledge holders from numerous communities identified several different areas of refugia where relatively little harvesting occurs (Fig. 5, below). They are described as remote areas with adequate food and habitat availability. Migration of young wolverines from these refugia is thought to sustain the harvest in other areas (Cardinal 2004).

Knowledge holders in Tuktoyaktuk indicated that there may be a refugium for wolverines near the community, as they are often seen 'coming out of' this area (Cardinal 2004). Wolverine refugia mapped in the NWT, Yukon and Nunavut during Cardinal's (2004) study are shown in Figure 5.

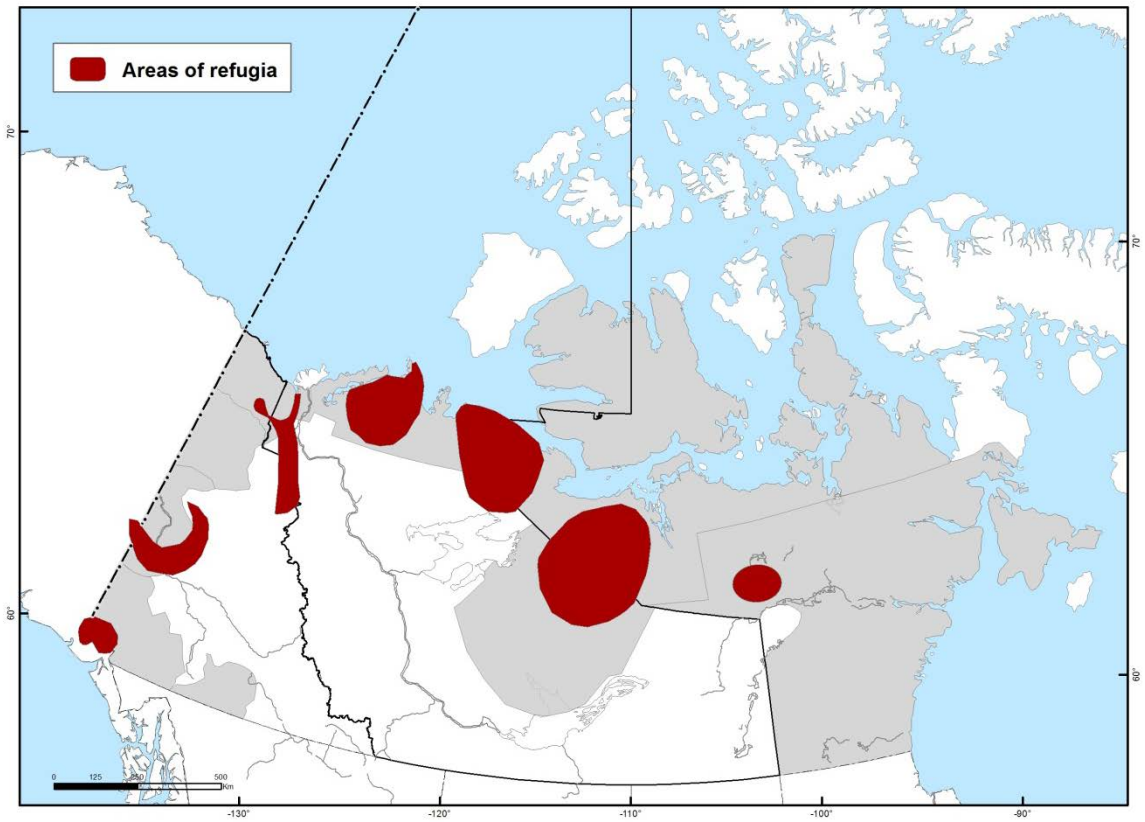

Figure 5. Refugia for wolverines (represented in red) superimposed upon boundaries of trend information (represented in grery) in Figure 4 (Map reproduction by B. Fournier, ENR and based on information from participants in Cardinal 2004. Used with permission from Nathan Cardinal). This map isn't representative of the complete distribution of wolverine in the NWT. Figure is representative of Cardinal's (2004) study and not of the

full range of wolverine in the NWT.

Some of these areas are protected in national parks. Even those that are not protected sustain little hunting due to localized hunting patterns. One knowledge holder described the harvesting pressure as follows:

> *Only certain people hunt in those areas, and then you have between here and Yellowknife, if you have all those big areas with the mines and that, but you only hunt in those little zones. And if you have that big middle buffer, those animals always move around, moving away. [Elders] say well, as long as you have those, you'll never have problems* (A. Niptanatiak *in* Cardinal 2004: 108).

Notwithstanding the presence of refugia, Benson (2014) notes that as a result of wolverines' ability to move over long distances, it's likely that wolverines from neighbouring areas could re-establish a population. It is also likely that there is suitable habitat available for wolverines coming into the NWT. Information regarding the status of Wolverine populations elsewhere is included in *Trends and fluctuations*, p.25.

Habitat

Habitat Availability

Habitat availability is not something that is explicitly addressed in the literature reviewed for this report. However, the availability of habitat can be inferred based on the presence of higher densities of wolverines in certain areas, indicating the presence of good habitat. Information regarding areas where large numbers of wolverines are present (and therefore likely good habitat) is presented in *Distribution*, p.5.

Habitat Fragmentation

No specific information on habitat fragmentation was found in the literature reviewed for this report. Based on participants' insights about wolverine refugia (see *Possibility of Rescue*, p.30) (Cardinal 2004), as well as the large home ranges of wolverines and their broad movement patterns, it would seem that these animals regularly move between different types of habitat, and would have a high potential of being able to travel fairly large distances to find good habitat.

However, wolverines are also considered shy in regards to some types of human disturbance, and would perhaps be less likely to travel through areas of industrial activity or high population density for example (Cardinal 2004).

Habitat Trends

No comments about wolverine habitat trends or loss were found in the traditional and community knowledge sources reviewed for this report. Any potential threats to habitat are included in *Threats and Limiting Factors*, p.34.

Distribution Trends

It was reported in all regions that past generations had also found and harvested wolverines in the same areas they harvest wolverines today (Cardinal 2004).

Two knowledge holders in the Kitikmeot region reported wolverines being found on Victoria Island, and others noted a general northward expansion of wolverine distribution:

> *We're starting to see more of a trend that they seem to be moving north, northward a little bit. Starting to see them on Victoria Island, compared to the past there were not as much down there* (A. Niptanatiak *in* Cardinal 2004: 88).

During interviews in 2005, Inuvialuit harvesters said that wolverines and other furbearers are getting harder to find, and that this may be due to industrial activity. One area south of Kiglavak Bay was specifically mentioned as having been previously abundant in wolverines, but with a lot of current activity they are no longer there (Community Corporations of Aklavik, Inuvik and Tuktoyaktuk 2006).

There is an increased presence and harvest of wolverines on Victoria Island, Baffin Island, and adjacent northeast and eastern mainland areas (Awan pers. comm. 2012; Popko pers. comm. 2014) as well as on Banks Island, where three wolverines were recently caught (Environment Canada 2013).

One knowledge holder in Tuktoyaktuk thought that fires in the south are forcing wolverines to migrate northwards (Cardinal 2004). However, traditional knowledge holders in the North Slave understand that fire results in more of the plants desirable as food for mice, hares and squirrels,

which attracts animals like wolverines (Beaulieu 2006). During a trapping/training program, traps were set in burned and unburned areas to investigate the effect of fire on fur-bearers. Over a roughly six week period, two wolverines were caught in the unburned area and three in the burned area. In comparison to previous years, this was the lowest amount caught in the unburned area and the highest amount caught in the burned area. In the five year summary of results, the authors stated that as predicted by traditional knowledge, the study showed that more fur-bearers, including wolverines, were being caught in the burned areas. Winter track counts indicated that there was also a higher number of prey species in the burned area (Beaulieu 2006).

Threats and Limiting Factors

Although no actual threats were identified in the sources reviewed for this report, several potential threats are identified that could negatively impact wolverine populations in the NWT.

Some knowledge holders feel that wolverines are somewhat sensitive to human development and human presence, though few active threats were identified, with the exception of the Mackenzie Valley Highway. If more development started taking place, knowledge holders identified increased access (leading to increased harvesting pressure), noise disturbance, vehicle collisions, possible degradation of habitat, and the presence of camps and landfills that may attract wolverines as possible threats associated with development. However, many knowledge holders did not consider wolverines to be especially vulnerable because they're not apt to form a dependency on human food and because of their demonstrated population recovery following the close of a wolf control program. This suggests that populations are able to recover from declines. Harvesting was identified as one of the main causes of wolverine mortality, but with harvest levels remaining low, it was not considered a significant threat. However, carcass collection programs in Nunavut suggest that harvest in many communities may be greatly underestimated. Low food availability was considered a potential threat, in that wolverine numbers are tied to total food availability. Climate change was thought to present a potential threat to wolverines, possibly affecting hunting ability, seasonality (which could affect mating and rearing of young), fur quality, and forest fire and flood patterns.

Industrial Activities and Other Human Disturbances

Some knowledge holders feel wolverines are somewhat sensitive to human development and

human presence, though few identified active threats to wolverines (Cardinal 2004). During the time of Cardinal`s (2004) study, knowledge holders generally indicated that there was little active development occurring over much of the range of wolverines in the NWT, such as petroleum and mining exploration, new roads, and forestry, with the exception of the Yellowknife area and areas in the southern Yukon. However, knowledge holders were concerned about what the impacts would be if such development were to occur (Cardinal 2004). In particular, Gwich'in knowledge holders identified the opening of the Mackenzie Valley Highway as a threat to wolverine, because it will increase access to the Travaillant Lake watershed and Caribou Lake area (which is predicted to increase the harvesting pressure on wolverines), increase levels of disturbance to wildlife, through, for example, noise pollution, and increase the incidents of wolverines being hit by vehicles (Benson 2014). Over the long-term, it is thought that increasing resource development may adversely impact the species (Awan *et al.* 2012). It was suggested that wolverine fidelity to denning sites be considered in regards to increased mineral exploration occurring in the NWT (Lee and Niptanatiak 1996).

Wolverines are generally described as shy and have been observed moving away from areas of activity and development (Cardinal 2004; Benson 2014), although food scents will sometimes attract them, even to an area that is occupied (Benson 2014). Wolverines tend to be found with increasing frequency the farther one gets from a community; however, they will return to areas of development if they do not feel threatened or if the development activities stop (Cardinal 2004). For example, there are recent reports from diamond exploration and mining sites that wolverines are curious and readily attracted to industrial sites (ConocoPhillips 2006).

One knowledge holder in Inuvik mentioned that seismic activity for oil and gas exploration is a threat to wolverine habitat (Cardinal 2004). In contrast, Benson (2014) noted that pipeline developments were not thought to pose a threat to wolverine as long as they are kept clean and allowed to grow over. Three other knowledge holders from the Yukon and Nunavut raised concerns about future development, such as increased road access bringing more hunters, and the possible degradation of habitat (Cardinal 2004). The onset of development could attract wolverines to camps and landfills, causing mortalities (SENES Consultants Ltd. 2008). While wolverines have been seen at garbage dumps, they do not generally form a dependence on human food (Cardinal 2004).

Wolverines are reportly sensitive to noise disturbance, especially females that are about to have

their young. While caribou and muskoxen can become less sensitive to noise with exposure over time, it seems that wolverines remain sensitive (Golder Associates 2003). In general, noises from blasting and other development activities were thought to make wildlife like wolverines disappear eventually; however, one knowledge holder in Kugluktuk stated that industrial noise will attract predators such as bears and wolverines, as they are curious (Golder Associates 2003).

> *They should use local trappers to trap out the small animals that hang around the mines, like foxes and wolverines. These animals get used to people, and they just hang around. They could even be dangerous. If you move them, they will just come back. They should trap these animals out. It would help out the local trappers too* (Łutsël K'e Dene participant *in* LKDFN 2001a: 44).

A tendency of wolverines to not form a dependence on human food, paired with evidence that they are recovering from a wolf poisoning program in the eastern Arctic, suggests that wolverine populations may be able to recover from population declines if given time and a large enough area free of impacts from human activity (Cardinal 2004). Consequently, while wolverines may be sensitive to certain threats such as land development, given that many of these threats are not present near many of the communities, wolverines are not considered vulnerable to them by most knowledge holders (Cardinal 2004).

In the Sahtú, it was reported that environmental contamination, over-harvesting, climate change, disease and the presence of invasive species are known stresses to all natural populations, including wolverines. Habitat loss and fragmentation are probably less of a threat in the Great Bear Lake watershed because the region remains largely undeveloped; however, climate change, over-harvesting of threatened species, disease and contamination by pesticides remain significant concerns.

Harvesting

The traditional and community knowledge sources reviewed for this report did not include information as to whether wolverine harvests – both in the NWT and Nunavut – are considered sustainable or not, or whether they constitute a threat to the species. There were just two mentions, in SENES Consultants Ltd. (2008) and MacDonald (2004), of the possibility that harvesting activities could impact populations. SENES Consultants Ltd. (2008: 106) noted: "*Harvest rates of the wolverine may have to be reduced in the future if the NWT population*

shows evidence of decline due to habitat loss". MacDonald (2004), in a more region specific comment, noted that both wolverine and grizzly bear populations in the Great Bear Lake watershed could be affected by continued hunting. Harvesting was one of the main causes of wolverine mortality identified by knowledge holders in Cardinal's 2004 study; however, as the harvest levels remain low, it was not considered a significant threat at present. Nonetheless, a brief discussion of harvesting patterns and numbers is warranted here. Both the wolverine and grizzly bear populations in the Great Bear Lake watershed could also be affected by continued hunting (MacDonald 2004).

