Species Status Report

Common Muskrat

Ondatra zibethicus

Muskrat | Rats | Rat musqué commun (French)

Kivgaluk (Inuvialuktun [Uummarmiutun])
Dzan (Teetł’it and Gwichya Gwich’in)
Dzę (K’ashógot’ı̨ne/South Slavey)
T’ehk’áe (Shúhtaot’ine/Sahtúot’ı̨ne/North Slavey)
Tehk’áa (Dene Yatié/Dene Zhatié/South Slavey)
Dzën (Chipewyan)
Dzın (Łutsël K'e Dene/Denesǫłıne)
Dzǫ / Tehk’á (Tłı̨chǫ Yatıì)

IN THE NORTHWEST TERRITORIES

NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

ASSESSMENT – SPECIAL CONCERN

APRIL 2026

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 Indigenous 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 Common Muskrat 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.

Environment and Climate Change, Government of the Northwest Territories, provides full administrative and financial support to the Species at Risk Committee.

Cover illustration photo credit: Liam Cowan

ASSESSMENT OF COMMON MUSKRAT

The Northwest Territories Species at Risk Committee met on April 14-16, 2026 and assessed the biological status of common muskrat 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 based on Indigenous and Community Knowledge (ICK) and Scientific Knowledge (SK) and are available at: www.nwtspeciesatrisk.ca.

Assessment: Special Concern in the Northwest Territories

Special Concern – A species that may become Threatened or Endangered in the NWT because of a combination of biological characteristics and identified threats.

Reasons for the assessment: Common muskrat fit criteria ICK (a) for Special Concern and was determined to be Data Deficient under the scientific criteria.

Status Category	Criterion	
Special Concern	ICK(a)	Knowledge holders are observing changes in abundance, habitat quality/quantity, movements, or range, but these changes are not yet large enough to qualify the species for Threatened **AND** knowledge holders express concern that the species is being adversely impacted by one or more natural or human-caused threats.
Data Deficient	n/a	A species in respect of which SARC does not have sufficient information to categorize as Extinct, Extirpated, Endangered, Threatened, Special Concern, or Not at Risk.

The Species at Risk Committee determined that common muskrat fit the Indigenous and Community Knowledge criterion for Special Concern but was determined to be Data Deficient under the Scientific Knowledge criterion. Based on the available information, SARC concluded that overall common muskrat is a species of Special Concern.

Main factors (ICK):

- Declines in muskrat abundance, outside of natural cycles, have been reported by Indigenous communities in the NWT; knowledge holders are concerned about these changes.

- Adverse impacts to muskrat habitat in the NWT have been observed by knowledge holders. Declines in muskrat abundance are linked to these adverse changes to their habitat.
- Changes to the aquatic habitat of muskrat are complex; they are tied to climate-related shifts and water-level regulation. Documented knowledge of observed changes to muskrat habitat includes changes in water flow, precipitation, and water levels. There have also been shifts in the seasonal timing of spring break-up and flooding. For instance, spring ice jams flood delta basins allowing nutrients to recharge, however these events have decreased.
- Ecosystem changes impact muskrat by reducing the availability of habitat or reducing habitat quality (e.g., shallow lakes freezing to the bottom, thereby reducing overwintering habitat), limiting growth of aquatic vegetation and access to food, and by decreasing the efficacy of shelters (i.e., pushups, bank burrows and houses) that protect muskrat from predation and freezing temperatures.

<u>Main factors (SK)</u>:

- The status report has fully investigated all the best available scientific information about common muskrat in the NWT. Although there is enough information to determine that common muskrat is not extirpated from the NWT, there was not enough information for the committee to further assign status.
- There are no reliable data on muskrat population trends nor on habitat trends for most of the NWT. Existing relative abundance data are spatially and temporally limited, and large areas have never been systematically surveyed. Past harvest records and fur returns offer insight into declines in abundance, however confounding variables (e.g., fur prices) and biases (e.g., regional differences) limit the utility of this data for assessment.
- There is limited information on muskrat distribution trends. Information on distribution is restricted to occurrence records based on limited studies of pushups and sparse opportunistic observations along roads and waterways.
- Some studies indicate that water-level regulation systems (e.g., dams) have a negative influence on muskrat abundance, and that drying wetland habitats are a primary driver for the decline of muskrats. There is evidence of localized population reductions based on pushup surveys, past harvest records and fur returns. However, more information is needed to understand the severity of these ecosystem changes and threats to muskrats.

Additional Factors:

- Threats related to climate change are extremely difficult to manage or reverse. Climate-driven changes or water-level regulation systems have the potential to impact aquatic ecosystems. Water levels that are excessively high or periods of drought are the greatest selection pressures affecting muskrat. Extreme drought conditions have persisted since 2022 and extreme variation in water flow and levels are becoming more common.
- Hunting and trapping activities can remove unhealthy and/or less vigorous muskrat from the population, allowing healthier animals to make the population more vigorous overall. Despite muskrat being culturally important throughout their range, there has been a shift and muskrat are not being harvested as often.

Positive influences on the species and their habitat:

- Muskrats have high reproductive outputs and high dispersal abilities; these biological characteristics allow them to effectively repopulate suitable habitat.
- Numerous areas of muskrat habitat in the NWT are formally protected as Indigenous Protected and Conserved Areas, National Parks, Territorial Parks, areas protected by Land Claim Agreements, areas conserved through land use planning, and Wildlife Sanctuaries.
- Muskrats are culturally important throughout their range in the NWT. Although the relationship with muskrat has shifted, the ongoing use of this species contributes to maintaining cultural continuity, transferring knowledge from Elders to youth, maintaining land-based traditions, and fostering individual and community well-being.

Recommendations:

- Develop and implement long term monitoring programs to gather information on trends related to muskrat population, distribution and habitat.
- Encourage researchers to fill knowledge gaps related to muskrat biology (i.e., predation, competition), habitat changes, and threats.
- Encourage hunting and trapping of muskrat to revive and support cultural connections to the species.
- Acknowledge that muskrat are valuable indicators of ecological and cultural health in freshwater aquatic ecosystems. Develop and implement monitoring programs using Indigenous and community knowledge as well as scientific knowledge that combines hydrology and muskrat trends to quantify changes impacting muskrat habitat.

- Inform best practices and policies regarding water-level regulation from hydroelectric facilities including the W.A.C. Bennett Dam.
- Continue to uphold the principles identified in the various bi-lateral transboundary water agreements between the NWT and adjacent jurisdictions,and ensure that these agreements provide protection to the aquatic habitats of muskrat and other wildlife using similar habitats.
- Encourage sharing common muskrat observations on iNaturalist.ca and reporting observations to WildlifeObs@gov.nt.ca.
- Canada and the NWT must uphold and, if possible, exceed international climate change agreements including reducing greenhouse gas emissions at the local level. Climate change in the NWT must be addressed by implementing the 2030 NWT Climate Change Strategic Framework and Action Plan.

Executive Summary

Indigenous and Community Knowledge	Scientific Knowledge
About the Species	
Description Muskrat are rodents that live in wetlands and feed on aquatic plants. They have sharp claws, beady eyes and large, sharp, yellow teeth. Muskrat can vary in size (weighing ~0.5 to 2.2 kg and ~25 to 40 cm long) and colouration (light to dark brown) in different areas, by season, as well as in response to the availability of good feed. **Relationship with People** Muskrat have been used widely as a source of food, fur, and income by Indigenous harvesters in the NWT for generations and their role in numerous oral history legends speaks to their importance. During the time of the fur trade, muskrat became an important driver of the yearly cycle for many Indigenous people, especially in areas like the Mackenzie River Delta. When fur prices were high from roughly the 1920s to 1950s, much of the regional economy in that area was dependent on muskrat harvesting. Even though fewer people are trapping for economic purposes than in the past, muskrat continues to be valued for economic and cultural reasons. Muskrat trapping and harvesting occurs during springtime and continues until they start having young around mid-June. Muskrat meat is consumed in many Indigenous households, with people	**Description** Muskrats are medium-sized semi-aquatic rodents that live in wetland environments. They look quite similar to a beaver while swimming, with brown fur, small paws with claws, and large flat front teeth. They are significantly smaller than beavers and have long, flat tails that are much narrower than a beaver. They eat vegetation on the shorelines and bottoms of water bodies and live in burrows in the banks or above-water houses constructed from vegetation. In the winter, they stay in one ice-covered water body and live in a bank burrow (den) and feed and breathe at holes in the ice that are covered by mounds of insulating vegetation, called pushups. **Life Cycle and Reproduction** On average, muskrats typically have a lifespan of 3-4 years in the wild, depending on predation or other factors that cause mortality. They can live up to a maximum of five years in the wild, but most do not live past 1-2 years old. They reach sexual maturity at 10-12 months old and can reproduce up to 6 times per year with 3-8 kits per litter. Muskrats in the southern parts of their range have smaller litters and more litters per year. Muskrats in the NWT and other northern parts of the muskrats' range are likely to

enjoying muskrat cooked over an open fire, or through freezing, drying and/or smoking. Muskrat are important to many Métis people, with mentions in legends and local uses such as making coats and clothing, commercial pelt sales, and food harvesting. For some people in the NWT muskrat trapping is seen more as a past activity now but still an important link to traditions.

Biology and Behaviour

Muskrat start mating when they are one year old. Breeding starts in late-May in many areas and this initial mating period lasts several weeks. Young are mostly born in June and July, however muskrat may have more than one litter a year depending on food availability and seasonal conditions. In the Mackenzie Delta, there may be as many as 17 kits to a litter, but six to eight is most common. Both parents take care of their young all summer and the young stay with the parents over the first winter.

Muskrat are very good at swimming; a muskrat can stay underwater for long periods of time and travel far beneath the surface. They can also move quite fast on land and fierce when defending themselves from predators. Because of their dependence on aquatic habitats, muskrat can be impacted by changes in water levels.

Muskrats use three types of shelters: houses; bank burrows and pushups. Pushups are mounds of mud and underwater vegetation that provide crucial shelter and food storage during the winter months. Muskrats also excavate dens and tunnels in lake banks to reproduce one or two times per year with an average of 7-8 kits per litter. Juvenile mortality is typically very high.

Interactions

Muskrats play an important role in aquatic ecosystems feeding on shoreline vegetation and submerged roots, rhizomes, and macrophytes. Muskrats affect the plant communities in wetlands they occupy.

Predators of muskrat include mink, fox, birds of prey, bears, otters, wolverine, and northern pike.

Beavers and muskrats are competitors in wetlands, however, they are also known to cohabitate within beaver lodges, living together without conflict.

For many Indigenous peoples, muskrat trapping and hunting holds deep socio-cultural significance, providing not only sustenance and economic resources, but also opportunities for intergenerational knowledge transmission and connection to the land.

live in, and avoid predators, for some months of the year. These dens can be quite extensive with many rooms and a network of tunnels, providing a home for up to 12 animals. In some places dens are considered the muskrat's main home; in other places, such as along the coast, muskrats tend to use their pushups as houses.

Diet and Feeding Behaviour

Muskrat primarily eats vegetation from the bottom of grassy lakes. Their food is said to resemble spinach, but the root they prefer is white or yellowish. Their food is thought to be 'clean', healthy, and like medicine for muskrat when they eat it. Muskrats eat fresh green growth as soon as it is available in spring, as well as willow bark.

In spring and summer muskrat are partly nocturnal –often coming out of their den later in the day to eat, returning at around nine o'clock in the morning. Although they feed at night, they may also sleep. In winter, muskrat continue foraging and eating vegetation and roots from under the frozen surface of lakes. When food is not plentiful muskrat move to a new lake.

Relationships Within and Among Species

The muskrat is not a solitary animal; a good muskrat lake will host many different species living together (e.g., moose and ducks). Muskrat can make lakes more attractive to some waterfowl species by clearing up the water, however, geese tend to avoid lakes with muskrat.

Muskrat and beaver are found in similar lakes and there are many legends about their relationships and sharing their homes. However, with beaver abundance increasing in some areas of the Mackenzie Delta since the mid-1980s, some knowledge-holders point out that beaver can be bad for muskrat if they change water levels in ways that no longer suit muskrat. River otter have also seen population increases since the mid-1980s. Otter are effective predators on muskrat. Other predators include mink, fox, wolf, eagle, hawk, owl, marten, lynx, black bear, grizzly bear, wolverine, and jackfish (Northern pike). They are most vulnerable to predation when travelling on land or on ice, when they are far from their pushups. Caribou and bison may eat muskrat pushups in the winter months, effectively destroying the muskrat food sources and shelters. Male muskrats will compete during the mating season; fighting can cause substantial injuries or force younger and/or smaller males to move to different areas.	
Place	
Muskrat are found in all regions of the mainland NWT, but especially in areas with rich aquatic vegetation such as the Mackenzie and Slave River deltas. Suitable habitat for muskrat requires rich aquatic vegetation. The Mackenzie Delta historically had a very strong population of muskrat, but recently there are some suggestions of a decline, and that muskrat may be moving further north. While	**Distribution** Muskrats are native to North America and are found throughout the northern hemisphere. In the NWT, muskrat is found on the mainland particularly in localized areas of wetland habitat notably the Slave and Mackenzie Deltas. They have not been documented on any of the Arctic islands in the NWT.

Indigenous knowledge-holders have a lot of information on where muskrat can be found in the NWT, very little of this information has been documented. **Movement and Dispersal** An individual muskrat may make several seasonal movements over the course of the year. After spring break-up, they may disperse to find mates and food; they may move again in the fall seeking food. Some of the environmental conditions that cause muskrats to leave a lake include overpopulation, changes in the amount or condition of food, and changes in water levels. Muskrats move along trails and travel in creeks and river channels. The spring movement is likely triggered by flood events, but can also be driven by competition between males. In the fall, muskrats move to lakes of the right depth that will not freeze to the bottom of the lake over winter. **Changes in Distribution** Very little IK/CK was found in the sources available for this report. There are indications from both Inuvialuit and Gwich'in knowledge-holders that current muskrat distribution may be changing. For instance, beaver and muskrat were not known to be as far north as Tuktoyaktuk, but they are present in that area now. The impacts of climate change affect muskrat habitat and may be changing where they are today **Search Effort and Harvest Patterns** For the most part, people harvest muskrat during the late winter and spring, however	**Movement and Dispersal** Muskrats typically occupy home ranges the size of the water body they reside in, staying within 30-100 m of their home bank burrow or floating house. In the Mackenzie Delta muskrats frequently move into and out of lakes that are within 1 to 1.6 km away from each other. Muskrats are highly mobile and exhibit strong dispersal abilities and can be transported by floodwaters. **Habitat Requirements** Muskrats require aquatic habitats that do not freeze to the bottom and that have an abundance of submerged macrophytes for food. Muskrat use dwellings or shelters including bank burrows, houses, and pushups. Relatively constant water levels are required to enable muskrats to access food and construction material for shelters during periods of ice-cover. **Habitat Trends and Fragmentation** Aquatic habitat trends in the NWT are complex with many contributing factors that could affect muskrat habitat. Extreme fluctuations and unpredictability of water levels and regimes are factors contributing to changes in the aquatic habitat of muskrat in the NWT, and across their range. Because changes are highly variable and uncertain throughout the territory, it is difficult to predict the impact to muskrat. It is likely that they will improve in some areas and decline in others. Some reductions in the suitability of muskrat habitat have been observed and

they may be harvested for food almost any time of the year. Generally, people start trapping in early March by snowmachine then by boat after breakup. Lakes that are known by harvesters to consistently have high numbers of muskrat are used preferentially. People often use the same trails and waterways to trap and hunt each year. Muskrats are easy to find when they have pushups; it is harder to find other sign of muskrats once these have melted.

Harvesting Rates

Broadly, muskrat harvest levels were much higher during the fur trade than they are today. Harvesting rates are driven by commercial fur prices. Between 1960 and 1965, the mean annual harvest by Inuvialuit was estimated at 98,000 muskrats; declining to approximately 10,000/year by the 1980s and 1990s. In 1988, the Inuvialuit Harvest Study recorded a total of approximately 3,200 muskrat pelts harvested in the Mackenzie Delta. The reported harvest numbers between 1988 and 2006 were lower.

Very few muskrat are harvested today. In the Dehcho, annual community harvest between 1993-1994 of muskrat was reported as 244 in Fort Liard and 62 in Nahanni Butte, and 231 in Fort Providence in 2003. In 2024, Gwich'in harvesters note taking perhaps only ten muskrat in a season.

Key Habitats

The Mackenzie Delta is considered ideal habitat for muskrat with its many lakes, streams, and marshes. Outside of the documented, for example in the Peace-Athabasca Delta in Alberta, the construction of the Bennett Dam changed flooding regimes and water flow and negatively impacted muskrat abundance.

Muskrat habitat in the NWT is likely mostly continuous, as muskrats have high dispersal abilities across both land and water, and the NWT is mostly within the interconnected Mackenzie River watershed and has a high density of water bodies.

Mackenzie Delta, there is not a lot of documented Indigenous knowledge or community knowledge on key habitats; some areas have been mapped as important for muskrat in the Sahtú and Dehcho regions. Muskrats require habitat that support numerous lakes, streams and marshes rich in aquatic vegetation. The Buffalo Lake area in the Dehcho region is important for muskrat, and several other important areas have been identified by members of the K'átł'odeeche and Pehdzéh Ki̜ First Nations. Important muskrat habitat within the Wek'èezhìı and Tłı̨chǫ lands include Marian River and Marten Lake. Yellowknives Dene noted Duck Lake as a site that used to be important for muskrat trapping. Members of the North Slave Métis Alliance identified Whatì, Gamètì, Behchokǫ̀, Marian Lake, and the North Arm of Great Slave Lake as good areas for muskrat. There are also important muskrat habitats throughout the Slave River and Delta, with the greatest concentrations on small Delta tributaries with abundant vegetation. Outside of the NWT, Old Crow Flats (Yukon) and the Peace-Athabasca Delta have been identified as areas of good muskrat habitat. **Habitat Requirements** In general, good lakes provide food, shelter and safety; they need to have aquatic and terrestrial vegetation and be the right depth – lakes that are too shallow can freeze to the bottom, and if a lake is too deep, muskrat cannot access their food. Lakes are often better for muskrat during years that follow a	

high flood, as it creates the right conditions for their food to grow. Muskrat may have different lake depth preferences during different seasons – that is, they select shallow lakes for summer use and deeper lakes for overwintering. If a lake dries out part-way through the summer though, muskrat will leave the area to find another lake. Muskrats require appropriate banks in which to excavate their dens; when no suitable bank sites are available, they will make nests in grassy spots on lakes or on stumps and logs. **Habitat Trends and Fragmentation** Knowledge holders and community members are observing changes to the aquatic habitat of muskrat. These changes are complex and are often tied to climate change; they are observed as changes in water flow, precipitation, and water levels as well as changes to the seasonal timing of events related to these indicators. In the Mackenzie Delta, people indicate that dropping water levels could be one of the reasons behind local declines in muskrat populations. Indigenous knowledge-holders report that there are many drained and/or drying lakes, as well as reduced water in channels and spring flood levels. In addition, melting permafrost, landslides, and streambank erosion are also increasing in the Delta, and the timings of freeze-up and break-up have shifted. People are also reporting changing vegetation, like increased willow growth, in many areas. Similar changes have been observed in	

Tłı̨chǫ/Wek'èezhìı areas, in Old Crow Flats, and in the Peace-Athabasca and Slave River basins.	
Population	
Observations in the Mackenzie Delta indicate that muskrat abundance has declined since the time of the fur trade. There have always been good years and bad years for muskrat harvest, but knowledge-holders do not recall populations levels staying low for so long. Recent declines appear to be outside of the normal range of variation for muskrat in the Mackenzie Delta. Different trends have been observed across the Delta and there are indications that declines are localized and non-uniform. Muskrat populations are known to follow a predictable natural five-to-seven-year cycle. However, Inuvialuit harvesters recall a drastic decline by about 2000-2005, and in 2016 muskrat were still considered to be in decline. Similarly, from around 1995 to roughly 2005-2010, the muskrat population was described as very low in the GSA. Their natural cycle appears to have changed, as they are taking longer to return now. Although there is high regional variation, there are some observations that muskrat may be recovering in some areas of the Mackenzie Delta since about 2010-2015. The availability of food impacts muskrat population numbers and if they are overpopulated the associated heavy feeding can lead to a crash in their numbers. When they recover from such a population decline, they tend to return to the preferred grassy	**Abundance** There is no empirical population estimate for muskrats in any region of the NWT. Efforts have been made to look at relative abundance (calculated using density of pushups) over time in some regions, but data are spatially and temporally limited within variable landscapes. In the absence of direct estimates of muskrat populations, researchers in the NWT and adjacent regions estimate that the number of muskrats in the NWT is in the range of hundreds of thousands to the low millions. The data do not exist to make a finer-scale population estimate. **Trends and Fluctuations** Muskrat populations in the NWT, as elsewhere, fluctuate in a sometimes-cyclical manner, though the period varies in different areas and at different times. Across North America, there have been apparent declines across their range. Declines in muskrat abundance have been observed by harvesters in the Peace-Athabasca and Slave River and Delta regions when water levels declined and flooding patterns changed after the Bennett Dam was constructed. Muskrat population declines have also been reported by harvesters in the Mackenzie Delta since the 1990s to 2010s,

lakes first, then spread out as their numbers increase again.

Elders observed decreasing muskrat populations where they were once plentiful throughout the Buffalo Lake, River and Trails area in a 2008 report. Knowledge-holders in the Peace-Athabasca Delta of northern Alberta also documented a dramatic decline in the relative abundance of muskrat there from approximately 1935 to 2014. A decline was also noted by residents of the Slave River area, starting in the 1970s and 1980s. More recent trends were not available for that area, nor for many other regions in the NWT.

Health

Harvesters pay attention to muskrat body fat and livers as to signs of health when harvesting for food. When there are too many animals and/or food becomes scarce muskrat livers do not look good or can get white spots on them. When people were trapping more, muskrat were healthier [perhaps because of reduced competition]. In the Mackenzie Delta people have noticed that muskrat health declines when there is less trapping. Muskrat health can vary from year to year, likely influenced by lake conditions the preceding summer.

Rescue Effects

Muskrats are able to quickly move into lakes with good habitat and harvester have observed muskrat repopulate areas post-trapping in the Mackenzie Delta in days.

While muskrat can usually 'bounce back' after a decline, there is a chance that if a lake

from the 1970s-early 1980s to the 2010s in the Slave River and Slave River Delta, and in the Old Crow Flats, Yukon. These declines may be related to climate-induced changes in vegetation, water flow, or other changes in habitat.

With their high reproductive output and high dispersal ability, muskrats can effectively populate suitable habitat. Therefore, if muskrats were extirpated from parts or all the NWT, the possibility of rescue and repopulation from adjacent populations would be likely.

changed in their absence, it may not be suitable habitat in the future.	
Threats and Limiting Factors	
Indigenous knowledge-holders in the Mackenzie Delta are reporting changes in the climate that are resulting in aquatic systems draining or drying up since the early 2000s; some feel that climate change could be the main reason for the decline in muskrat abundance. This could be compounded by the fact that many formerly good muskrat lakes and waterways in the Mackenzie Delta are now silting up and experiencing erosion, landslides, and slumping as well as changes to vegetation that may be unsuitable for muskrat. Despite muskrat being culturally important throughout their range, there has been a shift and muskrat are not being harvested as often. Hunting and trapping activities can remove unhealthy and/or less vigorous muskrat from the population, allowing healthier animals to make the population more vigorous overall. Therefore, a reduction in harvest and traditional population controls is considered a threat. Harvest also provides people with an opportunity to build knowledge of and a connection to these animals. Increases in beaver numbers in some areas of the NWT have been noted as a potential threat to muskrat. Beaver can have effects on the environment, such as influencing water levels through damming and changing the quality of water and vegetation in ways that no longer suit muskrat. This may impact	There are many threats than could influence muskrat abundance and distribution, however none have empirical data that characterizes both the threat and the impacts to muskrats. Habitat loss or degradation caused by anthropogenic changes to wetland ecosystems, land use activities, and environmental contamination are the most concerning threats to muskrat in the NWT. Several studies indicate that water-level regulation systems negatively influence muskrat abundance, and drying wetland habitats are a primary driver for the decline of muskrats. Water levels that are excessively high or periods of drought are the greatest selection pressure affecting muskrat. Furthermore, anthropogenic disturbances can cause extreme fluctuations in these aquatic systems that can surpass the adaptability of many species including muskrat. The amount of predation by mink and other predators and possible impacts to muskrat abundance in the NWT have not been quantified, however there is likely a relationship. Muskrats are exposed to many pathogens and parasites, many of which do not appear to cause mortality or population level impacts. In addition, the high reproductive

access to and availability of muskrat habitat or food sources. Increasing populations of otter may also affected muskrat. Otter are very efficient predators on muskrat. Increases in other predator populations, such as marten, mink and jackfish (northern pike) may also be a threat to muskrat, however there are some observations that mink and otter populations decreased in the early 2020s. Habitat change and/or disturbance caused by human activities can also pose a threat to muskrat populations. When the Mackenzie Gas Project was resurrected in 2004, many people were concerned that a development like that could further impact an already low muskrat population. Mackenzie Delta residents have observed the negative impacts on muskrat from blasting and seismic work; they are sensitive to underground vibrations and can be killed by the high-intensity pressure waves typical of seismic work. Communities are also concerned about water quality in the Slave River and Delta ecosystem and impacts from contamination from oil sands operations, agricultural pesticides, pulp mills, and mines. Impacts driven by changes to water levels due to the Bennett Dam and reservoirs are also a concern. Diseases and parasites can also threaten muskrat populations particularly during times of food shortages. Specific diseases were not discussed; however, harvesters have noted spots on muskrat livers that have accompanied population crashes in the past (1980s).	rates and high dispersal capabilities make muskrat populations resilient to negative impacts from pathogens and/or parasites. However, there is a need for further research and monitoring on the effects of pathogens and parasites on muskrat health. Impacts from these threats are heterogeneous across the NWT and region-specific trends could result in both increases and decreases in habitat quality and quantity for muskrats. This makes projecting their potential impacts across the NWT quite difficult.

Positive Influences

Due to their cyclic nature, muskrat tend to overpopulate an area and may benefit from regular hunting and trapping. These traditional activities, when done respectfully, can remove unhealthy and/or less vigorous animals from the population allowing the healthier animals to spread and increase the population. Harvesting protocols include stopping when muskrat have young, switching harvest locations to avoid over-trapping an area, not making fun of muskrat, not letting them spoil, and only harvesting the amount you need.

Conservation networks help ensure that plants and animals have the time and space needed to adapt to changes in their environment by protecting important habitats and connections between habitats. In 2019, Dınàgà Wek'èhodì was designated a candidate protected area under the *NWT Protected Areas Act* and the area has interim protection under the *Northwest Territories Lands Act*. Ejié Túé Ndáde (Buffalo Lake, River and Trails) is another candidate protected area in the southeastern corner of the Dehcho region that includes the western portion of Ejié Túé (Buffalo Lake) and Ejié Túé Dehé (Buffalo River). The Edéhzhíe Protected Area is an Indigenous Protected and Conserved Area in the Dehcho Region that was established in 2018 and covers over 14,000 km^2 of important wetland, lake, and boreal forest habitat that could be beneficial to muskrat.

Muskrats are highly adaptable, mobile, and have a very high reproductive rate; these features allow them to colonize new regions at a rapid rate and/or recover from pressures related to predation, harvest, pathogens and/or parasites.

Areas of muskrat habitat in the NWT are formally protected as Indigenous Protected and Conserved Areas, National Parks, Territorial Parks, areas protected by Land Claim Agreements, areas conserved through land use planning, and/or Wildlife Sanctuaries. Bi-lateral transboundary water agreements also provide protection of aquatic habitats. In addition, water use in the NWT is regulated through the water licensing process. Past impacts from seismic exploration are also now managed through guidelines and best practices.

Conservation measure including measures in the NWT *Wildlife Act* and the *Trapping Regulations* provide positive influences including restrictions on the harvest season, bag limits, and humane methods of trapping.

Technical Summary – Indigenous and Community Knowledge Component

Question	Indigenous and Community Knowledge
Population	
How often is the species observed compared to the past (less, more, same)? Include an estimate of how much of the species range these observations represent (percentage).	Muskrat are not seen as often as they were in the past in places where they used to be plentiful, such as the Mackenzie Delta and the Peace/Athabasca/Slave river basins. Population trends are not clear in other areas.
Have there been changes observed in the sizes of groups?	No information available in IK/CK sources.
If the species is observed less frequently, what is the level of concern (high, moderate, low)?	There is moderate concern with regard to the number of muskrat in the Gwich'in and Inuvialuit areas. The level of concern on muskrat observations is unknown in other areas of the NWT.
If concerns being expressed about the future of the species, are these concerns expressed in the short-, medium-, or long-term? (e.g. disappearance or decline within their grandchildren's lifetimes)	Concerns about the future of muskrat were expressed in the long-term in the ISR and GSA. No information was available for other areas.
Distribution	
Is the species still observed in all the places it was in the past? Or is the species now unavailable, or less available, in areas where it was historically abundant?	Muskrat are less available in some areas where they were historically abundant, but their distribution is not uniform across their range.

Have declines or changes to movements of the species been observed? If so, are these changes to movements or distribution considered normal or unusual for the species?	Knowledge-holders have stated that muskrat may be further north in the NWT than they used to be in the past.
How often do people talk about the disappearance of the species from its historic range? What is the level of concern (high, moderate, low)?	Little to no information available in IK/CK sources. There are some concerns that muskrat may be moving to different places in the Mackenzie Delta, or moving north of the delta, as their habitat changes.
Is there any indication the species has moved elsewhere?	There are some observations that muskrat might be moving further north than in the past.
What is the amount and quality of habitat available to the species? How does this compare to the past?	There is a lot of good quality habitat available to muskrat in the NWT, however there are changes to water levels and conditions throughout many areas that could be impacting muskrat.
Does the species have specific habitat requirements? (e.g. salt licks, ice patches, sea ice, karst, hot spring or specific food requirements)	Muskrat require certain aquatic vegetation to eat, and lakes of particular depths to survive. They also require banks in which to excavate their dens as well as grassy areas.
Biocultural linkages	
Have declines resulted in significant adverse impacts to Indigenous cultures and traditional ways of life tied to the species or its habitat?	Muskrat declines have impacted traditional harvesting activities, especially in the spring.
Are continued cultural connections and practices related to the species now impossible or extremely impaired?	Muskrat continues to be important culturally and celebrated in areas, such as the Mackenzie Delta. They continue to be trapped and consumed in many areas, but at much lower frequencies than during the fur trade.

	Other factors impacting the traditional practice of trapping include declining fur prices, increasing costs to harvest, availability of wage labour, etc.
Are people affected across the species range or only certain parts of the range?	The availability and reliance on muskrat have declined and affected people across all parts of its range.
Threats and limiting factors	
Is the species being adversely impacted by one or more natural or human-caused threats?	Changing environmental conditions due to climate change may be presenting the biggest threat to muskrat due to their dependence on aquatic environments. Muskrat are also threatened by a lack of trapping – regular harvesting keeps the population from growing too large and then collapsing due to starvation and competition. Increasing populations of beaver and river otter may be threatening muskrat through changes to habitat and increased predation. Habitat disturbance caused by seismic exploration can threaten muskrat, as can water pollution and/or contamination.
What level of concern is expressed about threats impacting the species (high, moderate, low)? How often are these concerns expressed?	People often express high levels of concern about climate change impacting muskrat.
How sensitive is this species to natural or human-caused threats?	Muskrat are usually resilient and able to rebound from population crashes, but it is unclear whether climate change and habitat change will hamper their ability to recover in the future.
To what extent are these threats being managed?	The threats of climate change are greatest in the north and there are very limited options for managing them. There are some habitat protection measures that could benefit muskrat, as well on-the-land

	programming that encourage trapping in several areas.
Does the species have characteristics that are likely to negatively affect their response to declines? (e.g. reproduces late in life, has few offspring, unable to go elsewhere if habitat becomes unsuitable)	Muskrat are able to have large litters and more than one litter a year when their habitat is good and there is good availability of feed. Muskrat will move to different lakes as necessary, but can suffer mortality if there is unusually cold weather and their lake freezes to the bottom in winter.
Positive influences	
Briefly summarize positive influences and indicate the magnitude and imminence for each.	Responsible trapping can help muskrat and reduce predators and competitors. Habitat protection measures can also benefit muskrat, but because there is limited information available regarding muskrat distribution and abundance, it is unknown whether current land protection measures will benefit muskrat.

Technical Summary – Scientific Knowledge Component

Question	Scientific Knowledge
Population Trends	
Generation time (average age of parents in the population) (indicate years, months, days, etc.).	Muskrats generally live around 3-4 years, and up to a maximum of five years. Muskrats typically reach sexual maturity at 10-12 months. The average generation time is 10-12 months.
Number of mature individuals in the NWT (or give a range of estimates).	There are estimated to be hundreds of thousands to low millions of muskrats in the Northwest Territories. The NWT Species Infobase also estimates the muskrat population in the millions based on annual harvest data between 1957 to 1999. The data do not exist to make a finer-scale population estimate.
Percent change in total number of mature individuals over the **last** 10 years or 3 generations, whichever is longer.	Unknown.
Percent change in total number of mature individuals over the **next** 10 years or 3 generations, whichever is longer.	Unknown.
Percent change in total number of mature individuals over any 10 year or 3 generation period that includes **both the past and the future**.	Unknown.

If there is a decline in the number of mature individuals, is the decline likely to continue if nothing is done?	There have been no scientific surveys to estimate numbers anywhere in the NWT, so population trend cannot be determined. Limited data and a study of densities between 1940s and the late 2010s suggests declines in the density of muskrat in the upper Mackenzie Delta.
If there is a decline, are the causes of the decline reversible?	Observed declines appear to be linked to water flow and timing, and they could be reversible if conditions change to be more favourable.
If there is a decline, are the causes of decline clearly understood?	No. Reasons for the possible decline in the Mackenzie Delta are unknown, but are likely related to changes in water flow regimes. Declines in the Peace-Athabasca Delta were attributed to changes in water flow and timing related to upstream hydroelectric development.
If there is a decline, have the causes of the decline been removed?	Unknown. Changes in water flow, if not from a water diversion (e.g. dam), vary throughout the territory and are caused by climatic conditions, which cannot be controlled.
If there are fluctuations or declines, are they within, or outside of, natural cycles?	Unknown. Data suggests that muskrats can experience extreme population reductions and recover. Data on muskrat populations in the NWT are lacking, therefore it is not possible to quantify current fluctuations or declines, or compare them to those in the past.
Are there 'extreme fluctuations' (>1 order of magnitude) in the number of mature individuals?	Currently unknown. Extreme fluctuations in abundance have been documented in the past and are likely cyclical in nature.
Distribution	
Estimated extent of occurrence in the NWT (in km^2).	The extent of occurrence for common muskrat was calculated using the EBAR range shown in Figure 19 and was estimated at 857,695 km^2 in the NWT less the areas of large lakes and rivers (scale 1:5,000,000). The range includes ecoregions where the common muskrat is abundant to rare

	and omits ecoregions where there is no evidence of presence (absent).
Index of area of occupancy (IAO) in the NWT (in km^2; based on 2 x 2 grid).	For common muskrat the IAO using observations only is 332 km^2 for the NWT only. However, this method is artificially low as the occurrence records are based on limited studies of pushups and sparse opportunistic observations along roads and waterways. Using the entire NWT range, based on the distribution outlined in the Ecosystem-based Automated Range (EBAR) map (Figure 19), the IAO is 893,404 km^2
Number of extant locations[1] in the NWT.	There are at least two locations for muskrat - the Mackenzie Delta and the Slave River and Delta – that may be defined based on water level threats. However, it is unlikely that a single threatening event involving water levels would rapidly affect more than half of all individuals in the NWT; especially considering that muskrat do not congregate but are distributed across a very large range. Therefore, it is not possible to count locations for common muskrat in the NWT.
Is there a **continuing decline** in area, extent, and/or quality of habitat?	Aquatic habitat trends in the NWT are complex with many contributing factors. Muskrats are widely distributed across the NWT; changes in the freshwater ecosystems across the territory occur at different rates and directionality. The Peace River and Peace-Athabasca Delta are experiencing lower water flow and less predictable spring flooding. Changes to the area, extent, and/or quality of habitat cannot be quantified across the territory.

[1] Extant location - The term 'location' defines 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.

Is there a **continuing decline** in number of locations, number of populations, extent of occupancy, and/or IAO?	Unknown.
Are there 'extreme fluctuations' (>1 order of magnitude) in number of locations, extent of occupancy, and/or IAO?	Unknown.
Is the total population 'severely fragmented' (most individuals found within small and isolated populations)?	No, habitat is likely continuous.
Immigration from Populations Elsewhere	
Does the species exist elsewhere?	Yes. Muskrats are found throughout the northern hemisphere in North America, Europe, and Asia.
Status of the outside population(s)?	Yukon: Apparently Secure / Secure British Columbia: Yellow list (Secure) Alberta, Saskatchewan, Manitoba: Secure Nunavut: Apparently Secure
Is immigration known or possible?	Yes.
Would immigrants be adapted to survive and reproduce in the NWT?	Yes.
Is there enough good habitat for immigrants in the NWT?	Yes.