Because wolverines are not common, in many areas harvesters do not actively seek them and harvesting is mainly opportunistic. Wolverine are not harvested for food; their meat is generally considered to be inedible (Benson 2014). Knowledge holders in all regions stated that only those who frequently hunted would catch more than one wolverine per year; only two knowledge holders stated that they actively looked for wolverines (Cardinal 2004). However, harvesting practices differ in each region and territory. In the Inuvialuit Settlement Region and the Gwich'in Settlement Area, wolverines are mostly trapped and tend to be targeted more than in other areas. In the Gwich'in area, wolverines are trapped from November through to March each year (Benson 2014).

Almost all of the wolverines caught in the Gwich'in and Inuvialuit Settlement Regions are sold locally (Benson 2014, Cardinal 2004). It was reported that selling the furs locally in the NWT can fetch a higher price than selling to the fur auction (Benson 2014, Cardinal 2004), and that some people feel it's their obligation to provide elders and community members with wolverine fur (Cardinal 2004). Still, there are relatively few harvesters in the Inuvialuit Settlement Region, and sport harvests of wolverines are low; for example, there were only two wolverine harvests by sport hunters in the Inuvialuit Settlement Region between 2006 and 2011 (ENR 2011).

Gwich'in knowledge holders indicated that it was important to keep the land clean while hunting and adhere to traditional harvesting practices in order to protect wolverines:

> *You could keep the country clean…Them old timers around McPherson, when they kill animals they just gather up the whole thing and maybe put it some place, and burn it up, and keep the country clean like that. Nowadays, these younger generations they don't care, they just throw the hide and everything away. During that time I went up with them oldtimers and*

you never see garbage or anything around (Charlie Stewart *in* Benson 2014: 43).

…it's something that we as Gwich'in have to manage…you know we don't ever get into big game hunting like for wolverine…because it's such a fine line where…if you kill too many, then you just clean them right out because they can't really produce fast enough. We got to be careful too where like right now…it's almost like a bountry. Like for a wolverine carcass you get, I think seventy five dollars. I think [there] should be an education for the young people. Just because you see a wolverine doesn't mean you have to go chase it, kill it. It's just how you think, out on the land. It's going to be there forever and we hope…because of our [land] claim and the right that we have. …But I…have grandchildren, I'd like them to be out there too. And be able to enjoy the life out there. We just got to be…educated about them. It's not only wolverines, everything that's out there…[you] don't take everything, you know? Just treat it like a farmer with his land…the land will only produce so much, then you let it rest. It seems out there you're always moving, your eye is always moving. So you don't clean out one area. Wolverine is the same thing. Like I said, the year before we go…lots of wolverine. So last year we just cut [our harvest] right back. We just went after the ones that were problems (James Firth *in* Benson 2014: 43)

In the North Slave region, pelts are either used locally for parka trimming or sold to the fur auction (Cardinal 2004).

Available data for wolverine harvests in the Inuvialuit, Gwich'in, Sahtú, Tłı̨chǫ and Dehcho regions are presented in Tables 2 through 6 respectively.

Table 2. Estimated total annual wolverine harvests reported by the Inuvialuit Harvest Study, 1988-1997 (Joint Secretariat 2003).

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Yearly Average
Aklavik	9	11	6	18	22	4	8	6	8	10	**10.2**
Holman	0	0	0	0	1	2	4	0	0	0	**0.7**
Inuvik	8	5	0	0	0	2	0	0	1	1	**1.7**
Paulatuk	19	19	14	25	18	13	24	11	12	38	**19.3**
Tuktoyaktuk	9	4	7	17	14	23	16	19	3	16	**12.8**
ISR total harvest	**45**	**39**	**27**	**60**	**55**	**44**	**52**	**36**	**24**	**65**	

Table 3. Estimated total annual wolverine harvests reported by the Gwich'in Harvest Study, 1995-2001 (McDonald 2009).

	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	Yearly Average
Aklavik	7	0	0	4	0	0	0	0	2	**1.4**
Fort McPherson	0	0	0	1	5	2	0	0	5	**1.4**
Inuvik	3	1	5	4	8	9	0	0	4	**3.8**
Tsiigehtchic	7	3	3	1			0	0	2	**1.8**
GSA total harvest	**17**	**4**	**8**	**10**	**13**	**11**	**0**	**0**	**13**	

Table 4. Wolverine harvests reported to the Sahtú Harvest Study, 1998-2001 (Bayha and Snortland 2002, 2003). Note: These totals have not been adjusted for participation rate and therefore do not represent estimated total annual harvests.

	1998	1999	2000	2001	2002	2003	2004	2005	Yearly Average
Colville Lake	4						2		**.8**
Déline		2	3						**.6**
Fort Good Hope	1	1	8	11	2	1	4	1	**3.6**
Norman Wells		2	1		1		1		**.6**
Tulit'a	3								**.4**
SSA total reported harvest	**8**	**5**	**12**	**11**	**3**	**1**	**7**	**1**	

Table 5. The yearly average number of pelts sold to the fur auction by communities in the Tłı̨chǫ Region, 2000-2005 (IMG-Golder 2006).

	Yearly average 2000-2005
Behchokǫ̀	7.6
Whatì	1.4
Tłı̨chǫ total average annual harvest (all communities)	**9**

Table 6. The yearly average number of pelts sold to the fur auction by communities in the Dehcho Region, 2000-2005 (IMG-Golder 2006).

	Yearly average 2000-2005
Jean Marie River	0
Fort Providence	5.2
Fort Simpson	1.8
Wrigley	0
Dehcho total average annual harvest (all communities)	**7**

Fur statistics in the NWT are based on furs exported to fur auction and not total harvest. However, carcass collection programs in Nunavut would suggest that the harvest in many communities may be greatly underestimated (Awan *et al.* 2012). The Government of the Northwest Territories is conducting a territory-wide wolverine carcass collection program to obtain better biological data and better data on regional harvest levels and patterns (Mulders, pers. comm. 2012). Land claim agreements required harvest studies in Sahtú, Gwich'in and Inuvialuit areas of the NWT in the past. Hunters and trappers in some communities are interviewed annually regarding their wildlife harvest.

Non-resident hunters are restricted to one wolverine each per year; there are currently no restrictions on the total number of each big game species that an outfitter can take within the zone for which they are licenced (Larter and Allaire 2013), but the average non-resident harvest is very low (no exact figures available for this report). A summary of resident hunter harvests of wolverines in the NWT are shown in Figure 6, p.41.

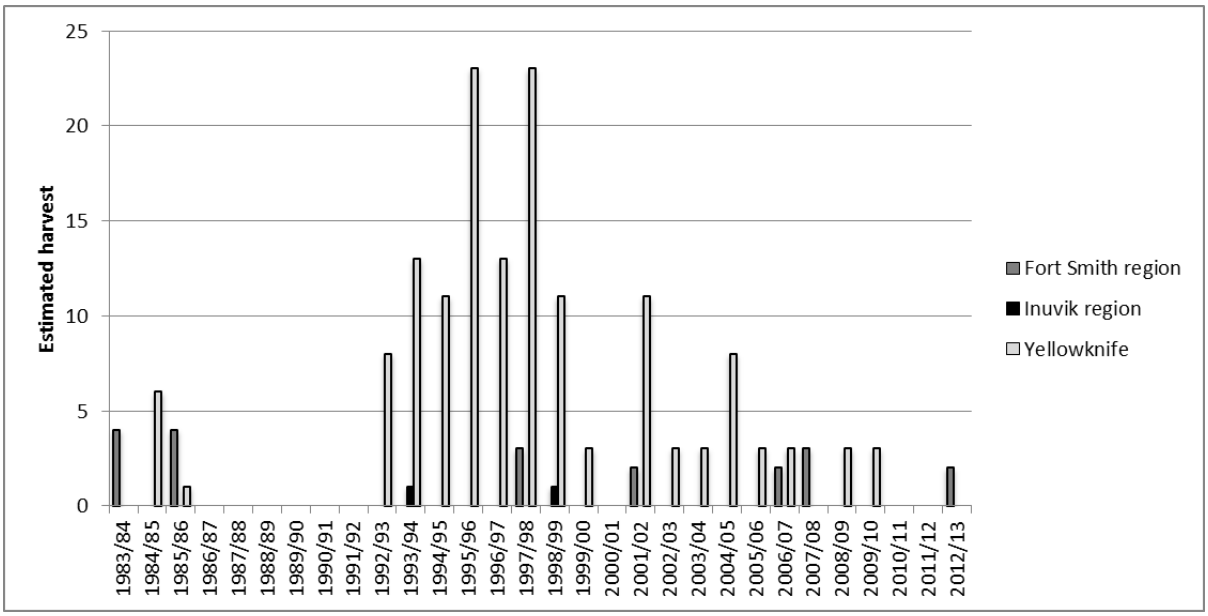

Figure 6. Estimated numbers of wolverines harvested by resident hunters in the NWT in seasons 1983/84 to 2012/13. Regions (Fort Smith, Inuvik, and Yellowknife) are where hunters reside, not where they hunted. The Fort Smith region includes the South Slave and North Slave, except Yellowknife. The Inuvik region includes the Inuvialuit, Gwich'in and Sahtú areas. Data up to 2008/09 from Carrière (2012), with 2009/10-2012/13 data from Carrière (pers. comm. 2014).

Nunavut Harvesting

Some Nunavut harvesters harvest wolverines in the NWT. The 2009-10 and 2010-11 carcass collection program in Nunavut indicated that of 155 reported wolverine kills most harvesting occurred in the western Kitikmeot, in the vicinity of Kugluktuk (Awan *et al.* 2012). Figure 7 gives and indication of the distribution of the Nunavut harvest and how many may come from the NWT.

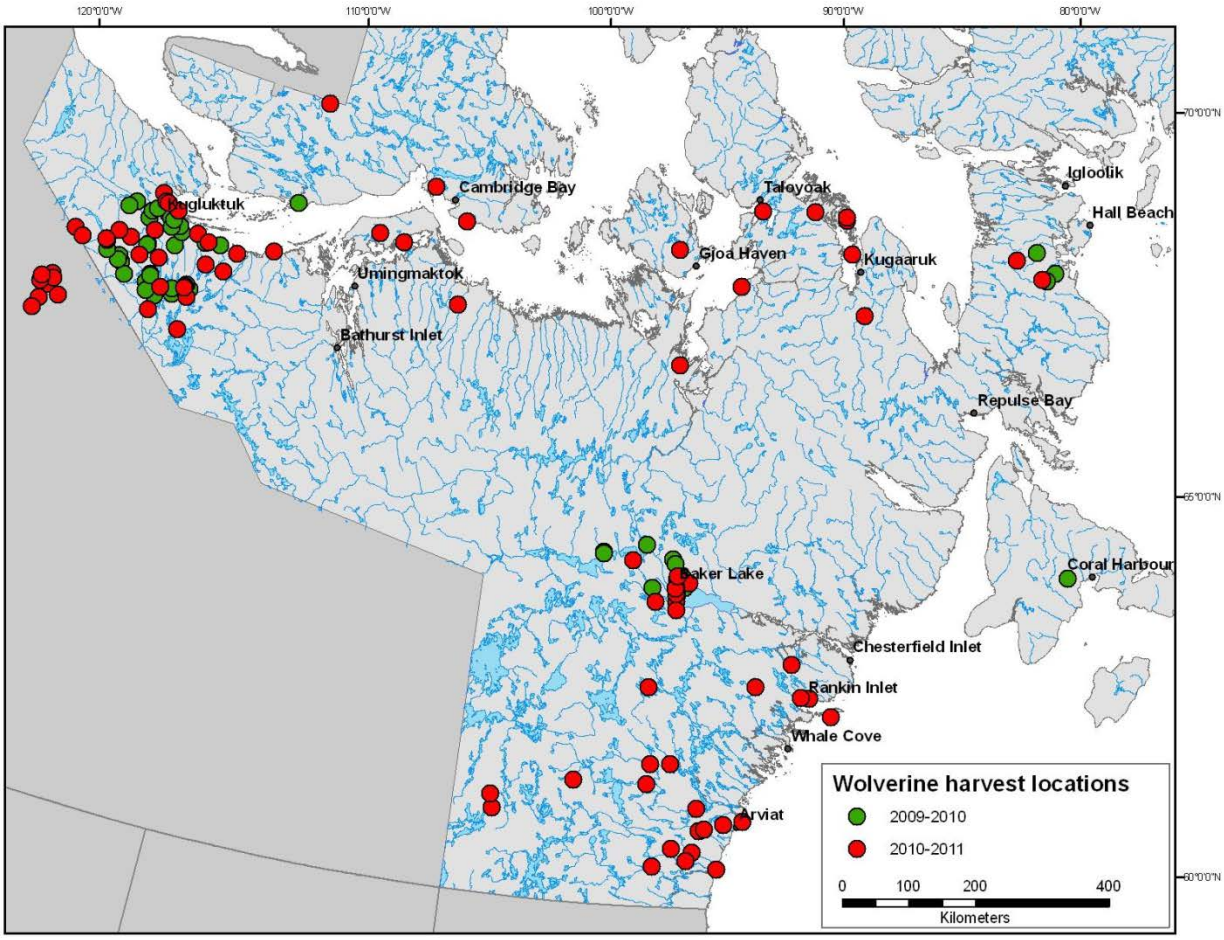

Figure 7. Distribution of Nunavut wolverine harvest, 2009/2010 and 2010/2011 seasons (from Awan *et al*. 2012).

Food Availability

Low food availability was one potential threat to wolverines that was highlighted by knowledge holders in Cardinal's (2004) study. Because wolverine numbers are tied to total food availability, when food availability is low, wolverine populations are also low. One participant pointed out that wolverines would be threatened if caribou populations crashed. This is also noted in Benson (2014).

Effects of Climate Change

One knowledge holder in Benson (2014) noted that climate change will impact wolverine because it will change the land, change the time of the year when seasons change (which could affect mating and rearing of young), and alter forest fire and flood patterns. There was no further

information in traditional or community knowledge sources from the NWT, Yukon or Nunavut that addressed or expanded upon this concern.

In Wainwright, Alaska, many community members have noted that there has been a warming trend over the last fifteen years. A warmer and longer fall season affects the quality of fur found on animals such as wolves, wolverines, and foxes (Kassam 2009). It has been observed that guard hairs, which are the longer and more wiry strands, are not as long as they were ten or fifteen years ago. For instance, the guard hair on the hindquarter of a wolverine now ranges between four and six inches, where it once was considered normal for them to reach eleven inches (Kassam 2009).

Positive Influences

This section only addresses actual and/or imminent positive influences that may currently be affecting wolverines. The available sources rarely contained information on positive influences, or the relative importance or magnitude of the positive influences.

Several wolverine refugia identified by knowledge holders occur within national parks, and most are situated away from major communities (see Figure 5 in *Likelihood of Immigration*, p.31) (Cardinal 2004). These protected areas will likely help to sustain wolverine populations in the north.

Wolverines are included in community conservation plans for five Inuvialuit communities: Inuvik, Tuktoyaktuk, Paulatuk, Ulukhaktok, and Aklavik (Community of Aklavik *et al.* 2008; Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008; Community of Ulukhaktok *et al*. 2008). For the most part, each of these communities suggests the same conservation measures be taken for wolverines, which are to: identify and protect important habitats from disruptive land uses; not disturb dens; not hunt in summer; not poison, and; support the bylaws of Hunters' and Trappers' Committees (if proposed) in designated trapping areas (Community of Aklavik *et al.* 2008; Community of Inuvik *et al.* 2008; Community of Paulatuk *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008; Community of Ulukhaktok *et al.* 2008).

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For help in identifying sources or providing further information and assistance, we thank Nathan Cardinal, Robert Mulders and Chris Hunter.

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Biography of preparer

Janet Winbourne B. Sc., M.E.S., R.P.Bio. ***Ethnobiologist*** Over the last 16 years, Ms. Winbourne has conducted TK research amongst and for many Aboriginal groups throughout western Canada and the Arctic. She is primarily a research ethnobiologist, and most often works identifying, documenting and reporting on the traditional knowledge of indigenous peoples, but her work also includes non-indigenous knowledge systems, and bringing the two together. Ms. Winbourne has previous experience compiling information specific to species at risk planning. Together, Ms. Winbourne and Ms. Benson prepared the ***Species Status Reports (Traditional and Community Knowledge Component)*** for ***Boreal Woodland Caribou*** and for ***Dolphin-Union Caribou*** in 2012 for the NWT Species at Risk Committee. They are also currently preparing the ***Species Status Report (Traditional and Community Knowledge Component) for Wood Bison***, also for the NWT Species at Risk Committee. In 2009, Ms. Winbourne prepared **Haida Traditional Knowledge of Abalone** for use in the ***2010 SARA Draft Abalone Action Plan***, and continued to compile traditional knowledge of species at risk such as abalone and sea otters with coastal First Nations in 2011-2012. She was the principal researcher on the Haida Marine Traditional Knowledge Study, responsible for collecting, compiling, analyzing and reporting information from hundreds of hours of interviews on approximately 150 species topics (2007-2012). She has worked directly with other Aboriginal groups including Nuu-chah-nulth, Nuxalk, Heilsuk, Gwich'in, Inuvialuit, and Sahtú Dene. Ms. Winbourne works researching, documenting and preparing information (scientific, local and traditional knowledge) for various research programs, harvest studies, management plans, environmental reviews, land use assessments and referrals, and also trains community workers in this field.

Scientific Knowledge Component

SPECIES OVERVIEW

Names and Classification

Scientific Name:	*Gulo gulo* Linnaeus, 1758
Common Names:	
English:	Wolverine
Chipewyan (Dene):	nogha (Cardinal 2004)
Cree:	kîhkwahâhkêw, cihkomisîs, or okîhkwahâhkêw (Online Cree Dictionary 2013)
Gwich'in:	nehttryooh or nehtryuh (Cardinal 2004)
Inuktitut:	kalvik or qavvik (Cardinal 2004)
French:	Glouton (European French) or carcajou (French-Canadian, of Algonquian origin from kwa•hkwa•če•w, also cognates with Cree, used by some First Nations south of Kugluktuk; Cardinal 2004).
Population:	Canadian (COSEWIC 2014)
Synonyms:	None
Class:	Mammalia
Order:	Carnivora (carnivores)
Family:	Mustelidae (weasels and allies)
Life Form:	Vertebrate, mammal, weasel

Systematic/Taxonomic Clarifications

Wolverines, *Gulo gulo* (Linnaeus 1758), were formerly known as *Gulo luscus* in North America and *Gulo gulo* in Eurasia; however, these two forms have been shown to be the same species (Kurtén and Rausch 1959). The most common taxonomic views either recognize a single subspecies, *G. gulo luscus*, in North America, or recognize *G. gulo* as a single taxon throughout its North American and Eurasian range (reviewed in Tomasik and Cook 2005). Various subspecies have been recognized in North America (e.g., Hall 1981; reviewed *in* Banci 1994); however, these have received little support. Currently, the most common taxonomic views either

recognize a single subspecies, *G. gulo luscus*, in North America, or recognize *G. gulo* as a single Holarctic taxon (reviewed in Tomasik and Cook 2005). A complete study of variation throughout the species range has been recommended (Nagorsen 1990).

Nuclear DNA has revealed genetic structuring at the eastern edges of the range of the Canadian population in Manitoba and Ontario (Kyle and Strobeck 2001, 2002; Cegelski *et al*. 2003, 2006; Zigouris *et al*. unpubl. data 2013). Genetic structuring also occurs at the southwestern periphery of the wolverine's range in southern British Columbia and the western United States (Kyle and Strobeck 2001, 2002; Cegelski *et al*. 2006). Wolverines from the NWT were part of a large panmictic core population. Consideration on whether the eastern genetic cluster should be recognized as a distinct evolutionary unit (ESU) for conservation planning and status assessment (i.e., COSEWIC Designatable Unit; COSEWIC 2014) will not affect status assessment in NWT. Implications from studies of maternally-inherited mitochondrial DNA (mtDNA), which included NWT samples and reported genetic structuring over relatively small geographic areas are discussed under *Biology and Behaviour: Movements*, p..

Description

Wolverines are a medium-sized carnivore and the largest terrestrial member of the weasel family in North America, appearing more like a small bear than a weasel (Figure 8, p.78). They have long, glossy coarse fur, which varies from brown to black, often with a pale facial mask and a single yellowish or tan stripe running laterally from each shoulder and meeting just above the tail. Most individuals have a pale white or orange patch on the neck and chest. They have a large head, broad forehead, short stout neck, short stocky legs, and a heavy musculature. The feet are large, ears short and the tail is long and bushy. The skull structure is robust, allowing it to crush bones and eat frozen carcasses. Wolverines are sexually dimorphic with adult females ranging in size from 7.5 to 12.5 kilograms (kg) and males weighing 13 to 18 kg (Magoun 1985; Banci 1994; Copeland 1996; Lofroth 2001; Cardinal 2004; Golden unpubl. data 2013). Mulders (2000) reported mean Wolverine weights from the central barrens near Daring Lake area, NWT. Adult, yearling and juvenile males weighed 14.8, 14.9 and 9.0 kg, respectively, while females weighed 11.4, 10.9 and 9.3 kg for the same age classes. Total length averages about one meter, with the average tail length being 23 cm. The general characteristics of wolverines are described by Wilson (1982), Hash (1987) and Copeland and Whitman (2003). In North America, northern

wolverines show less morphological variation between the sexes than southern wolverines (Banci 1994); northern wolverines are also larger, with those from the Southern Arctic Ecozone being the largest (Poole pers. comm., cited *in* Banci 1994).

Recognized age classes of wolverines include kit (with the adult female at den sites), juvenile (less than one year old), yearling (one year old), subadult (one to three years old, but not yet sexually mature) and adult (sexually mature at two years or older).

Figure 8. Illustration of the Wolverine, Gulo gulo (drawn by Lee Mennell).

Distribution

Continental Distribution

The historic range of wolverines in North America, as typically described (e.g., Kelsall 1981), was compiled from anecdotal evidence such as personal accounts and the interpretation of fur returns, which were often tied to factors other than furbearer populations, including socio-economic factors such as pelt price and demand. The two major fur trading companies, Hudson's Bay Company and the North West Company, traded over large areas, which encompassed several of today's jurisdictions (Novak *et al*. 1987, Obbard *et al*. 1987), so the harvest locations of furs could not be confidently assigned to the community at which they were traded, and so the true extent of historical range of the species is unclear. Most of the southern areas from which wolverines were presumably extirpated never produced significant numbers of Wolverine pelts

(see Aubry *et al*. 2007). Human activities and habitat changes may have influenced the range contraction in the United States and Canada, but a northward shift in spring snow cover that persists through the reproductive denning period may be a critical factor as well (Copeland *et al*. 2010).

Range reductions began in the mid-19th century, when wolverines were extirpated from New Brunswick, the southern half of Ontario, Québec and Labrador, and from the aspen parkland of Manitoba, Saskatchewan and Alberta (Dauphiné 1989). It is doubtful whether viable wolverine populations ever occurred on the prairies. The aspen parkland bordering the prairies and other vegetation associations on the edge of the wolverine's present range (Figure 9, p.80) may have represented population sinks, which were populated by immigration from the core range. An eastward range reoccupation may be occurring in northwestern Ontario (COSEWIC 2014). Harvesters report a northwards expansion of wolverines (Cardinal 2004) with an increase in wolverines on Victoria Island (Cardinal 2004; Awan pers. comm. 2012), Banks Island (Environment Canada 2013), and Baffin Island (Mallory *et al*. 2001).

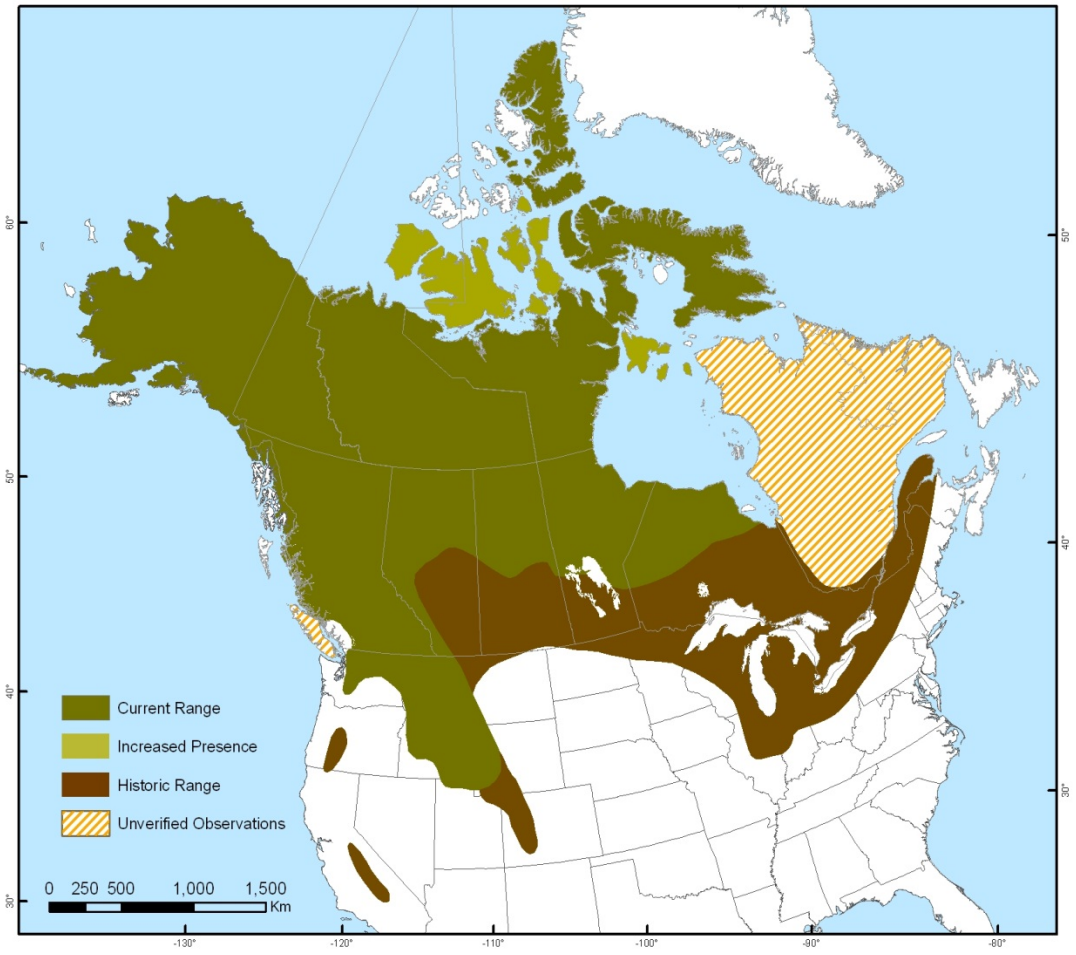
Wolverines are currently found across the boreal regions of northern Eurasia and North America. The Eurasian range of wolverines includes Norway, Sweden, Finland, the Russian Federation, Estonia, Mongolia and China. Range reductions have occurred in the European range south of 60°N latitude (Abramov *et al*. 2009).

In Canada they are found in northern and western ecologically intact forested areas, and in alpine tundra of the western mountains and arctic tundra (Figure 9, p.80). Wolverines have not been reported on the islands of Newfoundland, Nova Scotia, Prince Edward Island, Haida Gwaii, as well as some islands of the northwestern Arctic Archipelago in the NWT and Nunavut (Dauphiné 1989). Arctic islands that do support wolverines include Victoria, Banks, Stefansson, Prince of Wales, Somerset, Devon, Cornwallis, Amund Ringnes, Ellesmere, Baffin, Bylot (Carrière pers. comm. 2013). Wolverines have also recently been confirmed on Southampton Island (Awan pers. comm. 2012). Wolverine distribution on the Arctic islands is unclear, and is likely dependent on the availability of food resources. Wolverines occur on at least three Pacific islands: Vancouver (may be extirpated), Pitt (MacLeod 1950) and Princess Royale (Fraser pers. comm. 2013).