Is the NWT population self-sustaining or does it depend on immigration for long-term survival?	Self-sustaining. Populations in specific areas that are impacted by high mortality may rely on immigration to repopulate the area, but this is not a requirement for self-sustaining populations in broader regions or the whole NWT.
Threats and Limiting Factors	
Briefly summarize negative influences and indicate the magnitude and imminence for each.	Habitat loss or degradation caused by anthropogenic changes to wetland ecosystems, land use activities, and environmental contamination are the most concerning threats to muskrat in the NWT. Changing environmental conditions are ongoing and expected to increase. They range from small to large in magnitude. Changes in water flow and timing are the most well-documented threat to muskrat populations. They can cause muskrat populations in affected areas to decline; although populations are likely to rebound when conditions shift (e.g., a reduction in spring flooding for many years had a negative impact on muskrat populations in the Peace-Athabasca, but populations increased when flooding increased, and evidence exists that this dramatic change in population is part of the natural history of this muskrat population). Changes in average climatic conditions (e.g. temperature, precipitation), water flow, and other factors are ongoing and expected to increase across the NWT. These climatic conditions are ongoing and widespread. While some changes have clear trends, others vary in different parts of the territory. Their impact on muskrats is not clearly definable. The impacts of other changing environmental conditions are difficult to predict as those that impact muskrats are specific and usually a combination of factors, including the timing of weather events (e.g., cold temperatures and low snowfall can freeze muskrats out of their winter habitat and cause high mortality in a single winter season). Increases in unpredictable weather as the climate changes have not been

	quantified but could have negative impacts if they disrupt ongoing ecological processes. Predation is a known influence on muskrat populations and is likely moderate and ongoing. The impact of predation in the NWT has not been quantified. Harvest of muskrats' most important predators (fox and mink) has declined over the 20th century, which may result in higher abundance of those predators and rates of predation on muskrat. Pathogens including bacteria, fungi, viruses, and parasites are known to affect muskrats. The impacts of pathogens on muskrats have not been well quantified, but most seem to have negligible to small magnitude impacts on muskrat populations. The impact of pathogens on muskrats could change with changing climatic and environmental conditions. Some of the most potentially impactful pathogens include bacteria (i.e. *F. tularensis*), which can cause epizootic outbreaks and be harboured in the environment. At this time, no significant impacts from pathogens have been documented or are expected in the NWT. Human induced mortality from industrial development, including seismic surveys, construction, and environmental contamination can be a threat to muskrats. Muskrats are resilient to most kinds of development and can even thrive in developed areas, especially farmland. Industrial development is ongoing and of varying magnitude depending on the size of the project and impacts to natural ecosystems and water. Many contaminants accumulate in aquatic ecosystems and in vegetation used by muskrat as forage. Muskrats are susceptible to bioaccumulation and can be impacted by contaminants like heavy metals, agricultural contaminants, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). Contaminant in NWT muskrats remain low. Elsewhere, the impacts of contaminants on muskrats at the population level are low.

	Muskrat populations are resilient to intensive and ongoing harvesting. Furthermore, harvest in the territory has declined by two orders of magnitude since the 1940s. The impact of harvest is ongoing but minimal and declining in magnitude.
Positive Influences	
Briefly summarize positive influences and indicate the magnitude and imminence for each.	Muskrats are highly adaptable, mobile, and have a very high reproductive rate; these features allow them to colonize new regions at a rapid rate and/or recover from pressures related to predation, harvest, pathogens and/or parasites. Areas of muskrat habitat in the NWT are formally protected as Indigenous Protected and Conserved Areas, National Parks, Territorial Parks, areas protected by Land Claim Agreements, areas conserved through land use planning, and/or Wildlife Sanctuaries. Bi-lateral transboundary water agreements also provide protection of aquatic habitats. In addition, water use in the NWT is regulated through the water licensing process. Past impacts from seismic exploration are also now managed through guidelines and best practices. The NWT *Wildlife Act* and the Trapping Regulations outline measures to conserve muskrats and manage muskrat harvest. Positive influences include restrictions on the harvest season, bag limits, and humane methods of trapping.

Acronyms

Acronym	Term
AHTC	Aklavik Hunters and Trappers Committee
EBAR	Ecosystem-based Automated Range
ECC	Environment and Climate Change – Government of the Northwest Territories
ECCC	Environment and Climate Change Canada
ECG	Ecological Classification Group
DDT	dichlorodiphenyltrichloroethane
CCP	Community Conservation Plan - Inuvialuit Settlement Region
GBIF	Global Biodiversity Information Facility
GNWT	Government of the Northwest Territories
GRRB	Gwich'in Renewable Resources Board
IAO	index of area of occupancy
IHTC	Inuvik Hunters and Trappers Committee
IWS	Important Wildlife Areas
IUCN	International Union for Conservation of Nature
MRBB	Mackenzie River Basin Board
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
SARC	Northwest Territories (NWT) Species at Risk Committee
SRRB	ʔehdzo Got'ı̨nę Gots'ę́ Nákedı (Sahtú Renewable Resources Board)
SWE	snow water equivalent
THTC	Tuktoyaktuk Hunters and Trappers Committee
WMAC(NWT)	Wildlife Management Advisory Council (Northwest Territories)
WMIS	Wildlife Management Information System
WSC	Water Survey of Canada

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PLACE NAMES

Figures 1 display the geographic features (e.g., mountains, rivers, lakes) and place names referred to in this status report. Unfortunately, many of the Indigenous names identified in the Indigenous and/or Community Knowledge sources used to prepare this report were not found in available GIS data.

Figures 2 display land claim and settlement areas, communities, and place names of the Northwest Territories mainland mentioned in this report.

Figure 1. Map of the Northwest Territories mainland showing geographic features (e.g., mountains, rivers, lakes, deltas), regions, communities, place names, protected and conservation areas, and applicable candidate protected areas mentioned in this report.

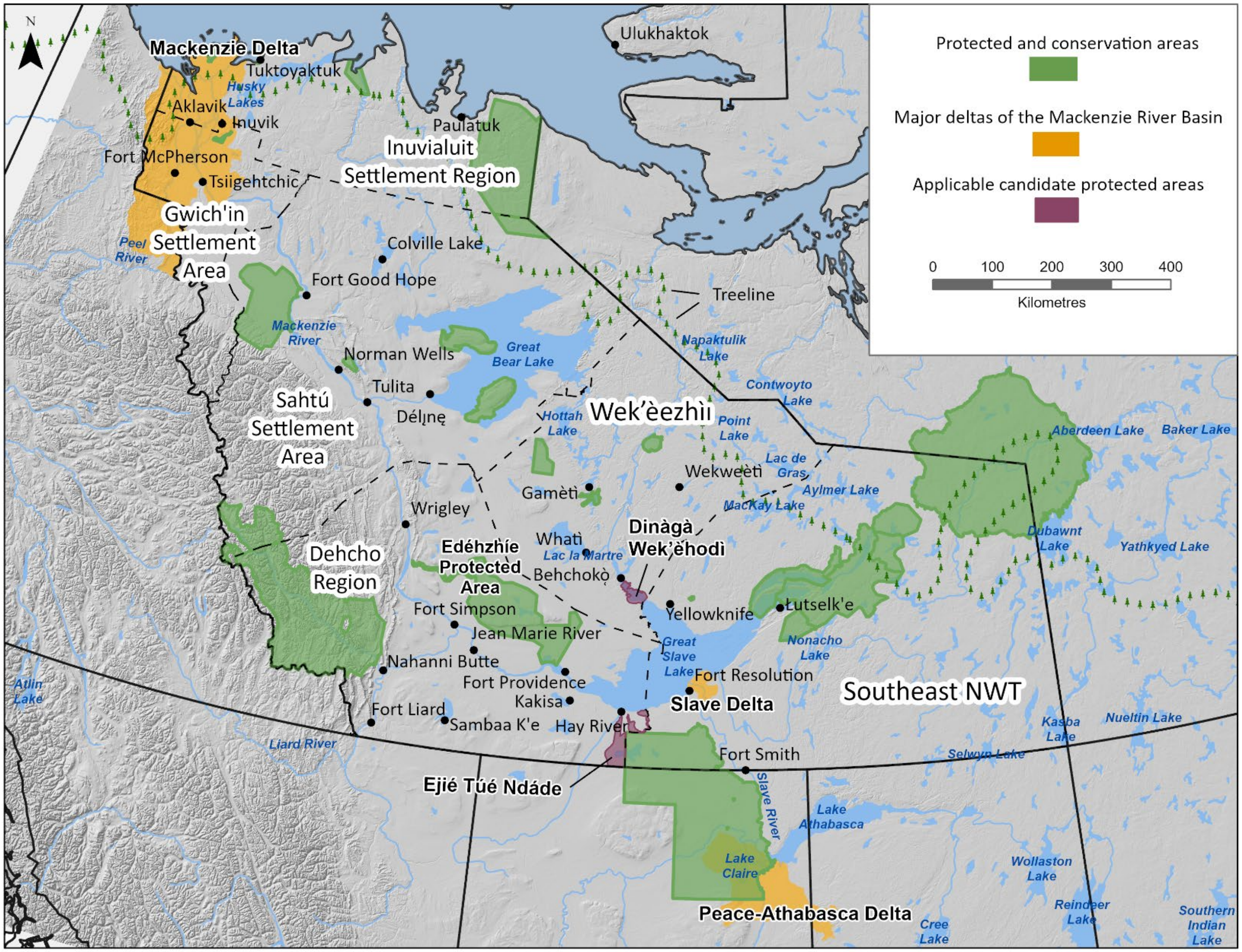
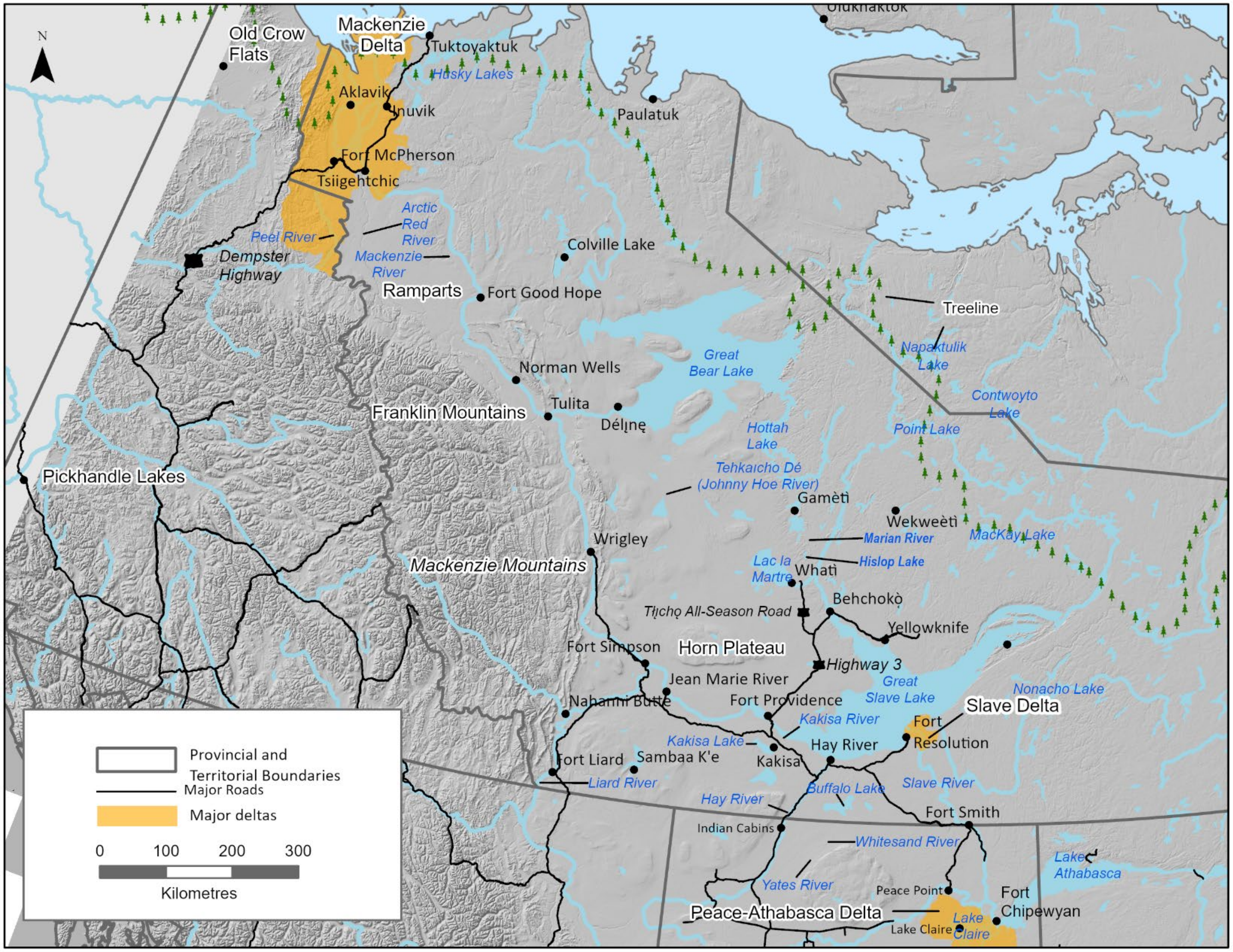


Figure 2. Map of the Northwest Territories mainland showing geographic features (e.g., mountains, rivers, lakes), communities, place names, and major deltas mentioned in this report.



INDIGENOUS AND COMMUNITY KNOWLEDGE COMPONENT

Preamble

Muskrat distribution spans so much of the Northwest Territories (NWT) that Indigenous Knowledge and/or Community Knowledge (IK/CK) is held in most communities. Muskrat is featured in many oral history legends and for many generations it has played an important role in the diverse cultures and economies of the north. Muskrat is a much-valued source of food, material for clothing, as well as a source of income from trapping. Knowledge about muskrat is passed on from generation to generation including personal experiences trapping or observing muskrat on the land, which is ever adapting as habitat and environmental conditions change.

Documentation of IK/CK related to muskrat has not been consistent across the NWT. For instance, the importance of muskrat in the Mackenzie Delta, both spiritually and as a source of subsistence, is echoed in the documented knowledge of muskrat from this region. The fur trade, value of muskrat and the harvest cycle reinforced that connection. As a result, substantially more effort has been put into documenting knowledge of muskrat in the Mackenzie Delta with several comprehensive, well-researched, and directly relevant IK/CK sources of information. Therefore, much of the information presented in this report is from the Mackenzie Delta.

Unfortunately, this level and depth of detailed information is not documented or available for most other areas of the NWT. In some cases, the only available IK/CK about muskrat consisted of a handful of incidental or anecdotal remarks in research or environmental assessment reports focussed on other topics. Therefore, for many of these regions, IK/CK about muskrat is considered an information gap. Further details about the sources available for inclusion in this report are summarized below by region.

Mackenzie Delta

In 2015-16 master's student Chanda Turner (*nee* Brietzke) conducted relevant IK/CK research in collaboration with scientific researchers and local governance organizations in four communities of the Mackenzie Delta. Chapter 2 of Turner's thesis was co-authored with Trevor Lantz and the Gwich'in Tribal Council Department of Cultural Heritage and published as '*Springtime in the Delta: the socio-cultural importance of muskrats to Gwich'in and Inuvialuit trappers through periods of ecological and socioeconomic change*' (Turner *et al.* 2018). This work was done as part of a project monitoring changes in muskrat health, habitat, and abundance in the Mackenzie Delta, and provided a comprehensive and well-researched source of information for this report. Researchers conducted interviews and held meetings with more than 70 community members from Aklavik, Inuvik, Fort McPherson, and Tsiigehtchic. Because the authors did not attribute information to members of either the Inuvialuit Settlement Region (ISR) or the Gwich'in Settlement Area (GSA), for most topics, this information has been included here in its own section, under a subheading for the Mackenzie Delta.

Gwich'in

In 2024, a compilation of available information was published by Benson (2024) on muskrat in the Gwich'in Settlement Area titled *Gwich'in Knowledge of Dzan (Muskrat): A part of the Nin Nihlinehch'ì' – Li' hàh Guk'àndehtr'inahtìi (Animals at Risk – animals we are watching closely).* . Three projects undertaken over a 30-year period contributed to most of the Gwich'in knowledge on muskrat in Benson (2024):

- Gwich'in Environmental Knowledge Project (1990s) including the books *Nành' Kak Geenjit Gwich'in Ginjik*: *Gwich'in Words about the Land (1997)* and *Gwìndòo Nành' Kak Geenjit Gwich'in Ginjik*: *More Gwich'in Words about the Land (2001),*
- Monitoring Changes in Muskrat Health, Habitat, and Abundance in the Mackenzie Delta: Traditional knowledge and scientific perspectives project (2015-2016), and
- Department of Culture and Heritage/Gwich'in Renewable Resources Board muskrat project, for which Benson 2024is the final product of research conducted 2022-2024.

In all, the compilation includes information from 38 knowledge-holders, 17 of whom were interviewed as recently as 2024. The work also included a final verification and knowledge sharing session held in Inuvik in April 2024. The report contains a wealth of relevant information, organized into topics that parallel those used in species at risk assessments and spanning roughly 100 years.

Inuvialuit

There were no comprehensive sources solely containing relevant Inuvialuit knowledge of muskrat identified for this work. The main source of information was the Traditional Knowledge assessment done in response to the Mackenzie gas pipeline proposal by the Inuvik (*Inuuvik*) Community Corporation (ICC), Tuktoyaktuk (*Tuktuuyaqtuuq*) Community Corporation (TCC), and Aklavik (*Akłarvik*) Community Corporation (ACC) in 2005-2006 (ICC *et al.* 2006).

Several other sources of Inuvialuit IK/CK were reviewed that contained incidental mentions of muskrat only; while that information has been included, it is not always clear how the information was researched, documented, or compiled.

Sahtú Dene and Métis

There were no comprehensive sources of muskrat information identified for the Sahtú Settlement Area (SSA). However, information from researchers and/or Indigenous governments and Indigenous organizations were included from around the Délı̨nę area regarding potentially good habitat or areas for muskrat. No similar information was found for the other four Sahtú communities.

In September 2024, during a harvesting workshop held by the ʔehdzo Got'ı̨nę Gots'ę́ Nákedı (Sahtú Renewable Resources Board, SRRB), a group of women from the five Sahtú communities were asked about their knowledge of muskrat to provide information for the SARC status assessment. Responses were captured in a graphic recording and are included in this report.

Dehcho

Very little information focusing specifically on muskrat was found for the Dehcho area. Several sources mentioning areas known to be good for muskrat were reviewed and included in this report. The richest source of documented muskrat IK/CK found for the Dehcho was a traditional knowledge study conducted for the proposed Mackenzie Gas Project by the Pehdzéh Kı̨́ First Nation (PKFN) in 2005 as well as documents related to the development of the Dehcho Land Use Plan (EBA 2003; DLUP 2006).