Wolverine range in the contiguous United States (not including Alaska) has declined with human

settlement since the mid-19th century. They have been extirpated from their range in the Great Lakes region, and from much of their range in the western mountains, where populations were naturally fragmented (Aubry *et al*. 2007). They ranged as far south as Colorado, Utah and California; however, tenuous populations currently inhabit montane regions in Washington, Idaho, Montana and Wyoming (Figure 9) (Aubry *et al*. 2007) with recent verified occurrences in Colorado (Inman *et al*. 2009), California (Moriarty *et al*. 2009) and Oregon (Magoun *et al*. 2013).

Figure 9. North American distribution of wolverine. Adapted from COSEWIC (2014), Magoun *et al.* (2004), Ray (2004, 2012), Aubry *et al.* (2007), Thibault unpubl. data (2013). Map produced by B. Fournier, ENR. Increased presence refers to observations of wolverine on various islands, but it is not known if these are established or vagrant individuals.



NWT Distribution

Wolverines are found across the NWT mainland, and on Victoria and Banks islands (Figure 9). They occur in all ecozones (Ecosystem Classification Group 2007 (rev. 2009)). They are apparently absent from other Arctic islands in the NWT. The Sachs Harbour Community Conservation Plan states that wolverines are found in low numbers on Banks Island (Community of Sachs Harbour *et al.* 2008). There is some evidence that wolverines may be increasing their range and numbers in the area (Environment Canada 2013). Only one wolverine is known to have been harvested from Ulukhaktok (Holman), Victoria Island since 2000 (Roussow unpubl. data 2012).

'Extent of occurrence' is defined by the Species at Risk Committee (SARC) as the area included in a polygon without concave angles that encompasses the geographic distribution of all known populations of a species (SARC 2010). The extent of occurrence of wolverines in the NWT is estimated at 1,868,289 km^2 (see Figure 2 in Traditional and Community Knowledge Component for Wolverine distribution in the NWT, p.6).

'Area of occupancy' is defined by SARC as the area within the extent of occurrence that is occupied by a species, excluding cases of vagrancy. This measure reflects the fact that the extent of occurrence may contain some unsuitable or unoccupied habitats. The area of occupancy is measured both as an estimate of the actual area occupied (the "biological occupancy") and as an index of area of occupancy (IAO), which uses a scale-correction factor to standardize this estimate across different spatial scales (SARC 2010). Although wolverines make use of all habitat types for travel, if not for foraging, including frozen fresh and salt water surfaces, glaciers and barren rock, for the purposes of this calculation, the area of occupancy was coarsely estimated as the range of wolverines in the NWT less the areas of large lakes, and not including Arctic Islands except Victoria and Banks islands, or about 1,241,593 km^2. The IAO is measured as the surface area of 2 x 2 km grid cells that intersect the area of occupancy. For wolverines in the NWT, this area is 1,316,908 km^2.

Location is defined as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the species present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a species is affected by more than one threatening event, location should be defined by

considering the most serious plausible threat (SARC 2010).

The major threats to wolverines in Canada (harvest as well as habitat losses, avoidance and fragmentation) have differential effects on populations across the country, where harvest controls, industrial developments and land uses vary. These threats are minor to wolverines in the NWT at present, where wolverines continue to be widespread and populations are connected (i.e., forming a panmictic or genetically well-mixed population). Within the current range of wolverine in the NWT there are a number of settled and unsettled lands, resources, and self-government agreements, and multiple protected areas, conservation zones and special management areas, both existing and proposed. Therefore, the number of 'locations' that are possible exceeds the threshold of 10.

Search Effort

Wolverine distribution and populations are monitored in the NWT using fur harvest data, carcass collections, DNA hair-snagging, winter track-counts, incidental observations, traditional knowledge, and field studies. Scientific field studies have included the use of radio telemetry to determine the movements of individual wolverines and estimate home range size, while DNA-based mark-recapture surveys provide a measure of relative abundance and population trends within study areas. Carcass collections provide information on patterns of harvest, winter diet, health, as well as the age and sex composition of harvested wolverines.

Wolverine pelts are valued by hunters and trappers, who use furs for domestic purposes in locally produced handicrafts and for parka trim. The fur's qualities include superior frost resistent properties, warmth and durability. As a result, these pelts remain in the territory and are not reflected in fur auction data or NWT Export Permit statistics (Table 7, p.148). Wolverine harvest patterns can also be monitored using community-based carcass collection programs (Tables 8, p.149 and 9, p.149). The unreported harvest may be underestimated by about 35% across the NWT, with about 80% being kept for domestic use within Inuvialuit coastal communities (Lee1994a, 1994b, 1998; Branigan and Pongracz unpubl. data 2012; Roussouw unpubl. data 2012; Mulders unpubl. data 2013). In Nunavut, Lee (1994a) estimated that the actual harvest was underestimated by 50-90% in the Coppermine, Bay Chimo, and Bathurst Inlet areas. Carcass collections provide an independent measure of harvest, which may also include a portion of the domestic harvest. Both methods of harvest monitoring provide harvest information

by community.

Wolverines harvested by Saskatchewan trappers (referred to as Border A harvesters) in the Rennie Lake area of the NWT, are not included in the NWT fur auction data. However, this harvest is monitored separately, with NWT Export Permits issued by Saskatchewan Conservation Officers (Table 7, p.148).

Biology and Behaviour

Habitat Requirements

Habitat is defined in this report after Hall *et al*. (1997), as the sum of specific resources present in an area that are needed by wolverines for survival and reproduction. Habitat is more than just vegetation, which is referred to as vegetation associations or types.

Wolverines inhabit a variety of treed and treeless vegetation associations at all elevations. They thrive in ecologically intact areas, where prey and other carnivore species are common and diverse. Wolverine habitat components include food (Cardinal 2004) and suitable physical features for natal and maternal den sites, and rendezvous sites, where kits are left during foraging periods by the female. Food, and hence habitat use, may vary at the landscape level, as described below for elevation zones. In a multi-scale habitat use study in two multi-use regions of British Columbia, male wolverines chose vegetation associations primarily based on food availability in summer and winter, while females were influenced by food, predation risk and disturbance (Krebs *et al*. 2007).

Wolverine locations recorded by Mulders (2000) in the Southern Arctic ecozone in the NWT were correlated with vegetation density and patches, especially sedge density (Johnson *et al.* 2005). The reason for this association is unclear, but wolverines were also associated with wolves (*Canis lupus*), barren-ground caribou (*Rangifer tarandus groenlandicus*) and grizzly bears (*Ursus arctos*). Viable populations of large carnivores such as grizzly bears and wolves are important as involuntary providers of ungulate carrion.

In mountainous areas, adult females use higher elevation alpine vegetation associations and steeper terrain more than other sex and age classes, while adult males and subadults of both

sexes make extensive use of low elevation forested areas (Krebs *et al*. 2007). Lower elevations are used more in winter by males and both sexes use all elevations in summer (Landa *et al*. 1998; Copeland *et al*. 2007; Krebs *et al*. 2007). Adult females may be reducing the risk of predation on their kits by choosing more rugged terrain. Banci and Harestad (1990) found that wolverines in the Kluane Game Sanctuary, Yukon, used vegetation associations according to availability, although males used coniferous subalpine areas more frequently than other vegetation associations in winter.

Den Sites

Wolverines have specific physical requirements for den sites. Dens are constructed either in talus boulders, along eskers, under deadfall, under logs in avalanche debris, or in snow tunnels at higher elevations and tundra (Copeland 1996; Magoun and Copeland 1998; Cardinal 2004; Inman *et al*. 2007a). Wolverine dens are also associated with large boulders and downed trees at lowland boreal sites in Ontario and Yukon (Dawson *et al*. 2010; Slough unpubl. data). Dens or sheltered areas may also be used for rendezvous sites after the kits are weaned but before they are able to travel with their mothers. Additional denning requirements are protection from predators such as Golden Eagles (*Aquila chrysaëtos*), bears (*Ursus* spp.), mountain lions (*Felis concolor*) and wolves. Adequate insulating snow cover (≥1.0 m deep) that persists throughout the denning period, until approximately the end of April, and proximity to kit rearing areas are also important (Magoun and Copeland 1998). Dens are sometimes found under less snow (Pulliainen 1968). Individual wolverines may reoccupy den sites or denning areas for several consecutive years (Magoun 1985; Inuit hunters, reported by Lee and Niptanatiak 1996).

Wolverine dens may be classified as natal or maternal, and multiple dens may be used in sequence (Magoun and Copeland 1998). Natal dens are used during parturition (birth; mid-February to mid-March) and maternal dens are used subsequent to natal dens and before weaning (mid-March to end of April) (Magoun and Copeland 1998; Inman *et al*. 2007b, 2012). Rendezvous sites are used in May and June. Female wolverines must leave their kits for lengthy foraging trips, and often select natal den sites in talus or avalanche debris with snow cover late into spring (Copeland 1996; Inman *et al*. 2007a) or under remnant snowdrifts (Magoun 1985).

Denning sites with spring snow cover allow wolverines to construct snow tunnels that provide thermoregulatory benefits for kits, are secure from excavation by predators, are located in areas

used by few other carnivores and also provide an abundance of small-mammal prey for rearing kits (Magoun and Copeland 1998). Such snow accumulation occurs in ravines and on leeward slopes.

Movements

Wolverines in North America typically occupy home ranges that vary from about 50-400 km^2 for females and 230-1,580 km^2 for males (Hornocker and Hash 1981; Gardner 1985; Magoun 1985; Whitman *et al*. 1986; Banci and Harestad 1990; Copeland 1996; Krebs *et al*. 2007; Dawson *et al*. 2010; Persson *et al*. 2010). Lofroth (2001) documented an average home range of 1,230 km^2 for subadult females and a range of 3,500 km^2 for dispersing subadult males. Yearling home range size in the NWT ranged from 107 km^2 to 8,736 km^2 (Mulders 2000). Wolverine home ranges on the central barrens near Daring Lake, NWT (Mulders 2000) averaged 126 km^2 for females and 404 km^2 for males. There may be home range overlap between members of the same and opposite sexes, with the latter being more common (Krebs and Lewis 2000). Persson *et al*. (2010) found that wolverine home ranges in Sweden overlapped between males and females, but home ranges were almost exclusive between members of the same sex.

A proportion of the wolverine population, typically yearlings, is transient at any given time. Yearling females tend to establish home ranges nearer their natal ranges than do yearling males, although both sexes are capable of long distance movements (Magoun 1985; Gardner *et al*. 1986; Copeland 1996; Mulders 2000; Aubry *et al*. 2012). Male dispersal records include >200 km (Copeland 1996; n=3), 378 km over eight months (Gardner *et al*. 1986), 874 km in 42 days (Inman *et al*. 2004), 541 km in 55 days (Inman *et al*. 2009), and 73-326 km (Mulders 2000; n=3). A dispersal distance of 100 km was reported for a juvenile male in Ontario (Dawson *et al*. unpubl. data 2004). Aubry *et al*. (2012) documented movements by a female >483 km over two months, with total distance moved about 280 km. Magoun (1985) reported a 300 km movement by a female of unknown age, and Mulders (2000) reported movements by five females between 69-225 km.

Vangen *et al.* (2001) attributed sex-biased dispersal patterns to resource competition between females and competition for mates by males. Wolverines are able to traverse rugged terrain, including tundra and glaciers that would act as barriers to the dispersal of many other species of mammals. Dispersal characteristics likely gave wolverines the capacity to recolonize gaps in

their distribution in Scandinavia (Vangen *et al.* 2001; Flagstad *et al.* 2004). Long distance movements (up to 500 km; Flagstad *et al.* 2004) place individuals at greater risk of mortality due to predation, trapping, accident or starvation (Copeland 1996).

Wolverines in the NWT are part of a large panmictic core population (where all individuals are potential reproductive partners) in northwestern North America where there are few barriers to migration. There is genetic structuring of maternally inherited mitochondrial DNA (mDNA) over relatively small geographic areas including areas within the NWT (Wilson *et al*. 2000; Chappell *et al*. 2004; Tomasik and Cook 2005; Cegelski *et al*. 2006; Schwartz *et al*. 2007; Zigouris *et al*. unpubl. data 2013). Together these studies suggest that gene flow is mediated by male-biased dispersal and a strong female preference to remain near their natal territories. Females that disperse long distances are expected to experience lower reproductive success (Tomasik and Cook 2005).

Life Cycle and Reproduction

Wolverines have a polygamous mating system, with males mating with more than one female. Breeding pairs generally share overlapping home ranges (Hedmark *et al*. 2007).

Most wolverines become sexually mature at two years of age, but few breed at this age (Banci 1994). Wolverines are thought to breed in the summer, from June through August (Magoun and Valkenburg 1983; Krott and Gardner 1985). The embryo develops to the blastocyst stage but does not implant in the uterus until November through March (Rausch and Pearson 1972; Banci and Harestad 1988; Inman *et al*. 2012). The use of delayed implantation of the blastocyst permits breeding in summer when food may be abundant; however, winter food availability and infanticide ultimately determine the reproductive success of the female (Persson 2003, 2005; Persson *et al*. 2003).

The proportion of adult female wolverine carcasses that were pregnant ranged from 74% (Banci and Harestad 1988) to 92% (Rausch and Pearson 1972) in studies in Yukon and Alaska. The pregnancy rate of subadults (one and two years old) was 7% in the Yukon (Banci and Harestad 1988) and 50% for a combined Alaska/Yukon sample (Rausch and Pearson 1972). The latter study might have included some adults (Banci 1994). The pregnancy rate declined from 92% for two and three year olds to 53% for five and six year olds and 37% for combined six year old and

older age classes. Recent (2005/06-2011/12) analyses of wolverine carcasses from the Yukon showed a pregnancy rate of 0% for juveniles, 31% for yearlings, and 80% for adults. Three to five year old wolverines had the highest pregnancy rates at 90% (Jung and Kukka unpubl. data 2013). In the Kitikmeot region between 1995-1998, 0% of juveniles (n=36), 22% of yearlings (10 of 46), and 72% of adult females (23 of 32) produced corpora lutea (Mulders 2000).

The average number of fetuses ranged from 2.8 (two and three year olds) to 3.4 (six years of age and older) in a Yukon study in the 1980s (Banci and Harestad 1988). A more recent Yukon study showed that the number of fetuses ranged from one to four, with most (44%) containing three fetuses (Jung and Kukka unpubl. data 2013). The mean litter size, from numbers of corpora lutea and fetuses was 2.6. Rausch and Pearson (1972) found a mean of 3.5 fetuses. In the Kitikmeot region (between 1995-1998), the count of corpora lutea per individual was 2.7 for yearlings as well as for adults >2 years of age (Mulders 2000). These studies were based on carcasses; therefore, the actual litter size, following early litter losses, was likely lower. Litter size was greatest for females over the age of six (mean of 4.4 corpora lutea, Banci and Harestad 1988; Rauset 2013), but the pregnancy rate for that age class was lower. Overall reproductive rates observed in Alaska and Idaho were 0.69 and 0.89 kits per female per year, respectively (Magoun 1985; Copeland 1996). The low values reflect the fact that females often breed every other year. Wolverines in Sweden have been found to have up to six litters during their lifetime at a mean of 0.74 (Persson *et al*. 2006) to 0.89 kits per litter (Rauset 2013). Litter size was closely tied to primary productivity (Rauset 2013). Similar to North American findings, there was a sharp increase in the proportion of females breeding between two and three years of age, followed by a slow decline with age. The probability of breeding in successive years peaked at five and six years of age.

Active gestation takes 30-40 days (Rausch and Pearson 1972). Litters of four or less are born between January and April (Banci and Harestad 1988), although there is no evidence that all individuals in litters of four survive. Birth takes place in natal dens. The kits reach adult size and independence by October. The maximum age reported for wolverines in North America is currently 16 years old, for an individual harvested in the Inuvik Region, NWT (Branigan and Pongracz unpubl. data 2012; Matson pers. comm. 2012). Lee (1998) reported a maximum age of 11 in the Kitikmeot Region of Nunavut; 12.9 was the maximum age reported in the Yukon (Jung and Kukka unpubl. data 2013) and 14 years was reported in Fennoscandia (Rauset 2013).

Generation time is the average age of reproductive females in the population. Since most females do not breed until the age of three, and the average age of females that are three or older may be seven or eight years of age, the generation time for wolverines is likely 7.5 years.

Physiology and Adaptability

Wolverine kits reach adult body size by seven months of age (Magoun 1985). Rapid growth of the energy-producing tissues (liver, heart, brain, and kidneys) requires a high metabolic rate early in life, which in turn places high energetic demands on the mother (Wilson 1982). The high metabolic rate should improve the kits' ability to thermoregulate during long foraging trips by the mother. Kits are weaned at nine to ten weeks (Banci 1994). Although energy expenditure during pregnancy is low for mustelids, lactation costs could be four to seven times greater than basal metabolic rates (reviewed by Young *et al*. 2012). Energy requirements peak at the time of weaning (Wilson 1982).

Wolverines show some adaptability to humans, being attracted to wilderness camps, traplines, mine sites, and snowmobile trails by virtue of their scavenging habits. There may also be a negative impact of disturbance, leading to the loss of functional habitat, possibly affecting the reproductive success of females. These issues are discussed under *Threats and Limiting Factors*, p.96.

Interactions

Wolverines are scavengers and predators, opportunistically feeding on abundant or readily procurable food (Cardinal 2004; Copeland and Whitman 2003; Inman *et al*. 2012). Food is frequently cached for later use. Diets of wolverines typically vary between seasons and years, as they switch between food sources depending on availability, according to a generalist feeding strategy (Dalerum *et al*. 2009). Fresh prey are eaten more during summer and carrion, including cached items, is used more in winter (Magoun 1987). Prey species may include rodents (beavers (*Castor canadensis*), muskrat (*Ondatra zibethicus*), porcupines (*Erithizon dorsatum*), hoary marmots (*Marmota caligata*), Arctic ground squirrels (*Spermophilus parryii*), voles and lemmings (Muridae), snowshoe hares (*Lepus americanus*), marten (*Martes americana*), mink (*Mustela vison*)), birds and their eggs (e.g., ptarmigan (*Lagopus* spp), Ross's Geese (*Chen rossii*), Lesser Snow Geese (*C. caerulescens*)), and young ungulates such as caribou and Dall's

sheep (*Ovis dalli*). The most common sources of carrion across the wolverine's range are ungulates, especially caribou, moose and muskox (*Ovibos moschatus*). Bison (*Bison bison*), mountain sheep, mountain goats (*Oreamnos americanus*), deer (*Odocoileus* spp.) and elk (*Cervus elaphus*) are consumed locally (Gardner 1985; Banci 1987; Magoun 1987; Mulders 2000; Samelius *et al*. 2002; Cardinal 2004; Lofroth *et al*. 2007).

In the Kitikmeot Region, Nunavut, Mulders (2000) reported that caribou remains were found in 62% of stomachs of winter harvested wolverines, and muskox was found in 11% of the stomachs. Minor food items included Arctic ground squirrels, voles and lemmings, and ptarmigan. Caribou were also the most common prey in the Inuvik Region, NWT (Branigan and Pongracz unpubl. data 2012), where they were found in 58% of wolverine stomachs. Caribou was found in 55% of all wolverine stomachs in the North Slave Region, 32% in the Sahtú Region, 13% in the Dehcho Region, and 12% in the South Slave Region, NWT (Mulders unpubl. data 2013). A wide variety of small mammals and birds, such as snowshoe hares, vole species, ptarmigan species, beaver and muskrat were each found in less than 10% of stomachs. Snowshoe hare is an important food for wolverines in the north when they are abundant (Banci 1987; Branigan and Pongracz unpubl. data 2012; Mulders unpubl. data 2013). Arctic ground squirrels are an important summer food in the Arctic (Magoun 1987). Fish (e.g., Lake Trout (*Salvelinus namaycush*), pike (*Esox lucius*), whitefish (*Coregonus clupeaformis*)) and marine mammals (e.g., seals) are scavenged (Cardinal 2004). In the Kitikmeot region, seal (Leporidae) was found in 3.6% (n=10) of wolverine stomachs examined (Mulders 2000).

The vegetation at food cache sites has been described as open old growth conifer or mixed-wood stands dominated by conifers in northeastern British Columbia, offering good visibility of the surrounding stand (Wright and Ernst 2004). Resting sites in the same study area were located on top of snow in similar open forest stands.

Large carnivores, such as grizzly bears and wolves, require large tracts of ecologically intact areas. These carnivores generate carrion, which is an important food source for wolverines, especially during the winter months (Wright and Ernst 2004). They also may compete with wolverines at kill sites, and are a potential source of wolverine mortality (White *et al*. 2002; Krebs *et al*. 2004; Jung and Kukka unpubl. data 2013). Johnson *et al*. (2005) found that wolverines were positively associated with wolves, grizzly bears and barren-ground caribou in

the central barrens, near Daring Lake, NWT.

Wolverines are preyed on by grizzly bear, polar bear (*U. maritimus*), wolves, mountain lions, Golden Eagles and other wolverines (Cardinal 2004). They may encounter large carnivores with greater frequency when scavenging carrion.

Parasitic nematode roundworms (*Trichinella* spp.) were found in 88% of wolverines tested from Nunavut (Reichard *et al*. 2008a) but were not detected in 38 wolverines collected from the lower Mackenzie River valley (Addison and Boles 1978). Addison and Boles (1978) did find six other species of Helminth parasites: trematodes, cestodes, and nematodes, in the digestive tracts of wolverines from the lower Mackenzie River valley. *Trichinella* species were found in 26% of wolverines (11 of 43) collected from the upper Mackenzie River valley, in the Dehcho Region of the NWT (Larter unpubl. data 2014). In early 2014, a previously genetically undocumented species of *Baylisascaris* (roundworm) was identified in the intestinal tract of a wolverine collected in the NWT (Jenkins pers. comm. 2014); other species of *Baylisascaris* (such as *B. procyonis*) are considered zoonotic. Wolverines may be a key host in their transmission among other carnivores and scavengers, but the effect of these parasites on the host wolverines is unknown. Protozoan parasites (*Sacrosystis* spp.) infected 80% of wolverines from Nunavut (Dubey *et al*. 2010). These parasites may be transmitted, in part, through cannibalism although there may be other pathways of exposure. Another protozoan parasite, *Toxoplasma gondii*, was detected in 41% of wolverines from Nunavut (Reichard *et al*. 2008b). The prevalence of clinical disease symptoms is unknown, but this parasite is transmissible to humans through skinning and fur handling. A rabid wolverine (infected with a strain of arctic fox (*Alopex lagopus*) rabies) was found in Alaska (Beckman pers. comm. 2012).

STATE AND TRENDS

Population

Abundance

The wolverine population of the NWT in 2003 was estimated at 3,500 to 4,000 residents based on the range of statistical and non-statistical density estimates, expert opinion from other North

American studies (Table 11), and a crude assessment of habitat quality (COSEWIC 2003; Slough 2007). Densities were then assumed to be lower in the Southern Arctic ecozone than in the taiga or boreal ecozones.

More recent studies in the Southern Arctic ecozone of the NWT and Nunavut have revealed Wolverine densities there are comparable with those in other boreal and montane regions of North America (Table 11) (Cardinal 2004; Mulders *et al*. 2007; Boulanger and Mulders 2008, 2013a, 2013b; Poole unpubl. data 2013). There is evidence from harvest patterns and local knowledge that wolverines are expanding their distribution on to Victoria Island (Awan pers. comm. 2012) and Banks Island (Environment Canada 2013), although they are still rare.

Wolverine densities declined in three study areas in the central barrens of the NWT between 2004/05 and 2011 (Table 11; Boulanger and Mulders 2013a, 2013b). At Daring Lake, the density declined from 10.73/1,000 km^2 (CV = 10.9%) to 3.72/1,000 km^2 (CV = 15.4%), between 2004 and 2011, 35% of the original density (Boulanger and Mulders 2013b). At Diavik the density declined from 11.43 (CV = 18%) to 3.87/1,000 km^2 (CV = 16%), between 2005 and 2011, 34% of the original density, and at Ekati the density declined from 10.05 (CV = 19%) to 6.14/1,000 km^2 (CV = 15%) over the same period, to 61% of the 2005 density (Boulanger and Mulders 2013a). Wolverine densities for Daring Lake vary slightly between those reported by Boulanger and Mulders (2013a) and Boulanger and Mulders (2013b), due to a meta-analysis approach used in the latter report as a way of reducing potential issues of small sample size and estimate imprecision. Wolverine densities were stable at Kennady Lake between 2005 and 2006 where there were 4.6 to 5.2/1,000 km^2 (Table 11; Boulanger and Mulders 2008). Mulders (pers. comm. 2013) believes that the declines are likely due to concurrent declines in the Bathurst caribou herd and associated wolves. However, these densities, even at their reduced levels, are in the range of moderate to high densities relative to other areas where wolverines have been studied in North America (Table 11).

Incidental observations from non-resident hunters in the Mackenzie Mountains between 1995 and 2011 indicate a relatively stable population over the long-term, with short term fluctuations (Larter and Allaire 2013). The hunters (89-171 with wolverine tags annually in the past decade) observed from nine to 31 solitary or groups (e.g., two or three travelling together) of wolverines per year. The wolverine harvest by these hunters is also stable, at zero to four wolverines taken

each year.

There is evidence that wolverines are increasing in numbers on Victoria Island and on the northeast and eastern mainland (Awan pers. comm. 2012). Wolverine density at High Lake and Izok Lake, western Nunavut was estimated at 6.85/1,000 km^2 in 2008 and 4.8 wolverines/1,000km^2 in 2012 (Poole unpubl. data 2013), respectively, which are similar to wolverine density estimates for the adjacent NWT.

A revised NWT wolverine population estimate based on density ranges of zero to three/1,000 km^2 in the occupied Northern Arctic ecozone (i.e., Victoria and Banks islands) (0.156 million km^2) and a minimum of three (minimum density in northwestern North America ecozones) to a mean of six wolverines /1,000 km^2 (from 16 study area-years in NWT) in all other ecozones (1.14 million km^2; not including water, but including barrenlands), is approximately 3,000 to 6,000 residents. There is no doubt that wolverine population densities vary among and within ecozones, and that they also fluctuate or cycle with prey populations. An additional 220-470 juveniles, many being transients, are estimated to be present in the fall (pre-trapping) population based on an annual growth rate of 6.4% (Krebs *et al*. 2004).

Trends and Fluctuations

The earliest wolverine harvest data attributed to specific Canadian jurisdictions indicate that populations, based on harvest success, may have been declining in the prairie provinces in the 1920s and 1930s (Novak *et al*. 1987). Ontario, Québec and Labrador harvests were already low by that time. Wolverine harvests in northern Québec and Labrador declined in the 1914-1923 period (Schmelzer unpubl. data 2012). Wolverines had been extirpated from New Brunswick by the early 1800s.

There is no evidence that wolverine populations in the NWT declined during the period of early settlement or fur trade. Long-term harvest data (Tables 7 to 9) are stable and indicate a stable population in the NWT. Caution must be used when interpreting harvest data, due to factors other than population levels that effect harvest; however, trapping effort is believed to be stable or decreasing in most areas. The recent decline of the Bathurst herd of barren-ground caribou from 480,000 to 32,000 between 1986 and 2009 (Boulanger *et al.* 2011) may result in a decline in Wolverine numbers in the central Arctic range of the herd. Wolverines in boreal habitat appear

to consume a more diverse range of species in their winter diet and consume less caribou. This would support the view that wolverines that are less reliant on caribou may not be as susceptible to population decline as those wolverine populations on the central barrens (Mulders pers. comm. 2014).