Tłı̨chǫ/Wek'èezhìı

There were no sources focusing specifically on muskrat for the Tłı̨chǫ/Wek'èezhìı region. Several sources with incidental mentions of muskrat were found and that information was included where possible.

Akaitcho Territory

Very few sources of muskrat IK/CK were found for the Akaitcho Territory. One Traditional Ecological Knowledge study was done by the West Kitikmeot Slave Study Society (WKSSS) for the Kaché Tué area; it includes incidental mentions of muskrat and/or their habitat only.

North Slave Métis

Despite knowledge of and traditional reliance on muskrat, very little information has been documented by the North Slave Métis (NSM) on muskrat. There was no information found on muskrat in the North Slave Métis Alliance (NSMA) database (Phelan pers. comm. 2024). The only relevant sources obtained for this work are limited to four environmental assessment reports done for proposed developments between 1999 and 2013, but they are limited in geographic scope as well as richness of information and relevant content.

Other Areas / Other Information

An additional source of information on muskrat in the western NWT was used in drafting this report (Wilson and Haas 2012). Researchers defined and mapped important wildlife areas for several species in the NWT, including muskrat, based on local observations, IK/CK, and scientific information. This report is an overlap of information between different knowledge systems.

Vuntut Gwitchin First Nation, Old Crow, Yukon

Two sources were acquired containing Vuntut Gwitchin knowledge of muskrat, including Jeremy Brammer's (2017) doctoral thesis, in which Local Ecological Knowledge was interpreted in the development of questions, conceptual models, and interpretation of results from a case study involving muskrat population dynamics in the Old Crow Flats, Yukon. Sheilagh Murphy's (1986) master's thesis, '*Valuing Traditional Activities in the Northern Native Economy: the case of Old Crow, Yukon Territory'* also provided some historical information regarding muskrat for this area.

Slave River and Slave River Delta

The Slave River flows approximately 420 km from the confluence of the Riviére des Rochers and the Peace River in Northern Alberta to the Great Slave Lake (Baldwin *et al.* 2017). The NWT portion of the Slave River is located within Akaitcho Territory, the Dene First Nation and NWT Métis Nation Claimant Areas (Pembina 2016b). The community of Fort Smith is located along the Slave River, near the Rapids of the Drowned, the area overlaps with the traditional territories of the Fort Smith Métis, Salt River First Nation and Tthebatthı Dënésųłıné (formerly Smith's Landing First Nation; Pembina 2016b). Fort Resolution is downstream near the Slave River Delta and overlaps with the traditional territories of the Deninu K'ue First Nation and Fort Resolution Métis (Pembina 2016b). Main sources that provided information for this area include:

- Pembina Institute 2016a: this is a report on a three-day workshop held in Fort Smith, NWT, to assess the vulnerability of the Slave River and Delta ecosystem and provide direction on monitoring priorities for the future.
- Pembina Institute 2016b: this report consolidates a large number of reports and articles referring to the Slave River and Delta to assess the state of knowledge and identify areas for future research, and does include a substantial amount of relevant information on muskrat populations and muskrat habitat, including Indigenous and Community Knowledge. High level summaries of information in this report have been included here, however, the reader is advised to consult the primary sources.

Peace Athabasca Delta

This large area spans northern British Columbia, Alberta, and Saskatchewan and is home to Mikisew Cree, Athabasca Chipewyan First Nation, and Fort Chipewyan Métis Association. Some information from relevant sources has been included here as these basins drain north into Great Slave Lake in southern NWT as well as encompass Wood Buffalo National Park, which spans the Northwest Territories. The main sources that provided information for this region include:

- Straka *et al.* 2018: a collaborative monitoring and research project between Western scientists and Indigenous knowledge-holders focused on the Peace-Athabasca Delta. While much of the work would fall under a more science than Indigenous research framework, Indigenous Knowledge did shape and guide the work as well as influence the interpretation of the findings, so the information has been included here in the IK/CK component of this status report.

ABOUT THE SPECIES

Names and Classification

Common Name (English):	Common Muskrat (Cassola 2016)
Inuvialuktun (Siglitun, Ummarmuitun)	Kivgaluk – A muskrat; Kivgaluuk – Two muskrats; Kivgaluit – Three or more muskrat (ICC *et al.* 2006; IHTC *et al.* 2016)
Teetł'it Gwich'in and Gwichya Gwich'in	Dzan* (Gwich'in Elders 1997, 2001; Gwich'in Language Centre 2003; Benson 2024)
North Slavey/Shúhtaot'ine (Tulít'a) and Sahtúot'įne (Délįne)	T'ehk'áe (SDEC 2012, n.d.b)
K'ashógot'įne	Dzę (SDEC n.d.a)
Dene Yatié/Dene Zhatié (South Slavey)	Dzę (SSDEC 2009)
	Tehk'áa (PKFN 2005)
Chipewyan	Dzën (SSDEC 2012)
Łutsël K'e Dene (Denesǫłıne)	Dzın (WKSSS 2001)
Tłįchǫ Yatıì and Yellowknives Dene	Dzǫ (DDBE 1996; Degray 2020)
	Tehk'á (Migwi pers. comm. 2026)
Common name (French):	Rat musqué commun (Cassola 2016)

*The Gwich'in name for muskrat is *dzan*, but they are also commonly called 'rats' (Gwich'in Language Centre 2003). Male muskrats are sometimes referred to as 'buck rats' (Allen Koe Sr. [Aklavik] *in* Benson 2024); some people specify the term buck rat refers to muskrats that are a reddish-brown colour (Gwich'in Elders 1997). Other Gwich'in names for muskrat (Gwich'in Elders 1997) includes the following:

- Dzan dinjii – Male muskrat
- Dzan gee – Young muskrat
- Dzan zhuu – One year old muskrat
- Dzan kun – Muskrat house (pushup)
- Dzan tri'k – Female muskrat
- Dzan nitjoo – Adult muskrat
- Oonjit – White muskrat

There is also a term for white muskrat in Tłįchǫ Yatıì – tehk'àa (Dogrib Divisional Board of Education 1996).

Description

The muskrat is a rodent that lives in wetlands (e.g., lakes, ponds, rivers, creeks) and feeds on aquatic plants (NERB 2016; Figure 3). They have sharp claws, beady eyes and large, sharp, yellow teeth (Gwich'in Elders 1997). Muskrat are small in their first year. On average, muskrat weigh between 0.5 to 1.0 kg but with good winter food they can be as heavy as ~2.2 kg (Gwich'in Elders 1997). While they average about 25 cm in length, large males may reach closer to 40 cm, not including the tail (Gwich'in Elders 1997). Gwich'in trappers have observed that muskrat generally all look the same, but there may be some differences between males and females in coloration and size as well as posture (Mary Kendi and Alfred Semple [Aklavik], and others *in* Benson 2024). Older muskrat have larger, more yellow teeth (John Kendo [Tsiigehtchic] *in* Benson 2024).

Figure 3. Muskrat swimming in their typical aquatic environment. Photo credit: D. Gordon E. Robertson, via CC 3.0 Wikimedia Commons.

Gwich'in harvesters and knowledge-holders note that there can be some variation in how muskrat look in different areas. They are observed to naturally vary somewhat in size across their habitats (Gwich'in Elders 1997; Catherine Mitchell [Inuvik] *in* Benson 2024). For example, they can be bigger in lakes around Tsiigehtchic than in the Mackenzie Delta (Irene Kendo

[Tsiigehtchic] *in* Benson 2024). Épįh Shíh Tia in the Dehcho is also known to have unusually large muskrat (PKFN 2005). Because having good feed available enables the muskrat to get bigger and 'fatter' in some lakes more than others, lake conditions or qualities, such as depth and freshwater inputs, can impact muskrat size (Benson 2024). Muskrat size may also vary from year to year.

"[S]ometimes people say, 'the rats are so small this year', they're catching mostly small rats, then there's other years people are catching bigger rats." (Mary Teya [Fort McPherson] in Benson 2024: 87)

Muskrat change colour with the season; during the winter trapping months they are darker, and in spring their coats are lighter brown (Gwich'in Elders 1997; Abe Wilson [Fort McPherson] *in* Benson 2024). Generally, muskrat fur is dark brown on the back and lighter on the belly. Males can be almost black, females are lighter brown, and young are greyish (Gwich'in Elders 1997). Occasionally very light, whitish muskrat are found, as well as the odd reddish one (Gwich'in Elders 1997; Abe Wilson [Fort McPherson], Allen Koe Sr. [Aklavik], and others *in* Benson 2024). Figure 4 shows pelts from two white or 'albino' muskrat caught by Ellen Firth [Inuvik] and her family.

Figure 4. All white or very light muskrat. Photo credit: K. Benson, muskrat caught by Ellen Firth and her family. Used with permission from Gwich'in Tribal Council report (Benson 2024).

All-black muskrat have also been encountered (Ellen Firth and Marilyn Maring [Inuvik] *in* Benson 2024). Albino and black muskrat are very rare (Ellen Firth [Inuvik] *in* Benson 2024), but there may be localized colour variations (i.e., differently coloured animals are more commonly found in certain areas).

"There is different coloured muskrats and they're usually always found in the same area. Like…there's one section of Mackenzie River out here that's pretty common to get black muskrats. And there's also—I'm not sure of any areas…where it's common—but we also get blonde ones that are…sort of white, but more of a yellowish color…Around the high population…years, people have killed albino muskrats in the past." (Ryan McLeod [Inuvik] in Benson 2024: 88)

Muskrat have been described as sneaky – not visible unless they show their noses to breathe at the surface of the water (ICC *et al.* 2006). They are cautious and wary (Walter Vittrekwa [Fort McPherson] *in* Benson 2024) but are fierce when competing with other muskrat during breeding season or when defending themselves from predators (Gwich'in Elders 1997; ICC *et al.* 2006; Benson 2024).

Relationship with People

Cultural and Historical Importance

Muskrat are culturally important throughout their range in the NWT; they have been valued for their role in subsistence and were a key species harvested during the fur trade. Although the role of muskrat in local livelihoods has shifted, the ongoing use of this species contributes to cultural continuity, knowledge transfer from Elders to youth, maintaining land-based traditions, and fostering individual and community well-being (Turner *et al.* 2018).

Mackenzie Delta

The Mackenzie Delta is encompassed by the traditional territories of the Inuvialuit and Gwich'in, with the Inuvialuit Settlement Region extending across the lower delta to the coast and the Gwich'in Settlement Area encompassing the upper delta (Turner *et al.* 2019). Residents of all four Delta communities — Inuvik, Aklavik, Fort McPherson, and Tsiigehtchic — travel year-round throughout the Delta to harvest species like muskrat for both subsistence and income; this is also an important way of maintaining extended social and family networks (Turner *et al.* 2019).

"Muskrats have an integral role in cultural events and the mixed economy of the Delta, which continues to connect individuals and communities to the land, and offers an experiential way for community members of all ages to remain active and engaged with their cultural practices and identity. The commitment of Delta residents to maintaining and reviving muskrat harvesting traditions contributes to individual and community health and wellbeing in tangible and intangible ways and highlights the potential role that muskrat harvesting traditions can play in efforts to maintain and strengthen cultural identity and knowledge transfer." (Turner et al. 2018: 9)

The muskrat has been especially important to residents of the Mackenzie Delta in part because of the substantial role they have played in the regional economy since the 1850s (Gwich'in Elders 1997; Turner *et al.* 2018; Turner *et al.* 2019). Trapping muskrat is very dependent on fur prices; when prices are very low there is little incentive for trappers to go out and harvest (ICC *et al.*

2006; GNWT 2022). From the 1920s to 1950s, fur prices were very high and trapping was the primary source of income for many Gwich'in and Inuvialuit, and it was a substantial source of food for both people and dog teams (Turner *et al.* 2018). 'Rat Sunday' was an important event for many Gwich'in and Inuvialuit residents of Aklavik; at the end of the spring ratting season people would offer some of their catch to the church to give thanks for a good spring harvest (ICC *et al.* 2006; Arnold *et al.* 2011). At one time, Aklavik was known as the 'Muskrat Capital of the World' and harvesting muskrat was how Inuvialuit were able to earn income to purchase flour, sugar, and other goods (ICC *et al.* 2006; Aklavik Hunters and Trappers Committee (HTC) *et al.* 2016).

Among the Delta residents trapping effort has declined considerably in the Mackenzie Delta since the 1980s (Turner *et al.* 2018).

"The conditions leading to the reduction in harvesting effort are interrelated and include both economic and ecological factors: the increased cost of trapping, substantial reductions in fur prices, the proliferation of wage labour, and reduced muskrat populations." (Turner et al. 2018: 7)

For example, prices for muskrat pelts in the Yukon dropped from approximate $20 per pelt in 1979 to less than $3 in 1989 (prices adjusted for inflation; Brammer 2017). For many Delta trappers, a similar reduction in income was the main reason they stopped commercial harvesting and shifted into the expanding wage labour market (Turner *et al.* 2018). Despite an overall drop in fur exports between 2013 and 2021, there has also been a rise in domestic fur sales and an increase in traditional crafters using fur in the NWT (GNWT 2022).

Today just a handful of Inuvialuit trap for economic purposes; some still go out because they enjoy muskrat meat for themselves (ICC *et al.* 2006). This change is likely having significant impacts on the communities that still rely on these animals for subsistence, trapping income, and their overall well-being (Turner *et al.* 2018; Turner *et al.* 2019). Interviews with Inuvialuit harvesters revealed the following important impacts resulting from the reduction in muskrat harvesting: loss of cultural identity and livelihood; decline in traditional activities; loss of an important food source and the ability to pass on information about harvesting and preparing muskrat (Turner *et al*. 2018).

Nonetheless, during research conducted in 2015-2016 with participants from all four Delta communities, it was found that while muskrat are less abundant and make a smaller contribution to food and income for residents of the Delta than in the past, nevertheless, they remain a vibrant and vital part of Gwich'in and Inuvialuit cultures (Turner *et al.* 2018).

"Intensive muskrat trapping in the Mackenzie Delta from 1900 to 1950 created a regional economy based on this animal and fostered the development of Gwich'in and Inuvialuit cultural traditions rooted in this economy. While ecological and economic changes have led to a decline

in muskrat trapping in the Mackenzie Delta, our analysis suggests that ongoing muskrat use provides communities with a way to cultivate health and wellbeing and maintain cultural knowledge, traditions, and values in the face of ongoing socio-ecological change." (Turner et al. 2018: 7)

Muskrat remains important culturally and economically, and they are still used for subsistence and income (Gwich'in Elders 1997; Brietzke 2015). People continue to harvest for various reasons; some consider muskrat meat a seasonal delicacy (Turner *et al.* 2018). Community members also expressed a desire to continue to go out on the land and maintain their traplines, even in times of low muskrat abundance, to maintain an emotional attachment to their experiences and traditions, as well as for practical reasons (e.g., to keep trails open) (Turner *et al.* 2018).

"[I]t doesn't quite feel like springtime in the Delta if you don't get out and get some rats, [a]fter a long cold winter you get out there in the spring and...plants are growing back and all the birds are making noise, it's just good for you...therapeutic, for Delta people." (Unidentified knowledge-holder [Inuvik] in Turner et al. 2018: 7)

Muskrat continues to be one of the many important traditional foods offered at community events such as the Muskrat Jamboree held in Inuvik each spring, and are important enough to be featured on the community of Aklavik's flag (Turner *et al.* 2018). As a result, researchers have suggested that muskrat are a cultural keystone species in the Mackenzie Delta Region (Turner *et al.* 2018). Further details regarding the socio-cultural impacts of the declining muskrat harvest in the Delta can be found in Turner *et al.* 2018.

Inuvialuit

Trapping muskrat is a traditional activity for Inuvialuit; harvesting begins in March and continues into June (ICC *et al.* 2006; Arnold *et al.* 2011). There are two main ways that Inuvialuit harvest muskrat: the first is trapping at pushups on the lake ice during early spring, the second is calling and shooting them from a canoe once the ice melts (ICC *et al.* 2006). Long ago, Inuvialuit harvested muskrat from kayaks using harpoons (Arnold *et al.* 2011).

Muskrat is considered a very important traditional country food and can also be a source of income (ICC *et al.* 2006; Arnold *et al.* 2011). People mostly sell and/or eat muskrat meat in the spring when it is fresh. Muskrat meat is prepared by freezing, drying and/or smoking (Wein and Freeman 1992; ICC *et al.* 2006). Boneless dry meat is also prepared over an open fire; when cooked this way it is said to be just like eating chips (ICC *et al.* 2006).

"When it's muskrat ratting season time ... the whole family go out together, you know, kids end up setting traps all day long, they have a picnic and they eat and then on the way home they start looking at trap again—that's how it used to be." (Unidentified knowledge-holder [Aklavik] in ICC et al. 2006: 11-105)

"We never threw anything away when [we] had dog teams; every carcass was saved for dog food. I remember seeing the schooners, with muskrat just hanging over the sides, smoked." (Unidentified knowledge-holder [Aklavik] in ICC et al. 2006: 11-104)

"The muskrats were cleaned and smoked for the dogs; they were gutted, smoked and dried. They'd also keep the innards and boil them with oats for the dogs." (Unidentified knowledge-holder [Aklavik] in ICC et al. 2006: 11-104)

Muskrat is a welcome dietary change from fish and some consider it a favourite food, as they are fat and good eating (Wein and Freeman 1992; ICC *et al.* 2006).

In a traditional food use study conducted in 1992, researchers found that muskrat was one of the small mammals most often consumed in Inuvialuit households; smoked and dried muskrat meat were found to be the most popular forms, generally eaten as snacks (Wein and Freeman 1992). A considerable number of muskrat are taken by harvesters and are frequently consumed by a large cross-section of the Inuvialuit population (Wein and Freeman 1992). Muskrat fur makes beautiful clothing, such as parkas, mitts, and hats (Arnold *et al.* 2011); long ago, muskrat fur was used for the inside of the parka for its warmth (ICC *et al.* 2006). People may also make crafts such as dolls and tapestries from scraps of leftover muskrat fur (ICC *et al.* 2006).

In 1912 the town of Aklavik was established as a fur trading centre, with people trapping muskrat all over the Mackenzie Delta.

"With the closing of coastal RCMP and trading posts as well as a new focus on muskrat trapping due to increased fur prices, most people had moved inland to the Mackenzie Delta, settling in Aklavik in the 1940s and Inuvik a decade later." (Byers et al. 2019: 9)

Today, fewer Inuvialuit trap full time due to declines in fur prices, but in the Delta some still trap muskrat on weekends in the spring; in general, subsistence harvesting of animals and plants continues to be vitally important to Inuvialuit communities (Aklavik HTC *et al.* 2016; Inuvik Hunters and Trappers Committee (IHTC) *et al.* 2016).

Gwich'in

Ehdiitat Gwich'in, Teetł'it Gwich'in, Gwichya Gwich'in, and Nihtat Gwich'in have extensive knowledge about muskrat as muskrat have always been important to the Gwich'in (Benson 2024).