Wolverine densities declined in the central barrens between 2004/05 and 2011 to between 61% and 34% of their original densities (Boulanger and Mulders 2013a; Boulanger and Mulders 2013b), possibly as a result of concurrent declines in the Bathurst caribou herd (Boulanger *et al*. 2011; Mulders pers. comm. 2013). However, these densities, even at their reduced levels, are in the range of moderate to high densities relative to other areas where wolverines have been studied in North America (Table 11, p.152).

There is evidence that wolverines are increasing in numbers, but still rare, on Victoria and Banks islands (Awan pers. comm. 2012; Environment Canada 2013).

Data from neighbouring jurisdictions give evidence of stable or increasing Wolverine populations (COSEWIC 2014). Populations are believed to be stable in northern British Columbia (Lofroth and Krebs 2007), northern Alberta (Petersen 1997), and Yukon (Jung *et al*. 2005; Slough 2009). Most hunters in Nunavut believe that wolverine populations there are stable or increasing (Awan *et al*. 2012). Wolverine populations are not monitored in northern Saskatchewan. Declines have been reported in southern British Columbia, and populations have not recovered in Quebec and Labrador (COSEWIC 2014).

Population Dynamics

The birth rate of wolverines was discussed under *Life Cycle and Reproduction* (p.86) while movements, immigration, and emigration, were discussed under *Movements* (p.85).

In a summary of mortality rates of radio-collared wolverines from 12 North American studies, Krebs *et al.* (2004) found that human-caused mortality from trapping and road/rail kill accounted for 46% of deaths. Natural sources of mortality included predation by wolves, mountain lions and conspecifics (30% of non-human causes), and starvation (49% of non-human causes). Survival was <0.75 among all age/sex classes in trapped areas, and >0.84 in areas where trapping does not occur. Intrinsic rates of increase (λ) were estimated at 0.88 in trapped populations and

1.064 in untrapped populations. Survival was highest among adult females (0.88 in untrapped areas, 0.73 in trapped areas) and lowest among subadult males (0.45 in trapped areas) (Krebs *et al*. 2004). This evidence suggests that most trapped populations would decline without immigration from untrapped refugia.

The fact that female reproductive rates are highest in early adult years has implications for trapline management using refugia to ensure that these age classes are conserved. Additionally, wolverines' large home ranges, long-distance dispersal movements, and relatively low survivorship contribute to the importance of maintaining areas with no or light harvest of wolverines in order to maintain a sustainable harvest and stable population (Golden *et al*. 2007a).

Possibility of Rescue

Healthy, stable populations of wolverines are known to inhabit all neighbouring jurisdictions (Yukon, British Columbia, Alberta, Saskatchewan and Nunavut) (COSEWIC 2014), making the possibly of rescue high. All of these areas are home to genetically similar wolverines (nuclear DNA) and connectivity among these populations currently exists.

Habitat

Habitat Availability

Habitat availability is not an issue for the wolverines in the NWT, where they inhabit all ecological regions. The quality of habitat however, may be an issue as discussed later under *Threats and Limiting Factors*, p.96.

In the southern part of wolverine range, considerable wolverine habitat was lost or fragmented with the extensive settlement, agriculture and forestry that occurred in the late 19th and 20th centuries, especially at the southern edge of their range (Figure 9, p.80; van Zyll de Jong 1975). The removal of ungulates in some regions of Canada remains a significant threat to wolverine populations today, especially where mountain caribou (*Rangifer tarandus caribou*) herds are being impacted by forestry operations and overhunting.

Habitat Fragmentation

Habitat fragmentation, causing barriers to movements and gene flow, is not an issue for wolverines in the NWT at this time.

In southern areas, habitat fragmentation has resulted in isolated and threatened populations in the western United States (Banci 1994), and this process may be occurring in southern British Columbia and Alberta, and in eastern Manitoba and Ontario (Kyle and Strobeck 2002; Zigouris *et al*. 2012). Across the range of wolverines, forestry, oil and gas and mineral exploration and development, and large hydroelectric reservoirs threaten habitat. Transportation corridors act as barriers to movement and essentially divide habitats and isolate populations (Austin 1998). Mortality may be a factor along transportation corridors, where motorized access is improved for hunters, trappers and recreational users into remote areas.

Habitat Trends

Trends in habitat losses and fragmentation were discussed previously in *Trends and Fluctuations* (p.92) and *Habitat Fragmentation* (above).

In the NWT, reduced numbers of essential prey/carrion species has probably led to declines for wolverines. For example, the Bathurst herd of Barren-ground Caribou decreased from 480,000 to 32,000 between 1986 and 2009 (Boulanger *et al*. 2011).

A study of the cumulative effects of developments on Arctic wildlife (Johnson *et al*. 2005) found that mines and other major developments had the largest negative effect on species occurrence, followed by exploration activities, and outfitters camps. The species most affected were grizzly bears and wolves, followed by barren-ground caribou and wolverines. The study made use of Mulders' (2000) wolverine radio relocation data from the central barrens (Mulders 2000). Wolverines experienced a 2.4% decrease in functional summer habitat even though there were few disturbance features present. This apparent loss may in part reflect partial avoidance by caribou of active diamond mine sites by up to 14 km (Boulanger *et al*. 2012); wolverines likely concentrated their habitat use where the main sources of prey or carrion were most abundant.

Spring snow cover during the denning period is closely related to historical wolverine distribution in the contiguous United States (Aubry *et al*. 2007). Brodie and Post (2010a, 2010b)

hypothesized that the declining snowpack in western Canada for the years 1974-2004 negatively affected wolverine population dynamics, as evidenced by declining harvests. Trapping effort, however, may also have declined over this period, due to declining pelt prices and license sales, changes in trapping regulations, and trapper success, raising questions about the interpretation of their conclusions (DeVink *et al.* 2010; McKelvey *et al*. 2011b). Harvest data may not be a reliable proxy for wolverine population size, which would dispute the supposed causal relationship with climate change.

The relationship of wolverines with snow and a cold climate is not in dispute, but a climate-driven population decline in Canada is not evident, since wolverine population trends, while largely unknown, are believed to be stable or increasing in many areas (COSEWIC 2014; Krebs *et al*. 2004; Lofroth and Krebs 2007; Slough 2007). Copeland *et al*. (2010) found that 97.9% of 562 reproductive dens that they investigated in Fennoscandia and North America occurred at sites with persistent spring snow cover in at least one of seven years. One den in Ontario fell outside the area of spring snow coverage. Reductions in spring snow cover associated with climatic warming will likely reduce the extent of wolverine habitat in southern mountainous areas of the United States (McKelvey *et al* 2011a), whereas in northern areas these climatic factors represent less important limits, and other more proximal factors such as prey or carrion availability likely determine wolverine presence and habitat use (Copeland *et al*. 2010). Reductions in spring snow cover have not been assessed for lowland or mountain habitats in Canada.

Distribution Trends

Wolverines are distributed throughout the NWT mainland and on Victoria and Banks islands. There is some evidence that wolverine range may be increasing on both Arctic islands. Wolverine distribution in mainland NWT appears to have remained unchanged.

Threats and Limiting Factors

Any activity that contributes to habitat loss or fragmentation must be considered detrimental to wolverines. Many land uses have direct negative impacts on Wolverine behaviour and survival. Human settlement, agriculture, forestry, oil and gas development, mining, hydroelectric power

development, linear developments, recreational developments, and the access that these developments bring, have contributed to wolverine population declines and extirpations (Banci 1994).

The NWT wolverine population is part of the single Canadian population designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2014) as *Special Concern* because its habitat was becoming increasingly fragmented by industrial activity; increased motorized access increases harvest pressure; and due to the species' low reproductive rate and sensitivity to human disturbance, vast secure areas are required to maintain viable populations. Climate change is likely impacting animals in the southern part of the range, and this impact is expected to spread northward. While none of these factors may be an imminent threat in the NWT, it should be kept in mind that wolverines here are sensitive to harvest, habitat changes (including declining barren-ground caribou populations) and disturbance.

Biological Factors

Wolverines' low intrinsic rate of increase, low natural densities and large home ranges limit population growth rates (Banci and Proulx 1999). On the other hand, long-distance dispersal abilities give wolverines the capacity to recolonize vacant habitats (Vangen *et al*. 2001; Flagstad *et al*. 2004). Repopulation may take several decades but is possible where factors favour wolverine survival (Johnson 1990; Vangen *et al.* 2001*).*

Harvest

Harvest has the greatest potential to reduce wolverine populations to levels that could have a detrimental effect on metapopulation dynamics and risk or cause extirpation (Lofroth and Ott 2007). Lofroth and Ott (2007) believed that the harvest of wolverines was stable at the provincial level in British Columbia, but was unsustainable in 15 of 71 population units. Low densities, large home range size, and long-distance movements by dispersing individuals contribute to wolverines' vulnerability to trapping and hunting. An increased vulnerability of wide-ranging wolverines to trapping after snowshoe hare population crashes may be misinterpreted as an increase in abundance (Hatler 1989; Jung *et al.* 2005; Slough 2009). Banci (1987) noted an increase in the harvest of adult males in March 1983 following a snowshoe hare population crash.

Although wolverine trapping and hunting are a potential threat in the NWT, harvest levels have remained stable (Tables 7 to 9). Harvest management, including quotas for some harvesters, limited seasons, and the persistence of untrapped refugia act to reduce the threat. Exported wolverine furs require permits; however, a proportion of wolverines (estimated at 35%) from the NWT, particularly from coastal communities, are not exported to fur auctions. The use of carcass collection provides another opportunity to review levels and pattern of harvest, particularly in coastal areas where a significant proportion of the harvested pelts are kept for domestic use. Wolverines harvested by non-resident hunters in the Mackenzie Mountains are monitored with mandatory reporting and varied from zero to four wolverines per year from 1991-2012 (Larter and Allaire 2013). During outfitted caribou sport hunts on the central barrens, which was active between 2003-2007, non-resident hunters occasionally harvested wolverines; in 2005, this harvest reached a peak of 21 wolverines. This harvest is also captured in the fur export data. Wolverine harvest by resident hunters may or may not be captured, depending on whether raw pelts are exported from the NWT. Wolverine pelts that are not sold at auction, exported from the NWT, or carcasses that are not submitted in voluntary carcass collections, would likely not be captured or included in current NWT data sets (Table 7) (Mulders pers. comm. 2013).

Boulanger and Mulders (2013a, 2013b; discussed previously in *Trends and Fluctuations*, p.92) documented the harvest of 15 wolverines from their three study areas in the NWT, and believe that this level of mortality, along with relocations of nuisance wolverines by the mining companies may have contributed to observed declines in wolverine density in those study areas. Between 1998-2011, some 27 wolverines were reported as either being killed or relocated from the Lac de Gras region in connection with mine related activities (Mulders unpubl. data 2013). However, declines in barren-ground caribou were likely a much more significant fundamental factor influencing the observed decline in wolverine abundance.

Wolverines harvested by Saskatchewan trappers (Border A harvest) in the Rennie Lake area are not included in the NWT fur auction data, but are reported separately by Saskatchewan Conservation Officers (Mulders unpubl. data 2013).

The characteristics of harvested wolverines depend on many factors, including biology (movements), population age, sex structure and harvesting methods. The sex ratio of wolverine carcasses analyzed in the Inuvik Region from 2004/05 to 2011/12 was 1.5 males: 1 female (Branigan and Pongracz unpubl. data 2012), reflecting the greater vulnerability of wider-ranging

resident adult males, and dispersing young males, to hunting and trapping (Table 10). Other regions in the NWT had a ratio of 1.7 males: 1 female in carcass collection studies between 2001/02 and 2011/12 (Mulders unpubl. data 2013). In the Kitikmeot region, Nunavut, hunter and trapper harvested wolverines had a ratio of 1.8 males: 1 female, but up to 89% of hunted wolverines were male (Lee 1998; Elliott and Dumond 2005), while trapped animals were more likely to be the more sedentary females or juveniles of both sexes and had an even sex ratio (Lee 1998).

The age structure of the wolverine harvest in the five NWT regions and the Kitikmeot region in Nunavut is biased to young animals (juveniles and yearlings) (Table 10, p.150), suggesting that traditional harvesting areas are being used year after year. The high proportion of young animals and low proportion of adult females harvested would suggest that the population is not being overharvested.

Cardinal (2004) identified several refugia from trapping across northern Canada (Figure 5, p.31). The local overharvest of wolverines may occur in some areas (Krebs *et al*. 2004), but this harvest is largely replenished by immigrants from untrapped refugia. Using untrapped areas as functional refugia is a trapline management strategy practiced by many trappers and is promoted in trapper education courses and materials (e.g., Yukon Department of Renewable Resources, no date). Many untrapped refugia are unplanned, and exist due to difficulties in trapping large, inaccessible areas. Krebs *et al*. (2004) pooled data from 12 North American studies, and estimated that at an average harvest rate of 12.2%, and an intrinsic rate of increase of 6.4%, refugia from trapping would need to cover twice as much area as harvested areas. Monitoring spatial and temporal harvest patterns is key to ensuring the effectiveness of refugia to sustain harvested populations, particularly where harvest and habitat encroachment threaten refugia (Golden *et al*. 2007a).

Since 1992, the mean annual harvest of wolverines, based on fur auction data for the NWT, is 109 (over 20 years; Table 7, p.148). Corrected for furs that are not exported in the Inuvik Region (Table 8; based on eight years of data), other regions (Table 9, p.149) and adding the reported harvest by Saskatchewan hunters (Border A harvest) (Table 7, p.148; based on nine years of data), the mean annual wolverine harvest is approximately 200 individuals. The unreported harvest from regions other than the Inuvik region is difficult to estimate from available data and

so was not used to augment the harvest estimate further.

Assuming a crude population estimate of 3,000-6,000, the harvest rate is estimated to be about 3.3 to 6.7% of the population, likely sustainable assuming an intrinsic rate of growth of 6.4% per year in untrapped populations (Krebs *et al.* 2004). The proportion of lands currently untrapped in the NWT is unknown. There are seven areas with full protection from development in the NWT covering 7.2% of the territory (Northwest Territories Protected Areas Strategy Secretariat 2011); however, Aboriginal subsistence harvest can still occur within those areas.

Habitat Loss and Fragmentation

Habitat losses have been minimal in the NWT, where oil & gas and mineral exploration and development pose the greatest threats.

Permanent, temporary and functional habitat loss and fragmentation continue to threaten Wolverine populations in southern Canada. Permanent habitat losses result from conversion of natural habitats for human land uses including agriculture, ranching, urban and suburban developments, mining, oil and gas development, and hydroelectric reservoirs, while temporary losses result from forestry. The increased density of roads in logged areas and elsewhere may have a direct effect on wolverines and their prey, such as caribou, through disturbance (Krebs *et al.* 2007; Bowman *et al.* 2010). Roads also make wolverines vulnerable to trapping and hunting. The effects of logging are not permanent or necessarily negative. Logging that mimics natural processes, such as fire, windthrow and insect outbreaks, and creates a landscape matrix of uneven aged forest stands, may actually diversify the prey base and maintain or improve wolverine habitat (see *Habitat*, p.94). Wildfires are a natural occurrence in northern forests and are assumed to be beneficial, since populations of prey and carrion species such as moose, beaver and snowshoe hare thrive in regenerating burns (Nelson *et al*. 2008).

May *et al*. (2006) found that wolverines in Scandinavia selected home ranges based on degree of human development and, to a lesser extent, habitat quality. Areas with roads or human structures were avoided or selected less than large roadless areas. A similar relationship was found in the northwestern contiguous United States, where road density or human population density were more important than vegetation association quantity or quality in determining wolverine counts (Rowland *et al*. 2003). Their watershed-scale models predicted lower wolverine counts at higher road densities (road densities of 0.44 to 1.06 km/km^2). In the Rocky Mountain region, Carroll *et*

al. (2001) predicted a decline in the occurrence of wolverines when road densities exceeded approximately 1.7 km/km^2. The mean road density in wolverine home ranges was 0.43 km/km^2 in Ontario, and individuals whose home ranges had a higher road density than the mean had a higher risk of mortality due to anthropogenic factors (Bowman *et al*. 2010). Wolverines avoided areas with human activities, including roads (mean road density of 0.37 km/km^2) and logging (i.e., temporary and functional habitat losses) (Bowman *et al.* 2010). Resource development is often accompanied by road access, so road density serves as a proxy for the extent of the human footprint (Bowman *et al*. 2010). Road density is not only associated with avoidance behaviour by wolverines, but there is an increased mortality risk due to trapping, hunting, and collisions with vehicles.

Road density in the NWT is extremely low when compared to areas where impacts on wolverine behaviour have been observed. The State of the Environment Report produced by the Government of the Northwest Territories (GNWT 2012) presents 2007 road density by ecozone. The Taiga Plains ecozone, which contains most NWT communities, has a density of main roads of 0.0049 km/km^2. Total road density in the ecozone, including winter and recreational roads is 0.0074 km/km^2. The scale of this analysis though is too large to detect road densities that might have an impact on wolverines at a landscape/home range scale. These studies did not account for vehicle traffic volumes that might impact wolverine avoidance behaviour or result in road-kill. The threat of traffic volume is discussed under *Transportation Corridors*, p.102.

Wolverines prefer large roadless areas, but home ranges frequently overlap active traplines, cross-country ski trails, busy roads such as logging roads, seismic lines (Krebs *et al*. 2007), and the edges of communities. Winter recreation in the form of helicopter skiing and backcountry skiing, snowmobiling (e.g., high-marking) and the presence of roads reduced habitat values (i.e., functional losses) for wolverines in the Columbia Mountains, British Columbia (Krebs *et al*. 2007).

Habitat avoidance results from human activities such as backcountry recreation, which may impact wolverine behaviour patterns such as denning, kit rearing, travel and foraging. Disturbance of wolverine maternal den sites may lead to den relocation or litter abandonment (Pulliainen 1968; Myrberget 1968). Moving kits between dens may be typical behaviour regardless, brought about by changes to predation risk, prey availability, or deteriorating den conditions, in addition to disturbance (Magoun and Copeland 1998). Evidence for direct impacts

of winter recreation on denning wolverines is conflicting (Heinemeyer and Squires 2012; Copeland 2009), but helicopter skiing and backcountry skiing have been shown to reduce functional habitat values for wolverines, especially adult females (Copeland *et al*. 2007; Krebs *et al*. 2007; May *et al*. 2012), whose reproductive success may be affected (Carroll *et al*. 2001; Rowland *et al*. 2003; Copeland *et al*. 2007; Krebs *et al*. 2007; Copeland 2009). Aboriginal knowledge holders feel that the use of snow machines has changed harvesting practices and patterns, allowing people to travel further and faster, which has resulted in increased wolverine harvest (Cardinal 2004). Wolverines are believed to opportunistically use snowmobile trails for travel and scavenging trapped animals and hunter kills.

Indirect effects on the prey base and large carnivores, which impact scavenging opportunities, will also impact wolverine populations. Such effects include overhunting of ungulates and carnivores, and population declines of prey and carrion due to loss and fragmentation of their habitats (Cardinal 2004). A recent recolonization of southern Scandinavia by wolves led to an increase in scavenged Moose in the diet of wolverines, and a decrease in the occurrence of wolverine-killed reindeer and rodents (van Dijk *et al*. 2008).

Parks may act as refugia from trapping and resource developments; however, parks do not necessarily provide any insurance to continued existence as described by both Kelsall (1981) and Dauphiné (1989). Parks run the risk of holding populations isolated from other wolverine habitats, thus fragmenting and destabilizing populations. Trapping is allowed in most protected areas and many wolverines range outside of protected area boundaries where they are vulnerable to trapping (Squires *et al*. 2007). Access roads in parks may act as barriers to movements and recreational activities, like snowmobiling and skiing, during the late winter denning period may result in disturbance to females and their litters leading to relocation or abandonment (Heinemeyer and Squires 2012). Habitat fragmentation and linear developments of this nature may be increasing in the Nahanni National Park Reserve (Tate pers. comm. 2014). The size requirement for an effective refugia from development has not been determined, but refugia larger than 20,000 km^2 may be required in isolated habitats (where immigration is limited) to maintain viable populations (Magoun *et al*. 2005).

Transportation Corridors

Disturbance by noise and traffic may lead to avoidance of transportation corridors or to collision

mortalities. Transportation corridors also improve motorized access for hunters, trappers and recreational users into remote areas. It is unlikely that any but the busiest roads around communities in the NWT cause any disturbance to wolverines, and the level of disturbance is probably temporary only, based on chance encounters with vehicles. Wolverines regularly cross open areas without cover, such as roads, frozen lakes, glaciers and barrenlands. Highway mortalities of wolverine are also believed to be negligible in the NWT due to low traffic volumes. Increasing resource development interest in the NWT has led to an increase in winter road activity, which provides the public with better access to more remote areas, which in turn is expected to potentially improve opportunities for harvesting wolverines.

Gibeau and Heuer (1996) documented highway mortalities of wolverines on one of the busiest roads in western Canada, the Trans-Canada Highway in Banff National Park, where they observed patterns of approach and retreat behaviour before successfully crossing roads during busy periods. Rights-of-way under 50 meters wide have less impact on wolverine movements than roads with wide rights-of-way over 100 meters (Austin 1998). Wolverine movements, and ultimately gene flow and population stability are at risk where habitats become isolated by transportation corridors or other human activities. In problem areas such as the Trans-Canada Highway in Banff National Park, wildlife crossing structures such as bridges, culverts and box underpasses are reconnecting fragmented wolverine habitats (Clevenger *et al.* 2011).

Average annual daily traffic volumes (AADT) on NWT highways are generally much less than 500; as low as 50 in remote areas, and as high as 5,600 near major communities (GNWT 2009). AADT for truck traffic, servicing mines and mineral exploration, on the Tibbitt to Contwoyto winter road between 1999 and 2008, was a maximum of 64 in 2007 (GNWT 2009). By comparison, the AADT in Banff National Park averages 14,000 where impacts on carnivores, including wolverines, have been documented (Alexander *et al*. 2005). Alexander *et al*. (2005) suggest that the carnivore movement threshold is between 300 and 500 vehicles per day, or an AADT of 3,000-5,000, assuming a 10:1 annual to winter traffic ratio. No wolverine crossings (n=39) were detected at that traffic volume (Alexander pers. comm. 2013).

Wolverine-Human Conflicts at Wilderness Camps and Mines

Wolverine-human conflicts at exploration camps or mine sites have recently been identified as a potential threat to wolverine populations in the NWT and Nunavut, where there are diamond

mines in the Southern Arctic ecozone. Wolverines generally avoid areas of human activity but are curious, and will investigate campsites, food caches, garbage dumps, kitchen grease traps, cabins, traplines and hunter kills, usually when humans are not present, and scavenge for food. Occupied mining camps are approached in the NWT and Nunavut for food and shelter under building skirting. ConocoPhillips' (2006) waste management plan also recognizes that certain petroleum-based products such as lubricants may attract wolverines.

Wolverines usually maintain a separation distance of at least 500 meters from human activity (AXYS 1998), but attraction to food sources at camps and other areas of human activity (see *Physiology and Adaptability*, p.88) may result in the habituation of animals, and increased vulnerability to problem wildlife and collisions with vehicles. Adaptive mitigative measures are used to reduce wolverine occurrences at diamond mines (Golder Associates 2012a, 2012b; Rescan Environmental Services Ltd. 2012).

Incidents involving wolverine–human interactions at diamond mines in the NWT and Nunavut usually result in deterrence (DDMI 2012; LeCompte pers. comm. 2013), and only occasionally result in relocation or mortality (Golder Associates 2010; Rescan Environmental Services Ltd. 2012). For example, there were 47 incidents involving wolverine deterrence from 2000 to 2011 at Diavik diamond mine, and only two relocations and two mortalities (DDMI 2012). There were 30 incidents involving wolverine deterrence and two reported mortalities at Meadowbank gold mine in the Kivalliq region, Nunavut, in 2011 and 2012 (LeCompte pers. comm. 2013). De Beers Canada Inc. (2013) reported a total of 11 wolverine mortalities at all mine sites in the region since 1996, and only three since 2006. Wolverine mortalities and relocations as a result of diamond mining activities appear minor, but in conjunction with trapping and hunting and barren-ground caribou declines, may be contributing to population declines (Boulanger and Mulders 2013a).

Responses of wolverines to flying aircraft are variable, ranging from no response to running away and hiding (AXYS 1998). No response was most common (38 of 40 encounters) in Yukon with respect to flights (Jung pers. comm. 2013).They are reluctant to leave carrion when disturbed.

Positive Influences

Habitat Protection and Conservation Planning

There are seven areas offering full habitat protection in the NWT (Northwest Territories Protected Areas Strategy Secretariat 2011) covering 7.2% of the territory. Cluff and Paquet (2003) considered wolverines as a potential umbrella species for deciding which lands to protect, and, along with wolves and grizzly bears, could be used as a surrogate species to satisfy the NWT Protected Areas Strategy goal of representing the territory's biodiversity within protected areas.

The Sahtú (Sahtú Land Use Planning Board [SLUPB] 2013), Gwich'in (Gwich'in Land Use Planning Board [GLUPB] 2003) and Tłı̨chǫ (Tłı̨chǫ Government 2013) Land Use Plans include zoning that add to habitat protection.

The Sahtú Land Use Plan (SLUPB 2013) establishes horizontal setbacks (800 m) and minimum flight altitudes (300 m) for wolverine den sites between October 15-May 15 in each year. In addition to these setbacks, the Sahtú Land Use Plan also establishes conservation areas, special management zones, and conservation zones. Sıhonılı̨ne (Anderson River) (conservation area), Edaííla (Caribou Point) (conservation zone), and Shúhtagot'ıne Néné (Mountain Dene Land) (conservation zone) all prohibit bulk water removal, mining exploration and development, oil and gas exploration and development, power development, forestry, and quarrying. Two proposed conservation initiatives, Ts'ude nılıne Tu'eyeta (Ramparts River and Wetlands) and Tuktut Nogait (Sahtú Expansion) prohibit these same activities. In addition to this, Neyádalín (Underground River), Arakíe Tué (Horton Lake), Sahtú (Great Bear Lake Watershed), and Neregah (Northshore), all special management zones, prohibit bulk water extractions.

The Gwich'in Land Use Plan (GLUPB 2003) establishes four conservation zones (1 - Ddlah zhıt han (Rat), Eneekaıı han (Husky), and Chıı gwaazraıı (Black Mountain), 2 - Dachan dha'aıı njık/Vıtreekwaa vıteetshık (James Creek/Vittrekwa River), 3 - Khaıı luk, Nagwıchoonjık/Dachan choo gehnjık (Travaillant Lake, Mackenzie-Tree River), and 4 - Tsıigehnjık (Arctic Red River). These all limit development activities to varying degrees.

The Tłı̨chǫ Land Use Plan (Tłı̨chǫ Government 2013) establishes a land exclusion zone (Hoòdoòdzo (Wolverine Hill or Sliding Hill) and Gots'ǫkàtì (Mesa Lake)) where development proposals will not be considered, and a habitat management zone, traditional use zone, cultural heritage zone, and an enhanced management zone. Hydroelectric power generation and utilidors

may be considered in the traditional use zone and cultural heritage zone, while more broader developments may be considered in the enhanced management zone. Only very limited activites, primarily traditional in nature, will be permitted in the land exclusion zone and habitat management zone.