"They're very important to our Elders. I'll eat it every day…when I was a kid I used to eat it every day, so I'll eat it every day if I had the chance now! They're healthy; they're good food." (Andrew Koe [Fort McPherson] in Benson 2024: 7)

A Gwich'in story describes how dzan dove into the water during the great flood to bring up a piece of earth to restore the rest of the world (Gwich'in Elders 1997). In the past, hunting and trapping muskrat was the most important activity of late winter/spring for many Gwich'in families; people would travel to camps in large numbers and stay there trapping muskrat for weeks (Benson 2024). Trapping muskrat takes place before the lake ice melts, by placing the traps in muskrat shelters or 'pushups' (more details on how muskrat construct and use pushups is included in *Adaptations to Environment*); after the lake ice starts to melt people switch to shooting muskrat from small boats during the open water season (Benson 2024). Although muskrat have always been important to the Gwich'in, they became particularly important during the fur trade when trappers could make a good income from the high price of muskrat pelts (Gwich'in Elders 1997; Mustonen and Tsiigehtchic Elders 2004; Benson 2024).

"You know when I first started, when I go out with my dad, [it was] way back in the 40s. I was 12 years old and I could shoot rats, I used to sit in the head of the canoe and he would paddle around and shoot.... Sometimes you would get 30-40 rats on [Shorty's Lake]. ...When I was just born in 1930, that's the first time they started buying muskrats good, and there was nobody hunting them before that; [muskrats were] just for eating. They were 10 for a dollar that time in 1930...and nobody bothered; they just trapped for mink and marten and lynx like that, and white fox, and coloured foxes... And then...leg-hold traps come in for muskrats... People were just learning how to trap, like my dad and them... Everyone had to learn the skill of those traps. You just don't go to a pushup and put your trap in and expect a rat, you got to chisel it out, and clean it out, and set it the best you can." (Allen Koe Sr. [Aklavik] in Benson 2024: 12)

Because people could make a lot of money from muskrat trapping, it was an important driver of their yearly harvest cycle and brought more people to live in the Delta during the fur trade starting as early as the 1850s (Gwich'in Elders 1997; Gwich'in Elders 2001; Turner *et al.* 2018; Benson 2024). Nonetheless, muskrat has always been a valued source of food and fur. They have also held spiritual importance since long before the fur trade and are commonly featured in Gwich'in legends and place names (Benson 2024). Today people tend to spend more time in the communities and less time in the Delta (Benson 2024). Contributing reasons for this change include the high cost associated with building camps, reduced fur prices, reduced harvest success (due to lower abundance), changes in trapping technology, and the need to work in town for a living wage (Benson 2024). Despite this, hunting and trapping muskrat remain very important and enjoyable traditional activities for Gwich'in today and many consider muskrat meat a delicacy, especially the tails (Gwich'in Elders 1997; Benson 2024).

"When we were kids, I mean the tails were a real delicacy to kids, you know, you just dipped the tails in boiling hot water and the skin would just peel right off, and then you just line them up in the pan and put them in the oven and bake them. They were a real delicacy for kids. We used to line 20 of them up in a pan and slurp them off the bone after." (Willie Blake [Fort McPherson] in Benson 2024: 53)

Muskrat meat is also an important source of food when other animals are not around or easily available.

"You can use it if there is no caribou around, or if there is no rabbits you can use it. It's real good to eat. It's there amongst the lakes, in case anybody goes hungry or gets stuck without food, you know there is muskrats out on the lake and you can use them that way." (Bertha Francis [Fort McPherson] in Benson 2024: 58)

Muskrat also can be used for dog food or as trap bait and have medicinal uses – some people use the bladder for medicine, the skin or fat can be used as a wound bandage, and the scent glands can also be used to make medicine (Benson 2024).

Interviewees stress that whether for fur or meat, trapping should always be carried out in a traditional manner that includes taking care of the land, caring for the pelts properly, sharing the meat and following traditional harvesting rules (Ellen Firth and Marilyn Maring [Inuvik] *in* Benson 2024). Much more cultural and economic information about Gwich'in use of muskrat can be found in Gwich'in Elders 1997, 2001, and Benson 2024.

Due to concerns about the decline of muskrat populations in the Mackenzie Delta, muskrat have been identified as a research priority in the GSA since at least 2014 and collaborative research and monitoring projects have been underway since 2006 (GRRB 2012; Hovel *et al.* 2014).

Sahtú Dene and Métis

For centuries, Sahtú Dene and Métis have travelled traditional territories and harvested animals, including muskrat, as critical subsistence resources (Andrews *et al.* 2000). A particularly important area for hunting muskrat is the Ramparts River and Wetlands which flow from the foothills of the Mackenzie Mountains east to the Mackenzie River, entering above the Ramparts Canyon, and the community of Fort Good Hope (Andrews *et al.* 2000). Another important spring hunting area for beaver and muskrat is Turılı̨ (Johnny Hoe Fishery) located at the southern-most part of the Great Bear Lake (Andrews *et al.* 2000).

In research examining traditional foods in the communities of Fort Good Hope and Colville Lake, muskrat was identified as one of the species most frequently used, and for people living in Colville Lake, muskrat was reported as one of the most important, frequently used traditional foods (Kuhnlein *et al.* 1994).

In September 2024 an opportunity arose to ask a group of women from all five Sahtú communities about their knowledge of muskrat during a harvesting workshop hosted by the SRRB. Responses were captured in a graphic recording of the session, see Figure 5.

The women were excited for an opportunity to talk about muskrat and while they said fewer people are harvesting them now because of less time being spent on the land, they are still important to Sahtú Dene and Métis (Owen pers. comm. 2024). They talked about the many different ways that muskrat are important, including their nutritional value, the use of their fur in sewing clothing like mukluks, mittens, hats and scarves, as well as their important role in the ecosystem; they also mentioned stories of muskrat finding land after the flood, as are told in other areas (SRRB 2024). Leon Andrew (Shúhtaot'ı̨nę Elder with the Tulı́t'a Dene Band) also talked about the unique nutritional value of muskrat, saying that they eat only the 'best food', found in deep water, and the plants that they feed on are medicine for muskrat – because of this, eating muskrat helps humans stay healthy too (Andrew pers. comm. 2024). While they are not considered essential to the Dene diet, they are still eaten; the women recalled that muskrat are very rich-tasting and tasty when cooked on an open fire (SRRB 2024).

Muskrat were used more in the past when people could make a lot of money hunting and trapping muskrat during spring time; however, the fur is not sold anymore, so there is little incentive to hunt them (SRRB 2024).

Figure 5. Muskrat knowledge documented during a September womens' harvesting workshop in the Sahtú Settlement Area (SRRB 2024).

North Slave Métis

Muskrat are mentioned in legends of the North Slave Métis and this species continues to contribute to peoples' physical, economic, social, cultural and spiritual well-being (NSMA 1999).

"…The moose and caribou are the mainstay for most of the Aboriginal people, but when they harvest rats, they eat rat and beaver and birds, a lot of birds. …Some people [trap], but very few people are trapping for livelihood these days, I mean the bleeding heart animal rights groups have killed our fur industry. …[But] people still use these animals for fur, for trimming and what not. Wolverine is always used as trimming around parkas, and muskrat and beaver pelts are always used for some form of clothing and will always be used. So they're all important. …They're all important to me, and they all have their reasons for being on the land, whether they're scavengers or they're there for us to eat, they have their use on the land. They're all important." (Bob Turner) [NSM] in NSMA 1999: 94)

North Slave Métis have long history of harvesting muskrat from the land around the Great Slave Lake and trapping was mostly for personal consumption or to share with family (NSMA 2012). Muskrat are harvested for food, used to make clothing, and pelts are sold commercially (NSMA 2013a); however, very few North Slave Métis currently trap muskrat to sell in the fur market (NSMA 2012). For some, muskrat trapping is seen as an activity from the past, as most North Slave Métis are engaged in the wage economy and harvest for personal sustenance only, with some furs traded, gifted, or sold to Elders to make clothing or moccasins (NSMA 2012).

Dehcho

Muskrat are common throughout aquatic habitats within the Dehcho territory (EBA 2003). Traditional subsistence economy, including harvesting muskrat is important in the Dehcho (DLUP 2006). In the spring, trapping activity focuses on beaver and muskrat (DLUP 2006). Spring muskrat harvesting for members of the Pehdzéh Kį́ First Nation (PKFN) usually begins in early April and extend into early June (PKFN 2005). During this time trapping activities are generally focused on the river and lake systems, and muskrat are one of the main animals harvested (PKFN 2005). Trappers generally go out and stay at cabins or camps for several days to weeks at a time for spring harvesting activities (PKFN 2005).

Tłı̨chǫ/Wek'èezhìı

Muskrat are featured in Tłı̨chǫ legends, such as the creation story '*When Muskrat Made the Earth*' which features muskrat creating land following a large flood in the world (Tłı̨chǫ Government 2018).

"Long, long ago it rained for 40 days and 40 nights. The world was flooded by water… God told Noah to make a boat… He told Noah to put all types of animals, male and female, in the boat… [after the flood] Noah didn't know how the earth was going to be recreated… He hoped that the animals would find a piece of dirt or mud… he asked Muskrat (Dzǫ)… He was gone, gone, gone for a long time. Finally, … He came to the surface with that bit of dirt… he [muskrat] found the earth for Noah. That is how Muskrat lives on earth. Muskrat brought out the dirt and floated it on the water. It floated and it got bigger and bigger and bigger… until it became the earth that we live on today." (Creation Story – When Muskrat Made the Earth as told by Michel L. Rabesca **in** ***Tłı̨chǫ Government 2018)***

In the Wek'èezhìı area, following the peak of the fur trade, efforts were made to reintroduce beaver in the Marion River area (Olson *et al.* 2012). After beaver were re-introduced in the 1940-50s, most of the rivers, lakes, and ponds in the study area became habitat for beaver and muskrat (TRTI 2015b).

Hunting and trapping muskrat for both food and fur has long been a traditional activity in this area (Olson *et al.* 2012). The main season for harvesting muskrat is spring, when harvesters travel by canoe to small lakes and ponds (TRTI 2015b). Muskrat continue to be widely hunted and trapped during the spring months by Tłı̨chǫ land users (Tłı̨chǫ Government 2013; TRTI 2015b). Once the ice melts, people travel by river in the spring and set camps for spring muskrat hunting (TRTI 2015b).

No other sources of information about the relationships between muskrat and Tłı̨chǫ were found in preparing this report.

Akaitcho Territory

Historically, trapping around Wı̨ìlı̨ìcheh (Yellowknife Bay) was integral to the livelihood of Yellowknives Dene (Degray 2020). While people have always relied on small game for subsistence reasons such as food and clothing, during the fur trade selling and trading animal pelts from animals like muskrat became an important component of the subsistence economy and a way for trappers to make a good income (Degray 2020). Muskrat and beaver continue to be one of the most prevalent animals trapped by Dene east of Wı̨ìlı̨ìcheh (Yellowknife Bay).

No further sources were found regarding Yellowknives Dene reliance on or knowledge of muskrat in other areas. No sources were found that documented information about the relationships between muskrat and members of the Deninu Ku'e First Nation, Lutsel K'e Dene First Nation, or Smith's Landing First Nation.

Vuntut Gwitchin First Nation

Muskrat are culturally and economically important to Van Tat Gwich'in harvesters in Old Crow, Yukon who traditionally spend the spring months trapping muskrat in the Old Crow Flats (Murphy 1986; Brammer 2017). This area is particularly important to Vuntut Gwitchin First Nation (VGFN) harvesters, as it is rich in muskrat and waterfowl and is located close to town (Murphy 1986). In the Old Crow flats, harvesting muskrat provide fur, food and a sense of cultural continuity (VGFN and Smith 2009 *in* Brammer 2017).

Van Tat Gwich'in trappers traded furs with Russians in Alaska as well as the Hudson's Bay Company until permanent European trading posts were established in the mid-1800s (Murphy 1986). In 1918 there was a rise in the price of muskrat pelts and a subsequent increase in the number of people participating in the fur trade, and muskrat trapping became a major springtime activity for Van Tat Gwich'in (Murphy 1986). Entire families would move north to Old

Crow Flats for two to three months starting in early spring, trapping until breakup, then switch harvesting method to shooting muskrat with a rifle during open-water season (Murphy 1986).

The muskrat harvest was still considered an activity central to the VGFN seasonally for both for cultural and economic reasons, and little changed in the 1970s and 1980s despite higher costs and declines in the price of furs (Murphy 1986).

Given the cultural importance of muskrat as a source of both fur and food, as environmental changes are increasingly documented in the north, VGFN members have expressed specific concerns around how these changes will impact muskrat populations (Brammer 2017).

Peace, Athabasca, and Slave River Basins

Muskrat are important to the Indigenous people of the Peace-Athabasca Delta and Slave River Delta regions who harvest the animals for both food and fur, and pelts may be used locally for making traditional clothes or sold commercially for trapping income (see sources *in* Pembina 2016a, b; Parks Canada 2024). In the 1930s, muskrat harvest could be as high as 1,000 animals per trapper in the Peace, Athabasca, and Slave River Basin (UMA Engineers Ltd. 1985 *in* Pembina Institute 2016b).

Approximately 80% of the Peace-Athabasca Delta lies within Wood Buffalo National Park; in 2011, the park and local Indigenous communities started working together on muskrat monitoring in response to questions and concerns about muskrat abundance raised by traditional land users (Parks Canada 2024). Members of the Mikisew Cree First Nation, Athabasca Chipewyan First Nation, and Fort Chipewyan Métis are all involved in conducting muskrat surveys in their respective traditional territories (Parks Canada 2024).

No other information on traditional or historical importance or the relationships between muskrat and people of the Peace, Athabasca, and Slave River areas was found during the preparation of this report.

Search Effort and Harvest Patterns

During the fur trade, the annual Gwich'in harvesting cycle included trapping and hunting for furs in the late winter and fall, fishing in the summer and fall, and hunting in the winter (Rosalie Ross [Fort McPherson] *in* Benson 2024). Muskrat harvest or 'ratting season' usually began with trapping in early March, followed by hunting as the rivers start to flood the lakes, and ending sometime in early to mid-June once mating season begins and the furs are no longer prime (Gwich'in Elders 2001; ICC *et al.* 2006; Arnold *et al.* 2011; Benson 2024). People may also hunt muskrat outside of this season for food, but do not generally bother them in the summer months when they have their young (Benson 2024).

People often trap muskrat in lakes around their camps or cabins while they stay there, then travel more broadly to other lakes once they start to hunt them (Rachel Villebrun [Fort McPherson] *in* Benson 2024). People mostly trap in the area where they learned to trap, as they are familiar with which lakes are good for muskrat in those areas. However, impacts of climate change such as erosion may be changing where muskrat are, meaning locations for hunting and trapping may also be changing (Peter Ross [Tsiigehtchic] *in* Benson 2024). Climate change is also causing shifts in the seasons resulting in warmer weather earlier. In response, muskrat breed earlier, and hunting season is shorter (Robert Alexie Sr. [Fort McPherson] *in* Benson 2024). Nonetheless, hunters and trappers focus harvesting activities on good muskrat lakes (Benson 2024). A good muskrat lake will have a lot of muskrat pushups visible in April or May, and there will be a lot of muskrat swimming around the lake edges where the ice is melting (Irene Kendo [Tsiigehtchic] *in* Benson 2024). Lakes that are known to be good for muskrat tend to have higher muskrat populations year after year, so these lakes are used preferentially by harvesters (Benson 2024).

Although muskrat do not leave a lot of sign (e.g., scat or tracks), pushups make them more visible and easier to find during trapping and hunting seasons (Alfred Semple [Aklavik] *in* Benson 2024).

In the Dehcho, the Kakisa River is identified as an area abundant in wildlife including muskrat (EBA 2003). Pehdzéh Kį́ First Nation (Wrigley) members use all major rivers and lakes, as well as smaller rivers and inland lake areas for their spring harvesting activities, using both waterways and trails as travel routes for trapping and hunting (PKFN 2005). Members mentioned using traditional trails around Tı K'ee Tí Deh, Łıe Tí (Fish Lake) Tapee Tí (Long Lake), Ts'ıp'ęę Tí (Spruce Lake) and K'ádzáh K'é (Bulmer Lake) when trapping for muskrat and beaver (PKFN 2005), as well as K'ádzáh K'é (Bulmer Lake; PKFN 2005).

"In the spring, harvesters would often travel by canoe, portaging between lakes and rivers from Ti K'ee Tí eastwards to Nóots'ehli Ti, Éhtáo Tah, and as far as Ti Gǫǫ Tí (Keller Lake), to hunt and trap beaver and muskrat. Harvesters would also travel southwards from Ti K'ee Tí Ndihfelįį along Dets'íh Deh to Nohpée K'éo, Tapee Tí (Long Lake), and Ts'ip'ęę Tí (Spruce Lake)." (PKFN 2005: 37)

Harvesters also travel from Xahndaa Deh to T'oh K'éa Tí and east to Tetł'eh Tí and Dahtaeʔáa to hunt and trap both beaver and muskrat (PKFN 2005). Éha Deha is a popular travel route as it links several small beaver lakes and is a common trapping area for beaver and muskrat (PKFN 2005).

Further information on areas that are important habitat for muskrat and/or used consistently to harvest muskrat is included in *Key Habitats.*

Harvesting Rates

Seasonal or annual totals for muskrat harvesting have been recorded by harvest studies in several regions within the range of muskrat in the NWT (see Scientific Knowledge Component – Interactions with Humans). This section includes historic information on harvesting as well as broad trends in muskrat harvesting over time. Overall, similar trends are seen in all regions of the NWT – that is, muskrat harvest levels used to be much higher during the fur trade than they are today.

During the fur trade and when muskrat were very plentiful, harvest rates could be very high. Gwich'in harvesters would get as many as 100-150 muskrat in one night and 1,200-3,000 muskrat in a season (Hyacinthe Andre [Tsiigehtchic] *in* Mustonen and Tsiigehtchic Elders 2004; Gwich'in Elders 1997; Catherine Mitchell [Inuvik] and Neil Snowshoe [Fort McPherson] *in* Benson 2024). An Inuvialuit harvester working with his sons in the Mackenzie Delta between 1941 and 1955 reportedly trapped over 30,000 muskrat (Arnold *et al.* 2011). Women in the SSA also talked about hunting muskrat a lot in the 1960s and 1970s, and how they would use the skins and eat muskrat for food; people remembered catching over 100 muskrat and skinning 30-40 muskrat in a day (SRRB 2024). In the Peace, Athabasca, and Slave River Basin muskrat harvests could be as high as 1,000 animals per trapper in the 1930s (UMA Engineers Ltd. 1985 *in* Pembina Institute 2016b). Vuntut Gwitchin First Nation trappers reportedly traded more than 50,000 pelts following a single, four month trapping season during the fur trade (Murphy 1986).

When people had dog teams, muskrat were often harvested and dried in large numbers as a source of food for working dogs (Benson 2024).

"We used to have to dry it for our dogs too. Make thousands of it, thousands of dry rats for dogs. That is, after ratting we all come up and we enjoy ourselves and... we don't have time to put net in. As long as we got dry rats for dogs, we don't worry about dog feed... for ourselves too. So, we make use of it. Make dry rat and for ourselves and for our dogs." (Joan Nazon [Tsiigehtchic] in Benson 2024: 58).

Between 1960 and 1965, the mean annual muskrat harvest by Inuvialuit was estimated at 98,000 pelts; that number dropped to 10,000 pelts annually from 1988 to 1997 (Usher 2001). These estimates indicate changes in harvesting rates and activities, which are attributed to declines in commercial trapping and in fur prices (Usher 2001). Usher noted that both fox and muskrat harvests were already lower in the early 1960s than they had been in the previous decades (2001). Still, in the 1960s, it was found in the study that over 50% of the terrestrial mammal harvest consisted of muskrat, and the greater part of that was used for dog food (Usher 2001).

Muskrat harvesting rates between 1960 and 1983 were detailed by Murphy in a study looking at the valuation of traditional activities; total harvests compiled there show no declining trend over that 23-year period, despite a drop in fur prices and higher costs associated with harvesting

(Murphy 1986). In the years between 1970 and 1983 there was a trend toward lower muskrat harvests, but it was described as 'not too significant' (Murphy 1986). Low returns in some years likely reflected periods of low abundance in the natural muskrat population cycle rather than reduced harvest effort (Murphy 1986). Nonetheless, the study concluded that while the number of muskrat camps had not changed significantly at that time, the percentage of adults participating in spring ratting activities had declined (Murphy 1986).

The highest number of muskrat harvested recorded by the Inuvialuit Harvest Study (1988 to 1997) was in 1988 at approximately 3,200 pelts; since that time, the reported harvest numbers have been lower (ICC *et al.* 2006). Another trend noted by the study was that harvesters from Tuktoyaktuk take far fewer muskrat than harvesters in Inuvik and Aklavik (ICC *et al.* 2006).

In the early 2000s, a harvester from Aklavik indicated that a large portion of his trapping income was still from trapping muskrat (ICC *et al.* 2006).

"Some trappers still trap muskrats in the ISR. An [Aklavik] resident indicated in his interview, 'trapping is very important to me, that's the only income I have'." (Unidentified knowledge-holder [Aklavik] in ICC et al. 2006: 11-103)

However, others remembered that when they were younger, a daily harvest of 200-300 muskrat was considered normal, but in 2005 no one harvests numbers like that anymore (ICC *et al.* 2006).

"Today there is less of an emphasis on traditional activities like trapping, and hardly anyone goes out to muskrat." (Unidentified knowledge-holder [Inuvik] in ICC et al. 2006: 11-103)

Today, most Gwich'in who harvest muskrat take only enough to eat and share, perhaps only harvesting ten in a season (Andrew Koe [Fort McPherson] *in* Benson 2024). Nonetheless, even traditional uses like sewing a parka could take as many as 60 large muskrat skins (Mary Kendi [Aklavik] *in* Benson 2024).

In the Dehcho, annual community harvest of Muskrat between 1993-1994 was reported as 244 in Fort Liard and 62 in Nahanni Butte (GC 1997 in DLUPC 2006), and 231 in Fort Providence in 2003 (Deh Gáh Got'ie First Nation 2004 in DLUPC 2006). Biology and Behaviour

Life cycle and reproduction

Muskrat mating starts in late May or early June. The initial mating period lasts a few weeks and during this time muskrat can be seen in pairs (Gwich'in Elders 1997; Benson 2024). Gwich'in and Inuvialuit harvesters usually stop hunting muskrat sometime in June and July when females start to have young (ICC *et al.* 2006; Benson 2024). Females are seen less frequently once they start to have young – during this time the females become 'wild', quickly disappearing into their dens if threatened (Marilyn Maring and Ellen Firth [Inuvik], and others *in* Benson 2024). In the ISR people have noted that muskrat give birth to young in June through to mid-August (Tuktoyaktuk

Hunters and Trapper Committee *et al.* 2016). Muskrat start mating when they are one year old (Gwich'in Elders 1997).

Newborn muskrat are thought to nurse for only a short time, possibly one month (Benson 2024). While Gwich'in trappers cannot observe within the nests, they know that young muskrat get their teeth very early, meaning they are probably off their mothers by that time (Allen Koe Sr. [Aklavik] *in* Benson 2024); others have suggested young nurse until the middle of winter (Gwich'in Elders 1997). Muskrat can have between six to 17 young in a litter (ICC *et al.* 2006; Mabel English [Inuvik], Abe Wilson [Fort McPherson], and others *in* Benson 2024), but six to eight young in a litter is most common (Gwich'in Elders 1997). Both male and female muskrat take care of their young throughout the summer; young stay in the den until they are old enough to come out and feed (Gwich'in Elders 1997; Abe Wilson [Fort McPherson] *in* Benson 2024). Young also stay with their parents over winter (Gwich'in Elders 1997). Occasionally a muskrat can be seen moving her young along a portage trail by holding them in her mouth (Mabel English [Inuvik] *in* Benson 2024).

Muskrat can have more than one litter of young a year (Gwich'in Elders 1997; ICC *et al.* 2006; Mary Kendi [Aklavik], Abraham Stewart [Fort McPherson], and others *in* Benson 2024); they may even mate as late in the year as August or September (ICC *et al.* 2006; Tony Andre [Tsiigehtchic] *in* Benson 2024). Food availability and seasonal timing affects how many litters a muskrat may have in a year – for example, an early spring can mean an early first litter and time to have a second one (Allen Koe Sr. [Aklavik] *in* Benson 2024).

Physiology and Adaptability

Muskrat are proficient swimmers and can stay underwater for over a minute at a time (Gwich'in Elders 1997). They can also float on driftwood (Joan Nazon [Tsiigehtchic] *in* Benson 2024). They can stay under water for long periods and travel quite far under water (Abe Wilson [Fort McPherson] *in* Benson 2024). They can also move fast on land (Ian McLeod [Aklavik] *in* Benson 2024).

Muskrat have very sharp teeth and claws that they use to defend themselves (Abe Wilson [Fort McPherson], Allen Koe Sr. [Aklavik] *in* Benson 2024).

Adaptations to Environment

The muskrat is well adapted to their range and knows how to live during each season; they also know all the good places to find food (Gwich'in Elders 1997). Muskrats in the Slave River Delta use three types of shelters: houses, bank burrows and pushups (UMA Engineers Ltd. 1984; Pembina 2016b). Houses are usually built in the fall in deeper water and are found on the lakes and outer Delta. Bank burrows are normally located at steep sloping shorelines and are used when water levels are low (MRBC 1981; Pembina Institute 2016b). Pushups are piles of submerged plant material and pieces of emergent vegetation debris that are built after wetlands become covered in ice (UMA Engineers Ltd. 1985; Pembina Institute 2016b).

Pushups provide protection from weather and predators during the winter as well as a secure place to store food (ICC *et al.* 2006; NERB 2016; Brammer 2017; Benson 2024; SRRB 2024). As soon as a lake freezes, muskrat will make an opening in the ice above their favourite feeding areas and bring weeds and mud up from the bottom to build a pushup (Gwich'in Elders 1997). Pushups can be seen above the surface of a frozen lake (ICC *et al.* 2006); sometimes a muskrat will create many pushups on a single lake (Benson 2024). The entrance to a pushup is underwater and there are holes for air exchange on the top (Abe Wilson [Fort McPherson] *in* Benson 2024). Muskrat make their pushups at the places where bubbles come up through the lake so that the entrance doesn't freeze (George Vittrekwa [Fort McPherson] *in* Benson 2024). They are well-constructed and airtight to protect them against freezing (George Vittrekwa [Fort McPherson] *in* Benson 2024). Snow falling on top of a pushup also acts as insulation against freezing (Willie Blake [Fort McPherson] *in* Benson 2024).

A pushup may have one or two rooms, plus a submerged ice shelf called a 'bed' when muskrat will sit and feed (Gwich'in Elders 1997).

Pushups are important to muskrat survival and muskrat work hard to build and then keep their pushups in good shape (Elizabeth Greenland [Aklavik], Mabel English [Inuvik], and others *in* Benson 2024). They use piles of vegetation that they bring up from the lake beds to build the pushups but may also use moss and other plants (Mary Kendi and Alfred Semple [Aklavik], and others *in* Benson 2024). They also store vegetation to eat inside the pushups (ICC *et al.* 2006; Alfred Semple [Aklavik] *in* Benson 2024). An important function of the pushup is to provide a route between the water and the air above (Allen Koe Sr. [Aklavik] *in* Benson 2024). Muskrat may have other breathing holes in the ice as well (Alfred Semple [Aklavik] *in* Benson 2024). Muskrat work on or add to their pushups throughout the winter to keep them open to the air above (Benson 2024). If there is not enough insulative snow and the pushup freezes, it will be useless to the muskrat (Allen Koe Sr. [Aklavik] *in* Benson 2024); sometimes muskrat can also fix frozen pushups (Gwich'in Elders 1997; Benson 2024).

"Well, sometimes the house, the whole pushup is not insulated enough; they didn't put enough grass and then the opening where they come out [into the water] would freeze. So then [the muskrats can] just chew right through the ice, and re-make the hole and bring up more weeds, and put it along the walls to insulate it, so it doesn't freeze again." (Joan Nazon [Tsiigehtchic] in Benson 2024: 83)

One pushup may be used by many muskrat and a really large one may have up to four 'rooms' in it (Abe Wilson [Fort McPherson] *in* Benson 2024). A whole muskrat family can stay in a large pushup, sometimes with as many as eight or ten muskrat in one (Allen Koe Sr. [Aklavik], Fred

Koe [Fort McPherson], and others *in* Benson 2024). Muskrat may also use pushups other than the ones they made themselves (Catherine Semple [Aklavik] *in* Benson 2024).

Muskrat pushups start to dry or fall into the lake as the ice melts, sometimes as early as April but more often in May or June (Allen Koe Sr. [Aklavik], Mabel English [Inuvik], and others *in* Benson 2024).

Muskrat also use their sharp claws to excavate dens and tunnels in the banks and may live in those in the winter months, as they provide safety from predation (ICC *et al.* 2006; Benson 2024). Muskrat dens can be quite big (Allen Koe Sr. [Aklavik] *in* Benson 2024). They have tunnels under the surface of the lake to access them and may have a network of long tunnels (Malcolm Firth [Aklavik], Tony Andre [Tsiigehtchic] *in* Benson 2024). Gwich'in Elders say that muskrat spend most of their time in the bank houses, and that the dens may be large with several rooms lined with grass for bedding, providing a home for up to 12 animals (Gwich'in Elders 1997).

In some places muskrat may use their bank holes or dens for sleeping in, and the pushups for eating in (Mary Kendi and Malcolm Firth [Aklavik], and others *in* Benson 2024).

"In the winter they live in the bank hole…They live in the bank hole and when they feed, they come out, they dive, they get their root or their plant and they go to their [pushup] house and that's where they eat. Then they go back down and they go back to their bank hole…the pushups, that's not their home; that's just for eating." (Andrew Koe [Fort McPherson] in Benson 2024: 85)

In some places in the Delta muskrat dens are their main home (ICC *et al.* 2006; Benson 2024). In other places, such as along the coast, muskrat tend to use their pushups as houses, perhaps because there are fewer good places for dens or bank holes in these areas compared to the Mackenzie Delta (Joe A. Vittrekwa [Fort McPherson] *in* Benson 2024).

Despite the muskrat's adaptations to the cold environment, their population can still be affected by very cold winters. Temperature determines the level to which lakes will freeze, and lakes that are too shallow and freeze to the bottom are not good for muskrat (Brammer 2017; Straka *et al.* 2018; Benson 2024). Abe Ookpik told the Berger Inquiry about this in 1975:

"…when we have severe cold winters in this Mackenzie Delta and there is hardly any snow, the lakes freeze to the bottom, and all the muskrats, certainly the large population will disappear, and I know this for a fact because I used to trap in this land, and I used to hunt muskrats, when there was open water, and when I know that for a fact, when the ice freezes to the bottom of the lake, it comes up with the whole bottom of the lake, all the food comes up with it and then the muskrats for the next year, although they may have populated, die off in certain areas." (Abe Ookpik [Aklavik] in Berger 1975: 140)

Further information on how lake depth and hydrology influence muskrat habitat selection and survival is included in *Habitat Requirements.*

Muskrat are otherwise considered adaptable and known to be able to bounce back after a population decline (Willie Blake [Fort McPherson] *in* Benson 2024). Nonetheless, they may not be able to adapt to warming water temperatures or changing seasons (Andrew Koe [Fort McPherson], Walter Vittrekwa [Fort McPherson] *in* Benson 2024). More on how climate change may affect muskrat is included in *Threats and Limiting Factors*.

Muskrat in the Slave River Delta have been described as more adaptable regarding shelter construction as compared to populations in other regions (MRBC1981 *in* Pembina Institute 2016b).

Diet and Feeding Behaviour

Muskrat live and feed in the water (ICC *et al.* 2006). They eat only vegetation/fresh food; they are known to be a 'clean' animal and do not eat other animals or unclean feed (Gwich'in Elders 1997; Rosalie Ross [Fort McPherson], Mabel English [Inuvik] *in* Benson 2024). Muskrat dive to the bottom of grassy lakes and bring aquatic vegetation or 'muskrat food' to the surface or to shore to eat (Gwich'in Elders 1997; ICC *et al.* 2006; Inuvik HTC *et al.* 2016; Malcolm Firth [Aklavik], Mabel English [Inuvik], and others *in* Benson 2024). Their feed is said to resemble spinach mostly from the leafy material, but also marshmallows or mushrooms from root material (Catherine Mitchell [Inuvik], Tony Andre [Tsiigehtchic], Alfred Semple [Aklavik] *in* Benson 2024). Muskrat food has also been described as 'black and half-decayed' with a particular smell when found in pushups during the trapping season (Ryan McLeod [Inuvik] *in* Benson 2024).

Muskrat use their large sharp teeth to eat roots, or 'rat root', found in lakes and on shorelines and banks (Walter Vittrekwa [Gwich'in Elders 1997; Fort McPherson] *in* Benson 2024). The root is described as white or yellowish and sweet like a coconut; muskrat dive down and knock them off their stalks, the roots then float to the lake surface where the muskrat eat them (ICC *et al.* 2006). Others say rat root resembles a wild onion; it has been identified as American sweet flag (*Acorus americanus*) (Alestine Andre [Tsiigehtchic] *in* Benson 2024). It is known to be a particularly important—perhaps even required—food for muskrat (Andrew Koe [Fort McPherson] *in* Benson 2024) and may have medicinal qualities for muskrat as well as for humans (Mabel English [Inuvik], Willie Blake [Fort McPherson] *in* Benson 2024).

Muskrat add fresh, new green growth to their diet as soon as it is available in spring (Gwich'in Elders 1997; Ryan McLeod [Inuvik], Joan Nazon [Tsiigehtchic], and others *in* Benson 2024). They also eat fine new willow bark in spring (Gwich'in Elders 1997; Allen Koe Sr. [Aklavik] *in* Benson 2024). Muskrat tracks are seen on portages between lakes as they move around to find new feed or grass (Gwich'in Elders 1997; Mary Kendi and Alfred Semple [Aklavik] *in* Benson 2024).

Muskrat are mostly active during nighttime hours in the spring and summer (note however, that the sun does not fully set during the spring/summer in the north); people often begin hunting by three or four o'clock in the afternoon as that is when the animals are coming out of their dens to eat (Bertha Francis [Fort McPherson], Joan Nazon [Tsiigehtchic], and others *in* Benson 2024). They tend to go back into their bank houses about nine o'clock in the morning (John Kendo [Tsiigehtchic] *in* Benson 2024), but are not actually feeding all night and may be seen sleeping or going to bed at different times (Ellen Firth [Inuvik], Alfred Semple [Aklavik], and others *in* Benson 2024). Muskrat are not generally seen in the morning or during daytime (Allen Koe Sr. [Aklavik], Catherine Mitchell [Inuvik] *in* Benson 2024). In the fall, muskrat start to eat as much as they can to prepare for winter (Benson 2024).

In winter, muskrat continue foraging and are seen eating vegetation and roots from under the frozen surface of lakes (Abe Wilson [Fort McPherson] *in* Benson 2024). Muskrat learn from their mothers and are also naturally knowledgeable about where to find the foods that are good for them (John Kendo [Tsiigehtchic] *in* Benson 2024). When their food is plentiful, they can become very fat, even during the winter. However, if there is a food shortage they will move to a new lake, fight others for food, or even starve (Gwich'in Elders 1997).

More information on what factors may drive muskrat distribution is included in *Movement and Dispersal*.

Relationship Within and Among Species

Relationships with Muskrat

The muskrat is not a solitary animal; a good muskrat lake will have many different species living together (Bertha Francis [Fort McPherson] *in* Benson 2024). Males will compete for mates in the spring, fighting and possibly forcing smaller and younger males to move to different areas (Figure 6; Gwich'in Elders 1997; ICC *et al.* 2006; Brammer 2017; Benson 2024). Fighting can be fierce, and muskrat can sustain substantial injuries (Gwich'in Elders 1997; ICC *et al.* 2006; Benson 2024).

Figure 6. Muskrats will often compete for mates in the spring or in defence of territories. Photo credit: Vicky St. Germaine.

More information on muskrat spring movements are included in *Movement and Dispersal.*

Relationships with other Species

Moose use the same lakes as muskrat, as they similarly eat aquatic vegetation (Joan Nazon [Tsiigehtchic], Ryan McLeod [Inuvik] *in* Benson 2024). Muskrat are also known to clear up water, making lakes more attractive to waterfowl (Ian McLeod [Aklavik] *in* Benson 2024). Muskrat are said to share lakes with ducks, but not geese or shorebirds such as yellowlegs due to habitat preference (Ellen Firth and Marilyn Maring [Inuvik], and others *in* Benson 2024). However, in the Dehcho territory, Trumpeter swans have been noted to nest near shore, on small islands, or on muskrat and beaver lodges (EBA 2003). There are other birds that do not like living around muskrat including crows [ravens], seagulls, and nighthawks (Malcolm Firth [Aklavik] *in* Benson 2024).