Six communities in the Inuvialuit Settlement Region (Aklavik, Ulukhaktok, Inuvik, Paulatuk, Sachs Harbour and Tuktoyaktuk) have adopted community conservation plans, updated in 2008 (available from the Joint Secretariat – Inuvialuit Settlement Region web site: http://www.jointsecretariat.ca/documents.html). Recommended wolverine conservation measures include the identification and protection of important habitats from disruptive land uses, avoidance of den disturbance, discouraging hunting in summer and forbiddance of poisoning.

Global Climate Change

The impact of increased snowfall and a modestly earlier spring snow melt on wolverines should be negligible across their range in the NWT.

Spring snow cover during the denning period is an important habitat requirement of wolverines (Aubry *et al*. 2007). Climate models predict increases in temperature and precipitation in Canada (IPCC 2007), with the largest warming projected for northern Canada. Precipitation is likely to increase in winter and spring, but decrease in summer. Snow season length is predicted to decrease, but a net increase in snowfall should make up for the shorter snow season, resulting in a net increased snow accumulation. Spring snow cover in the Arctic has melted about four to seven days earlier since the late 1980s (Foster *et al.* 2008), but that should not affect the natal denning period, which might extend from February into April (Magoun and Copeland 1998). Earlier snowmelt could actually benefit wolverines by improving primary (plant) productivity (Rauset 2013).

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Status and Ranks

Region	Coarse filter (Ranks) To prioritize	Fine filter (Status) To provide advice	Legal listings (Status) To protect under species at risk legislation
Global	G4TNR – Apparently Secure (2005) Rounded Global Status not yet ranked		
Canada	N3N4 – Apparently Secure/Vulnerable (2012)	Special Concern (COSEWIC 2003)	
Northwest Territories	S3 - Sensitive (NWT General Status Ranking Program 2011)	Not at Risk (SARC 2014)	**To be determined**
Adjacent Jurisdictions			
Alberta	SNR – Status Not Ranked		
Yukon	SNR – Status Not Ranked		
Nunavut	SNR – Status Not Ranked		
Manitoba	SNR – Status Not Ranked		
Ontario	SNR – Status Not Ranked		
Saskatchewan	SNR – Status Not Ranked		

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Figures

Table 7. Wolverine pelts produced in the Northwest Territories, and Canada, 1992/93 to 2009/10.

Season	NWT[1]	Border A/B Export[2]	Unreported Harvest – Inuvik Region[3]	Unreported Harvest – Other Regions[4]	Canada[1]
1992/93	93	-	-	-	637
1993/94	121	-	-	-	485
1994/95	119	-	-	-	559
1995/96	59	-	-	-	350
1996/97	86	-	-	-	597
1997/98	175	-	-	-	607
1998/99	62	-	-	-	385
1999/00	99	-	-	-	476
2000/01	56	26	-	-	545
2001/02	111	60	-	-	516
2002/03	106	22	-	-	468
2003/04	132	45	-	-	518
2004/05	118	3	45	-	513
2005/06	126	72	47	44	485
2006/07	154	25	25	-	497
2007/08	76	72	30	15	395
2008/09	133	23	30	8	543
2009/10	103	-	70	-	559
2010/11	135	-	52	-	-
2011/12	119	-	58	-	-
Total	2,183				9,135

Source:
Statistics Canada, Fur Statistics. Statistics Canada does not publish Fur Statistics – Wildlife Pelts (Publication 23-013-X) after 2009/10. 2010/11 and 2011/12 NWT data provided by Rossouw (unpubl. data 2012). Not corrected for furs used personally or for handicrafts, and were not exported, by hunters or trappers. Does not include Wolverine harvest from Nunavut. Data collection began for Nunavut in 1992/93 for political reasons related to an Inuit land claim, in preparation for the establishment of Nunavut as a territory, which occurred on April 1, 1999.

1. Wolverine harvest from the Rennie Lake area by trappers from Saskatchewan (Mulders unpubl. data 2013).
2. Minimum unreported harvest from Inuvik Region, based on carcass collections (see Table 8).
3. Minimum unreported harvest from other NWT regions based on carcass collections (see Table 9).

Table 8. Wolverine carcass collections vs. pelts produced in Inuvik Region, NWT, 2004/2005 to 2011/12.

Season	Aklavik		Ft. McPherson		Inuvik		Paulatuk		Tsiigehtchic		Tuktoyaktuk		Total	
	Carcasses	Pelts	Carcasses	Pelts	Carcasses	Pelts	Carcasses	Pelts	Carcasses	Pelts	Carcasses	Pelts	Carcasses[1]	Pelts
2004/05	7	5	2	0	7	1	14	0	0	2	24	1	54	9
2005/06	11	4	2	0	16	5	16	0	0	0	19	8	64	17
2006/07	13	9	0	0	6	1	9	0	0	0	7	0	35	10
2007/08	10	1	1	0	9	1	11	0	0	0	1	0	32	2
2008/09	8	6	5	0	6	0	0	0	1	0	16	0	36	6
2009/10	19	7	2	0	20	0	10	0	1	0	21	0	77	7
2010/11	12	11	3	1	23	5	10	0	0	0	17	0	69	17
2011/12	10	13	0	2	17	2	17	0	0	0	31	0	75	17
Total[1]	90	56	15	3	104	15	87	0	2	2	136	9	442	85

Source: Carcass data from Branigan and Pongracz (unpubl. data 2012). Pelt production data from Rossouw (unpubl. data 2012).

1. An additional four Wolverine carcasses were collected from unknown communities in the Inuvik Region in 2009/10 and 2010/11.

Table 9. Wolverine carcass collections vs. pelts produced in other NWT Regions, 2001/02 to 2011/12.

Season	Dehcho		Sahtu		South Slave		North Slave		Inuvik Region		Total	
	Carcasses	Pelts	Carcasses	Pelts	Carcasses	Pelts	Carcasses	Pelts	Carcasses	Pelts	Carcasses	Pelts
2001/02	0	5	11	46	0	24	4	36	-	-	15	111
2002/03	1	11	2	21	4	42	4	53	-	-	11	129
2003/04	0	12	0	19	0	30	23	60	-	-	30	130
2004/05	2	13	3	4	23	26	74	75	54	9	156	127
2005/06	6	9	19	15	37	44	129	62	64	17	255	147
2006/07	9	18	28	9	29	47	43	54	35	10	144	138
2007/08	4	20	14	8	33	25	39	19	32	2	122	74
2008/09	6	13	26	15	55	51	58	52	36	6	181	137
2009/10	15	22	29	27	38	36	32	31	77	7	191	123
2010/11	19	33	14	12	53	47	29	25	69	17	184	134
2011/12	14	26	8	9	40	41	21	18	75	17	158	111
Total[1]	69	182	154	185	312	413	456	485	442	85	1001	1361

Source: Carcass data from Mulders (unpubl. data 2013). Pelt production data from Rossouw (unpubl. data 2012). Does not include non-resident hunter harvest that remained in the NWT (Table 7).

1. An additional 10 Wolverine carcasses were collected from unknown regions/communities (seven in 2003/04, one in 2009/10, and two in 2011/12).

Table 10. Sex ratio and % age composition of Wolverine carcasses harvested from five NWT regions and Kitikmeot, Nunavut.

Region	Dehcho		Sahtu		South Slave		North Slave		Inuvik		Kitikmeot	
Age Class	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Juvenile	62.5	70.1	58.0	61.5	58.0	66.7	39.6	59.0	31.9	39.4	32.2	27.5
Yearling	22.5	13.3	14.8	14.8	18.9	13.3	18.7	10.9	31.9	31.2	37.0	41.4
Adult	15.0	16.7	27.2	27.2	23.1	20.0	41.7	29.7	36.1	29.4	30.8	31.1
No. carcasses	43	25	90	52	189	105	284	144	259	173	435	244
Sex ratio	1.7:1		1.7:1		1.8:1		2.0:1		1.5:1		1.8:1	

Source: Carcass data from Branigan and Pongracz (unpubl. data 2012; 8 years of data 2004/05 to 2011/12), Mulders (unpubl. data 2013; 11 years of data 2001/02 to 2011/12) and Lee (1998, 10 years between 1985/85 and 1996/97).

Table 11. Wolverine density estimates from North American studies.

Density (per 1,000 km^2)	**Location**	**Study Area** (km^2)	**Relative Habitat Quality**	**National Ecological Area or Ecozone**	**Methods**	**Reference**
6.5 (SE = 1.9)	Omineca Mountains, northern British Columbia	8,900 km^2	High	Northern and Southern Mountain	Mark-recapture and mark-resight (cameras)	Lofroth and Krebs 2007
5.8 (SE = 1.1)	Columbia Mountains, southern British Columbia	7,000 km^2	High	Southern Mountain	Mark-recapture and mark-resight (cameras)	Lofroth and Krebs 2007
0.3 - 2.0 - 4.1	British Columbia	n/a	Rare, Low and Moderate	Pacific, Boreal, and Southern Mountain (plateau regions)	Predictions based on habitat quality ratings	Lofroth and Krebs 2007
4.8	Northeast British Columbia	51,200	Moderate	Boreal	Trapper catch and snow tracking	Quick 1953
6.8	Willmore Wilderness Park, Alberta	4,600	High	Southern Mountain	DNA mark-recapture (NGT, non-invasive genetic tagging)	Fisher *et al*. 2009, unpubl. data 2013
3.0	Foothills, Alberta	6,400	Moderate	Boreal	DNA mark-recapture (NGT, non-invasive genetic tagging)	Fisher *et al*. 2009, unpubl. data 2013
5.6	Kluane Wildlife Sanctuary, Yukon	1,800	High	Northern Mountain	Based on known residents only, identified by live capture and telemetry	Banci and Harestad 1990

10.8	Kluane Wildlife Sanctuary, Yukon	1,800	High	Northern Mountain	Calculated from mean home range size and assuming saturated habitat	Banci and Harestad 1990
9.7 (CV 6.5%)[2]	Old Crow Flats, Yukon	3,375	High	Northern Mountain	Quadrat sampling of tracks in snow using sample-unit probability estimator (SUPE)	Golden *et al*. 2007b
Declining 10.73 (CV 10.9%) to 3.72 (CV 15.4%)	Daring Lake, NWT	2,556	Moderate to high	Southern Arctic Ecozone	DNA mark-recapture	Boulanger and Mulders 2013b
Declining 11.43 (CV 18%) to 3.87 (CV16%)	Diavik, NWT	1,269	High	Southern Arctic Ecozone	DNA mark-recapture	Boulanger and Mulders 2013a
Declining 10.05 (CV 19%) to 6.14 (CV 15 %)	Ekati, NWT	1,062 to 1,647	High	Southern Arctic Ecozone	DNA mark-recapture	Boulanger and Mulders 2013a
4.6-5.2 (SE=1.3 F-2.4 M)	Kennady Lake, NWT	1,575	Moderate to High	Southern Arctic Ecozone	DNA mark-recapture	Boulanger and Mulders 2008
6.85 (SE=1.05) 3.5 F, 3.3 M	High Lake, Nunavut	3,000	High	Southern Arctic Ecozone	DNA mark-recapture	Poole unpubl. data 2013
4.80 (SE=0.8) 1.5 F 3.3 M	Izok Lake, Nunavut	3,000	Moderate to High	Southern Arctic Ecozone	DNA mark-recapture	Poole unpubl. data 2013
0.7-1.4	Red Lake, Ontario	7,626	Low to Moderate	Boreal	DNA mark-recapture and mean home range size	Dawson, Magoun, Ray and Bowman unpubl. data 2004 and 2013
USA						
9.7 (5.9–15.0)	Southeast Alaska	2,140	High	Pacific	Camera trapping and spatial capture-recapture model	Royle *et al*. 2011
3.0 (CV 12.0%)[1]	South-central Alaska	4,340	Moderate	Maritime montane (N. Kenai Mtns)	SUPE	Golden *et al*. 2007b

5.2 (CV 20.3%)[1]	South-central Alaska	1,871	High	Maritime montane (N. Chugach Mtns)	Transect intersect probability sampling (TIPS)	Becker 1991
4.7 (CV 13.0%)[1]	South-central Alaska		Moderate	Montane (E. Talkeetna Mtns)	TIPS	Becker and Gardner 1992
4..0 – 7.4	South-central Alaska		Moderate to high	Montane (Susitna River Basin)	Home range/telemtery	Gardner and Ballard 1982
4.9 (CV 8.9%)[1]	South-central Alaska	3,663	Moderate	Maritime montane (W. Chugach Mtns)	SUPE	Becker and Golden 2008
4.6[2] (no variance est.)	South-central Alaska	1,050	Moderate	Maritime montane (W. Chugach & N. Kenai Mtns)	Total count of small study area	Golden 2010
5.0 (CV 17.1%)[1]	South-central Alaska	1,939	Moderate to high	Maritime montane (N. Kenai Mtns)	SUPE	Golden unpubl. data 2013
7.2	Arctic Alaska	~5,000	High	Arctic, western Brooks Range	Home range/telemetry	Magoun 1985
20.8 (fall estimate)	Arctic Alaska	2,400	High	Arctic, western Brooks Range	Home range/telemetry	Magoun 1985
4.0-11.1	Idaho	8,000	Moderate to High	Montane	Live capture, telemetry and reproductive potential	Copeland 1996
15.4[2]	Montana	1,300	High	Montane	Capture and snow tracking	Hornocker and Hash 1981

1. Surveys based on the TIPS or SUPE techniques, should be considered minimum population estimates, since they are conducted in late winter/early spring, after trapping mortality and dispersal have occurred (Golden pers. comm. 2013).

2. May be overestimated due to edge effect of small study area (Lofroth and Krebs 2007) and may have included juveniles (Banci and Harestad 1990).