Barren-ground and woodland caribou as well as reindeer (within the Inuvialuit Settlement Region) may go onto frozen lakes and disturb or eat muskrat pushups (ICC *et al.* 2006; Ian McLeod and Catherine Semple [Aklavik], and others *in* Benson 2024). Sometimes caribou completely empty a lake of muskrat by eating all their pushups (Gwich'in Elders 1997). Inuvialuit interviewees have suggested that caribou do this to obtain important nutrients during the winter or when food is scarce (ICC *et al.* 2006). This behaviour occurs in the Mackenzie Delta and on the Yukon North Slope in areas with high muskrat densities (WMAC-NS and AHTC 2018). Harvesters have reported seeing 10-15 caribou in the middle of a lake eating the same pushup (ICC *et al.* 2006). Moose may also do this (Gwich'in Elders 1997; Donald McLeod [Inuvik], Walter Vittrekwa [Fort McPherson] *in* Benson 2024). Disturbing pushups like this can ruin them beyond repair, especially if it freezes solid before a muskrat can fix it (George Vittrekwa [Fort McPherson], Ryan McLeod [Inuvik] *in* Benson 2024).

In Yukon, local First Nations were concerned that reintroduced bison were causing declines in muskrat populations because they were eating pushups (Jung *et al.* 2019). Pushups in some lakes may be favoured by bison because of their high nutritional quality (Jung *et al.* 2019).

Muskrat and beaver are found in similar lakes and there are many Gwich'in stories about them trading places or switching tails (Johnny Charlie and Fred Koe [Fort McPherson] *in* Benson 2024).

"Muskrat used to have a big tail which was good for making a big splash, and Beaver wanted it. Beaver essentially tricked Muskrat into switching tails. As soon as they had switched, Muskrat knew he had made a mistake, but it was too late. … Other versions of the story say that Muskrat was tired of pulling his big tail along behind him, so negotiated with Beaver to switch tails as they journeyed together." (Johnny Charlie and Fred Koe in Benson 2024)

Some Gwich'in knowledge-holders point out that beaver can be bad for muskrat. Beaver dams may influence water levels and change the quality of water and vegetation in ways that no longer suit muskrat; these changes then influence the distribution of muskrat (Peter Kay [Fort McPherson], Peter Ross [Tsiigehtchic] *in* Benson 2024).

"I always think the beaver tear the willow down ... the lakes get a willowy taste and [the muskrats] tend to move out. I always think that. You notice in a little lake when there's beaver there the water changes colour." (Unidentified knowledge-holder [Aklavik] in ICC et al. 2006: 11-99)

In response to negative impacts on populations from the fur trade, the government deliberately reintroduced beavers to the Mackenzie Delta and the Marion River area of the Tłı̨chǫ/Wek'èezhìı region (Olson *et al.* 2012; Benson 2024).

In research involving both Inuvialuit and Gwich'in residents of the Mackenzie Delta, participants noted that changing wildlife interactions could be one of the things affecting muskrat populations, particularly increases in otter and beaver density since the mid-1980s (Turner *et al.* 2018).

There are also observations that if beaver change water levels in a way that better suits moose, moose may move in and may eat some of the same food as muskrat (Tony Andre [Tsiigehtchic] *in* Benson 2024).

"I don't know if the moose eat that same food…when you go to the lake and you see the moose eat? It looks familiar as what the rats eat. So you look at one little rat compared to a moose, well that moose could clean up that whole [lake] and starve this little rat… I'm thinking they eat the same food!" (Andrew Koe [Fort McPherson] in Benson 2024: 91)

There are also ways that beaver and muskrat help each other and modify each other's habitats in good ways (Allen Koe Sr. [Aklavik], Neil Snowshoe [Fort McPherson], and others *in* Benson 2024).

"The old timers say that when the beaver is [muskrat's] friend, they say he stays with him. They stay with one another. He puts grass down for that beaver and that beaver's got a big house. He's sitting there, he's got his own little room, too. He sits there and he's warm in there; he lives with him, I guess." (George Vittrekwa [Fort McPherson] in Benson 2024: 91)

Muskrat may also benefit from hearing a beaver's warning tail slap (Bertha Francis [Fort McPherson] *in* Benson 2024).

Elder Leon Andrew remembered hearing an ancient Dene story about how muskrat and beaver were friends and agreed to not take over each other's areas; muskrat said, 'This is where I want to live,' and beaver picked his spot. He also mentioned that beaver is sometimes considered a big brother to muskrat, so that's why they can sometimes share a lodge over the winter (Andrew pers. comm. 2024; SRRB 2024).

Further information on how increasing beaver and otter predator populations can negatively affect muskrat habitat, food availability, and health are included in *Threats.*

Predators

As mentioned above, river otter prey on muskrat in the Mackenzie Delta (Gwich'in Elders 1997, 2001). One Inuvik respondent in the 2019 ABEKS survey suggested that otter hunt in packs like wolves, saying they will go into their dens to kill muskrat (ABEKS 2019).

Mink also live in the same lakes as muskrat and can enter muskrat pushups and dens (Figure 7), chase them on land and in water, and kill them (Gwich'in Elders 1997, 2001; Allen Koe Sr. [Aklavik], Gabe Andre, and others *in* Benson 2024). It is unclear whether mink kill muskrat to eat them or to keep them out of the area (Malcolm Firth [Aklavik] *in* Benson 2024). Both mink and otter have been observed to eat muskrat caught in traps (Ryan McLeod [Inuvik] *in* Benson 2024).

Small fish have been observed inside pushups, perhaps brought there by mink or otter (Gwich'in Elders 1997; Catherine Semple [Aklavik] *in* Benson 2024). Knowledge-holders have observed a lot more otter in the Mackenzie Delta now (WMAC-NS and AHTC 2003; ICC *et al.* 2006; Turner *et al.* 2018; Ellen Firth [Inuvik] *in* Benson 2024). Otter are known to disturb muskrat pushups and prey on muskrat if there are no fish available (Peter Ross [Tsiigehtchic], Rebecca Francis [Fort McPherson], and others *in* Benson 2024). Otter and muskrat abundance are negatively correlated; when you see less otter sign, you see more muskrat (Willie Blake [Fort McPherson] *in* Benson 2024).

In 2003, several Inuvialuit knowledge-holders observed an increase in otter abundance in the Mackenzie Delta; they were eating muskrat, living in their houses and clearing out all of the muskrat (WMAC-NS and AHTC 2003). The increase in otter was also noted in the 2019 Arctic Borderlands Ecological Knowledge Society (ABEKS) report by knowledge-holders in Aklavik, Inuvik, and Fort McPherson.

Foxes can dig into and disturb or damage muskrat pushups (Figure 7) (Gwich'in Elders 1997; Willie Blake [Fort McPherson], Joan Nazon [Tsiigehtchic] *in* Benson 2024).

"Just fox, he always go after them. He opens their house and wait for them. As soon as they come up, he'll grab them—I've seen that! I seen that once … that fox, he's going to get that rat. Sitting behind like that, he just jumped, [when] the rat came up, he grabbed it and ran in the bushes." (George Vittrekwa [Fort McPherson] in Benson 2024: 84)

It is harder for a fox to catch a muskrat once the pushup is already made and frozen, but muskrat are vulnerable while they build pushups (Ian McLeod [Aklavik] *in* Benson 2024). Foxes prey on muskrat when they are on land or ice (Gwich'in Elders 1997, 2001; Abe Wilson [Fort McPherson] *in* Benson 2024).

Marten are also predators of muskrat and have been seen with muskrat in their mouths (Robert Alexie Sr. and William Charlie [Fort McPherson] *in* Benson 2024). In the mid-1990s, knowledge holders suggested that increasing populations of marten may have been part of the reason for the muskrat decline (Abraham Stewart *in* Benson 2024). Wolves also prey on muskrat; they dig at their pushups which freeze – then they wait for muskrat to come out of their houses (Figure 7; Mabel English [Inuvik], Walter Vittrekwa [Fort McPherson] *in* Benson 2024).

Grizzly bears are not typical predators of muskrat, but will prey on muskrat opportunistically during the transition period between winter and spring. At this time, grizzly bears are emerging from hibernation and muskrats are actively using pushups on frozen lakes – these conditions provide grizzly bears with opportunity to prey on them (Gruben pers. comm. 2026).

Figure 7. Muskrat pushups in the southern Northwest Territories during the winter with predator tracks. Photo courtesy J. McKinnon, ECC.

Raptors are considered predators of muskrat (EBA 2003). Eagles and hawks will hunt muskrat and take them out of traps (Laura Firth, Donald McLeod [Inuvik] *in* Benson 2024; Gwich'in Elders 1997; Ryan McLeod [Inuvik] *in* Benson 2024). Inuvialuit have also reported that eagles have been seen killing muskrat and could be one reason for the decline in the muskrat population; others mentioned the increase in river otter and jackfish (northern pike) predation (ICC *et al.* 2006). Owls may also hunt muskrat (Mary Kendi [Aklavik] *in* Benson 2024).

Other species noted by Gwich'in knowledge-holders as muskrat predators include lynx, black bears, grizzly bears, and wolverine (Gwich'in Elders 1997, 2001; Alfred Semple [Aklavik], Ryan McLeod [Inuvik], and others *in* Benson 2024).

Avoiding predators

Muskrat may communicate with danger calls to stay safe (Gwich'in Elders 1997; Allen Koe Sr. [Aklavik], Tony Andre [Tsiigehtchic] *in* Benson 2024). They escape from predation by hiding, running into thick brush, and/or swimming underwater (Gwich'in Elders 1997; Bertha Francis [Fort McPherson], Andrew Koe [Fort McPherson], and others *in* Benson 2024). They are most vulnerable to predation when travelling on land or ice, especially when they are far from their pushups (Allen Koe Sr. [Aklavik], Willie Blake [Fort McPherson] *in* Benson 2024). This can be when they are dispersing to new lakes in spring (Malcolm Firth [Aklavik] *in* Benson 2024). Their mating behaviours can also put them at greater risk of predation (Willie Blake [Fort McPherson] *in* Benson 2024).

Muskrat are known to be dangerous and fight back with their sharp claws and large teeth when a predator tries to catch them; they may even hurt or kill a predator (Benson 2024). They can jump quite high to attack in retaliation (Mabel English [Inuvik], Willie Blake [Fort McPherson] *in* Benson 2024). Overall, muskrat are seen to be cautious and wary, quickly disappearing if they sense something out of the ordinary (Walter Vittrekwa [Fort McPherson] *in* Benson 2024).

PLACE

Distribution

Muskrat are found in all regions of the mainland NWT, but especially in areas with rich aquatic vegetation such as the Mackenzie and Slave River deltas (see Figure 1 and 2; GNWT 2024). Various studies, and traditional and local knowledge, have noted the presence of muskrat throughout the Slave River Delta (Pembina Institute 2016b) with the greatest concentrations on small tributaries where there is abundant vegetation (Soper 1942; Law 1950; Geddes 1981; UMA Engineers Ltd. 1985; Environmental Management Associates 1984; Pembina Institute 2016b). Historically, the Mackenzie Delta has had a very strong population of muskrat. However, some Inuvialuit knowledge-holders report seeing muskrat as far north as the coast, and they may have moved there from the Delta (ICC *et al.* 2006). Inuvialuit knowledge-holders identified good places for muskrat including Marcus River, Napuuyaq, Raymond Channel and Williams Island, among others (ICC *et al.* 2006). Muskrat live throughout the Delta and live everywhere except in the mountains (Gwich'in Elders 1997).

"The whole Delta is muskrat areas; you can't just name only one certain area because they don't stay in one area. They go all over." (Unidentified knowledge-holder [Aklavik] in ICC et al. 2006: 11-102)

Muskrat harvesting areas mapped by Inuvialuit interviewees during the assessment for the Mackenzie Gas Pipeline indicate that the distribution of muskrat is substantially further north than depicted by the current IUCN range. The map presented in the TK report for the ISR extends muskrat distribution to the north and east of Tuktoyaktuk (see Figure 67 in ICC *et al*. 2006). Another map, available in the Inuvialuit Community Conservation Plan, also extends muskrat distribution further along the northern coast to the west of the Mackenzie Delta (see Map 23 in Inuvik HTC *et al.* 2016). During Ekwǫ̀ Nàxoèhdee K'è: Boots on the Ground work, muskrat were observed at Point lake on the Coppermine River north of Wekweètì (Jacobsen pers. comm. 2025).

See *Key Habitats* section for additional information on muskrat habitat and/or harvesting areas.

Movement and Dispersal

A muskrat may live in one lake for its entire life (Gwich'in Elders 1997). However, they are known to move if lake conditions or access to forage changes, or when the seasons change (Alfred Semple [Aklavik] and George Vittrekwa [Fort McPherson] *in* Benson 2024). In the fall they move around searching for food (George Vittrekwa [Fort McPherson] *in* Benson 2024). After break-up in the spring, muskrat will move around seeking mates (George Vittrekwa [Fort McPherson] *in* Benson 2024). A muskrat may also move to another lake when the population is high or growing (Gwich'in Elders 1997; Malcolm Firth [Aklavik], George Vittrekwa [Fort McPherson] *in* Benson 2024). When an area is overpopulated with muskrat, smaller muskrat may be forced to live in rivers, as larger muskrat are often found in lakes with the best habitat (Gwich'in Elders 1997; Benson 2024). Muskrat will also move to a new lake if their lake dries up; they remember good places to live from their spring movements (Gwich'in Elders 1997).

Muskrat can be seen travelling along portages and through creeks, especially in the spring when the ice breaks up (Benson 2024). Muskrat are often seen in river channels, travelling to find mates or food (Catherine Semple [Aklavik] *in* Benson 2024). Muskrat can move long distances to find new habitat (Gwich'in Elders 1997).

Spring Movement

Muskrat move around a lot in spring for good habitat and mates (Inuvik HTC *et al.* 2016); they start to move around as soon as the ice melts and there is open water around the edges of lakes and rivers (Benson 2024). During the spring and summer, they make trails or use creeks to go from lake to lake (Gwich'in Elders 1997).

"They move all over. They go in the creeks and the rivers and they're always moving. …When they're mating, they're all over the place. They don't just stay in one lake; they go from lake to lake, down creeks and into other lakes. They're moving until they start nesting, and like I say, they go into grassy lakes then. [And] they go across land and everything. … It's not unusual to see them on dry land, going to find another body of water or… moving all over. They're all over the Delta." (Willie Blake [Fort McPherson] in Benson 2024: 64)

Once the ice is gone, lake water levels drop, and muskrat go back to their bank-houses (Gwich'in Elders 1997).

Spring movements are likely facilitated by water levels; it is thought that spring floods and high water triggers the movement of muskrat (Gwich'in Elders 1997; Catherine Semple [Aklavik], Donald McLeod [Inuvik], and others *in* Benson 2024). Young muskrat primarily disperse in the spring to find new lakes or areas of good habitat; competition may also force them to disperse (Ryan McLeod [Inuvik] *in* Benson 2024). People familiar with the Mackenzie Delta and Old Crow Flats have suggested that muskrat dispersal happens in the spring because during this time of year the males are fighting over mates and territory (Brammer 2017; Benson 2024).

"I think those are the ones that are just taking off to find their own lake." (Ryan McLeod [Inuvik] in Benson 2024: 65)

"Oh, maybe they got kicked out of their house or something. Maybe another big male moved into their territory and made them move away (Unidentified knowledge-holder." [Old Crow] in Brammer 2017: 61)

Fall Movement

Muskrats typically move from creeks to lakes in late fall, as the creeks may freeze as winter sets in (Gwich'in Elders 1997; Benson 2024). While some young muskrats disperse in the fall time, others stay in larger pushups and dens with family members (Allen Koe Sr. [Aklavik] *in* Benson 2024).

Further information on muskrat movements and habitat choices is provided in *Seasonal Habitat Requirements.*

Changes in Distribution

Harvest and trapping do not cause muskrat to leave an area. Muskrat cannot be chased out of an area, when they move to a new area, they do it on their own schedule and with their own motivations (Gabe Andre, Robert Alexie Sr. [Fort McPherson] in Benson 2024). They may also disperse to new areas when their numbers become too high (Benson 2024).

"They must know something about carrying capacity because it seems like when they get a certain number, that's when they really move out there, find their own new territory." (Ryan McLeod [Inuvik] in Benson 2024: 23)

As mentioned above, knowledge-holders in the ISR observe muskrat beyond the current documented distribution. Those areas were documented up to twenty years ago, and it is not clear whether they indicate a historical representation of muskrat distribution or a more recent change. Nonetheless, interviewees in Benson (2024) also indicated that the range of muskrat may be changing and habitat within their range is not consistently of the same quality. Beaver and muskrat were not known to be as far north as Tuktoyaktuk, but they are present in that area now; one knowledge-holder suggested this could be because it is too warm in the Mackenzie Delta now (Ellen Firth [Inuvik] *in* Benson 2024). The impacts of climate change affect muskrat habitat and may be changing where they are today (Peter Ross [Tsiigehtchic] *in* Benson 2024). More details on how climate change may be affecting muskrat and muskrat distribution are included in *Threats and Limiting Factors.*

Because very little information was found on muskrat distribution in the NWT, this topic should be considered an information gap in this report.

Key Habitats

Muskrat habitat can be quite specific or localized across their range (Benson 2024). Muskrat require habitat that support numerous lakes, streams and marshes rich in aquatic vegetation (Arnold *et al.* 2011). Muskrat use their whole range, and 'muskrat lakes' are found all over (Benson 2024). Therefore, muskrat benefit less from the conservation of small, localized sections of habitat, and more from the conservation of large areas of generally suitable habitat, such as in the Mackenzie Delta (Benson 2024). Mapping and protecting these areas is important for muskrat conservation (Benson 2024).

Wilson and Haas (2012) defined and mapped important wildlife areas for several species in the western NWT (GSA, SSA, and Dehcho Territory), including muskrat. The information is compiled from local observations, IK/CK, and scientific information. In that study, three areas were identified as Important Wildlife Areas for muskrat: Inner Mackenzie Delta, Muskrat Concentration Areas A, Muskrat Concentration Areas B (Figure 10). An additional six areas were identified as Important Wildlife Areas to multiple species including muskrat: Mackenzie Delta, Southern Gwich'in Settlement Area, Ramparts River Wetlands, the Buffalo Lake Area, Alluvial Zone South of Tathlina Lake, and Johnny Hoe River. These areas are shown in Figure 10 and described in Table 1.

Additional information from other IK/CK sources on harvesting locations, muskrat habitat and areas with an abundance of muskrat are presented below by region. Where possible, place names for these locations have been mapped in Figures 1 and 2.

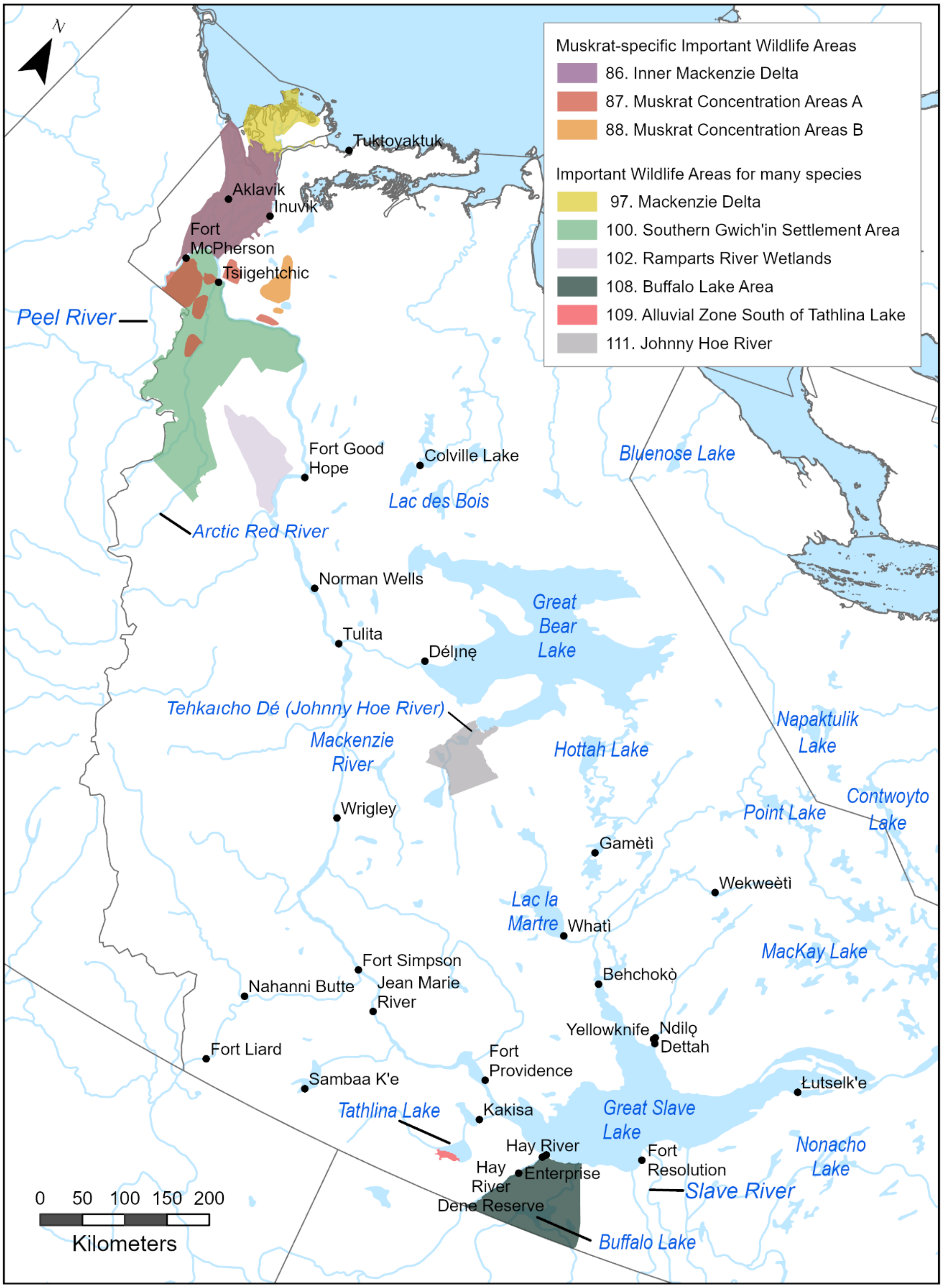


Figure 8. Important Wildlife Areas (IWAs) identified for common muskrat as well as unique areas important for many species including common muskrat in the Northwest Territories. Map produced using data from Wilson and Haas 2012. Map courtesy E. McHugh, ECC.

Table 1: Important Wildlife Areas identified for common muskrat and to many species including muskrat in the NWT (Wilson and Haas 2012).

Information in Wilson and Haas (2012) is based on discussions from 2006 and 2009 with communities, co-management boards, departmental staff, and others, as well as review of available reports. Note: unique areas considered to be important for multiple wildlife species were also mapped; any areas considered as sensitive were not included in that report. This table is a summary of Important Wildlife Habitat identified in Wilson and Haas (2012); it only seeks to provide information specifically pertaining to muskrat, overarching reasons for habitat identification/inclusion, and it only includes information regarding traditional use. Refer to Wilson and Haas 2012 for further information and sources.

ID#	Name (size)	Substantiation
Important Wildlife Areas for Muskrat in the NWT (Under Criterion #2 – a place where muskrat consistently occur in relatively large numbers)		
86	**Inner Mackenzie Delta** (10,360 km²)	• Generally, supports a high density of muskrat, but numbers have fluctuated in the past.
		• Described as excellent muskrat habitat, some of the best in the Mackenzie Valley; muskrat are very abundant and use eroded cutbanks of channels and lakes for dens/burrows.
		• Muskrat likely use entire area, wherever lakes do not freeze to the bottom. Within inner Delta, areas west of Caribou Hills and west of Campbell Hills have been highlighted as particularly good muskrat habitat.
		• Very important traditional area for trapping muskrat in spring.
87	**Muskrat Concentration Areas A** (3,431 km²)	• Five areas known by Gwich'in to have a high density of muskrat.
		• In 1997, Elders reported muskrat had not been seen up Arctic Red River since 1958, but that they were starting to come back there.
		• Residents of Tsiigehtchic report there are always lots of muskrat at Martin House.
		• Habitat modelling predicts several zones of highly suitable muskrat habitat within these five areas.
		• Portions of areas between the Peel and Arctic Red Rivers that have been identified as productive habitat for muskrat.
		• Easternmost area, along Mackenzie River, is part of a larger area that is known to be good for trapping muskrat.
88	**Muskrat Concentration Areas B** (1,330 km²)	• Two areas known to have many muskrat pushups.
		• Muskrat habitat in these areas was previously classified as poor or insignificant by Government of Canada.
		• Described as part of a larger area that is a good trapping area for muskrat by Gwich'in.

Important Wildlife Areas (IWAs): Unique areas important for many species in the NWT (Under Criterion #6 (unique area used by many different species)		
97	**Mackenzie Delta** (14,017 km²)	• Unique area containing habitat important to many different bird, fish and wildlife species including muskrat; also important area for subsistence harvesting.
		• Wildlife species that find particularly good habitat in the Delta include muskrat, beaver, moose, black bears, grizzly bears, and polar bears.
100	**Southern Gwich'in Settlement Area** (22,300 km²)	• Large and unique portion of GSA containing good habitat for many species.
		• IWA includes concentration areas for moose, beaver, muskrat, and peregrine falcon, also supports many boreal woodland caribou, marten, mink, fox, wolves, wolverine, lynx, and hares. Otters are starting to come into the area as well.
		• Lowland area between Peel and Arctic Red Rivers specifically highlighted as unique area featuring many water bodies, some of which are active with methane gas and do not freeze in winter. Important habitat for beaver, muskrat, moose, boreal woodland caribou, and fish; also supports concentrations of waterfowl in the spring and summer (Gwich'in Land Use Planning Board 2003; MRBC 1981).
102	**Ramparts River Wetlands** (4,637 km²)	• Extensive wetland along lower Ramparts and upper Ontaratue Rivers important to many different species.
		• Wetlands are known to Sahtú residents to be important for muskrat, beaver, waterfowl and moose.
		• Important harvesting area for Fort Good Hope families and particularly important for hunting moose, beaver, and muskrat.
108	**Buffalo Lake Area** (9,164 km²)	• Area around Buffalo Lake, extending from Great Slave Lake to Alberta border, supports abundant wildlife.
		• Alluvial zones to south and southeast of Buffalo Lake highlighted as particularly productive wildlife habitat; several creeks and rivers drain into lake deposit moist, rich mineral soils that support diverse plant communities and relatively vigorous forests.
		• IWA very important for traditional hunting, trapping and fishing.
		• Alluvial area south of Buffalo Lake described as most productive area for muskrat in the Hay River district.
109	**Alluvial Zone South of Tathlina Lake** (217 km²)	• Extensive alluvial zone south of Tathlina Lake; unique area important to many different species. Cameron River and other streams drain into lake from slopes of the Cameron Hills, delivering nutrient-rich sediments that support heavy riparian growth, diverse plant communities, vigorous forests and very productive habitat for several species of wildlife.
		• Important habitat for muskrat.
111	**Johnny Hoe River** (4,192 km²)	• According to Elders of Déline, area contains very productive wildlife habitat and is important to life cycles of many wildlife species.
		• Traditional knowledge indicates that area is important habitat for beaver and muskrat and is an important harvesting area for these species.

Inuvialuit Settlement Region

The Mackenzie Delta is considered ideal habitat for muskrat (Arnold *et al.* 2011). The Inner Mackenzie Delta (Site 719C as shown in Figure 9) was identified as an important area for trapping and hunting muskrat during the spring (IHTC *et al.* 2016). This area is also important habitat for fish, waterfowl, moose, and other furbearers and encompasses many historical, cultural, and archaeological sites (Inuvik HTC *et al.* 2016). Other areas that are important habitat for muskrat include the entire Mackenzie Delta, northern parts of the Yukon territory, the Tuktoyaktuk Peninsula, and Anderson River (Inuvik HTC *et al.* 2016).

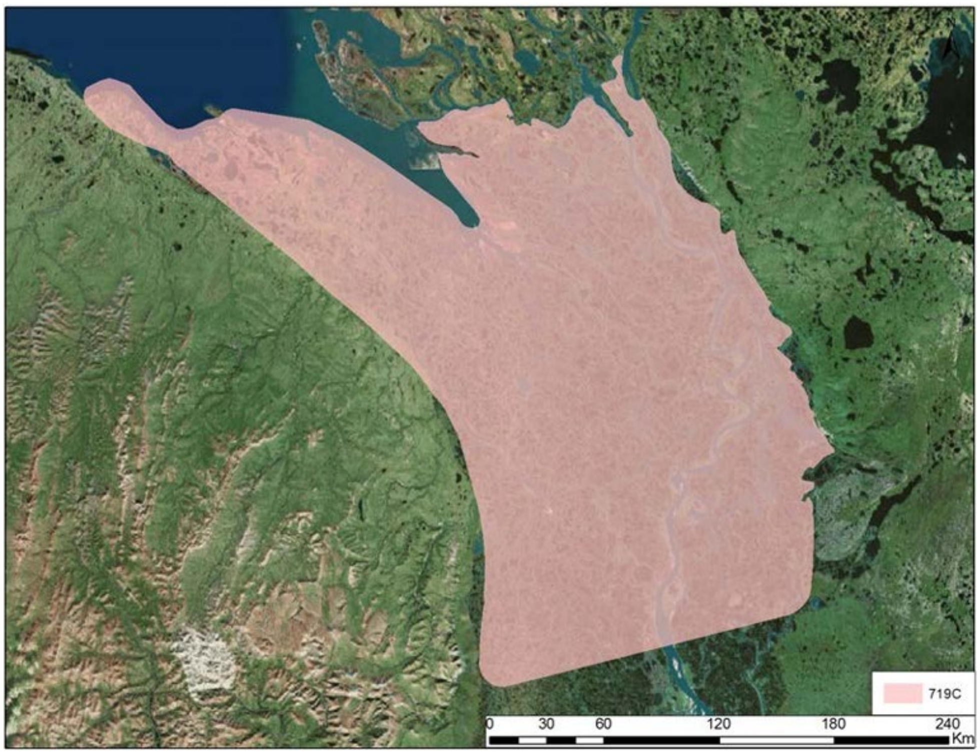


Figure 9. Map of the Inner Mackenzie Delta Wildlife Area of Special Interest, Inuvialuit Settlement Region, Northwest Territories. This region was identified as an important area for trapping and hunting muskrat (reproduced from IHTC et al. 2016).

Gwich'in Settlement Area

In the Gwich'in Settlement Area, some knowledge holders have observed that the Mackenzie Delta north of Aklavik is better for muskrat than areas south of Aklavik (Ian McLeod [Aklavik] *in* Benson 2024). Several traditional Gwich'in place names named after muskrat (dzan) were documented in the 2024 report by Benson and are shown below in Figure 10: Map of Gwich'in place names including "dzan" (muskrat). Reproduced with permission from Benson (2024).Figure 10. More detailed information about key habitat types for muskrat based on Gwich'in observations are included in *Seasonal Habitat Requirements*.

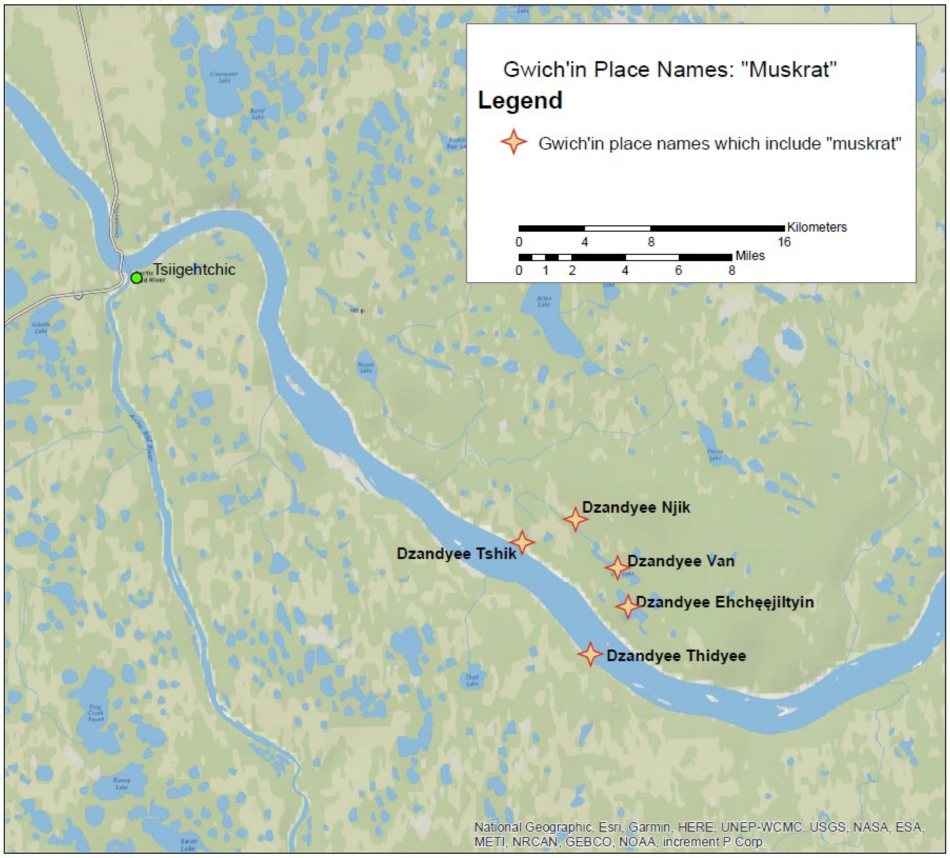


Figure 10. Map of Gwich'in place names including "dzan" (muskrat). Reproduced with permission from Benson (2024).

Sahtú Settlement Area

The Sahtú Land Use Plan (SLUPB 2013) and the management plan for Great Bear Lake and its watershed (GBLWG 2005) both describe areas where muskrat are plentiful and/or have habitat values to be respected including Conservation Zones, Special Management Zones and Heritage Zones. These areas include:

- Nilı̨n Tué (Lac Belot),
- Neyádalín (Underground River),
- Neregah (Northshore),
- Edaííla (Caribou Point),
- Luchaniline (Whitefish River),
- Tehkaıcho Dé (Johnny Hoe River),
- Datzımı Tué (Oscar Lake),
- K'ąąlǫ Tué (Willow Lake and Wetlands), and
  Ts'ude niline Tu'eyeta, (Ramparts River and Wetlands) – Indigenous Protected Area and Territorial Protected Area (GBLWG 2005; SLUPB 2013; GNWT 2026)

In addition, a Deline Land Corporation (DLC) and Deline Renewable Resources Council (DRRC) traditional knowledge study for the Łuchánılı̨ne & Tuetah Area documented 14 places that are special beaver and muskrat habitat, including:

- Bek'etets'enıə Tʉ́é – Lake Where People Drowned,
- Kárebə Tʉ́é – Swimming Out Lake,
- Tehlǫnəǫ Tʉ́é – At The End Of It Lake,
- Deneɫéréghǫ Tʉ́é – Dene War Lake,
- Bek'eı̨ɫı̨tʉ́é – River Flows Into It Lake,
- Nébe Tʉ́é – Swim To It Lake,
- Dagóéjétʉ́é,
- Karkegıe River,
- Tɫıtǫrılı Łuenekǫnewǫ,
- K'átʉ́é,
- ŁuenınaʔoTʉ́é,
- Luechanıh – Whitefish River Conservation area,
- Kw'atarato – Broken Plate Creek, and
- Nogha ʔe' Tue (DLC and DRRC 2006).

There was one place name recorded by the project – Tehk'áıcho Deh (Giant Muskrat River) which is likely a story location (DLC and DRRC 2006). ʔehdacho was also noted as good muskrat habitat in the assessment done for the Sahoyʉ́é-ʔehdacho candidate protected area (Sahoyʉ́é-ʔehdacho Working Group 2006).

In the 2004 State of Knowledge report for Great Bear Lake (SRRB 2004), the following areas were noted for muskrat:

- Norman Range (Ecoregion #55: extending from Fort Good Hope to Willowlake River, south of Great Bear Lake)
- Keller Lake Plan (Ecoregion #59: encompasses Johnny Hoe River and Taché and Grandin Lakes south of Great Bear Lake), and
- Coppermine River Upland (Ecoregion #68: extending from McTavish Arm of Great Bear Lake to Howard Lake).

In 2000, the Sahtú Heritage Places and Sites Joint Working Group identified important sites that are travelled and used for hunting and trapping (Andrews *et al.* 2000). Sites important for muskrat including the Ramparts River and wetlands including the sacred site ʔıdıtué Dáý̨dá (The Thunderbird Place – located on a sharp bend in the Ramparts River), and a spring beaver and muskrat hunting location called Turılı̨ (Johnny Hoe Fishery; Andrews *et al.* 2000).

Dehcho

Within the Dehcho region, the Kakisa River is abundant in wildlife including muskrats, as well as aquatic and emergent vegetation (EBA 2003). The Kakisa River was identified as an International Biological Programme Ecological Site (IBP Site 25) due to the importance of this site to nesting waterfowl and abundant wildlife (EBA 2003).

The Buffalo Lake area, where the Yates and Whitesand Rivers enter, is identified as being good muskrat habitat by members of the Dehcho First Nation and based on intensive surveys of muskrat pushups (DFN and RWED 2002; Haas 2014). The 2010 study noted 435 muskrat pushups observed in a study area of approximately 320 km^2 (Haas 2014). Community input at a regional wildlife workshop held in 2002 stated concerns over muskrat populations in the Buffalo Lake area, these concerns were echoed during the Phase I Ecological Assessment for the Buffalo Lake, River and Trails Candidate Area report in 2014 (DFN and RWED 2002; Haas 2014). Information regarding a relevant candidate protected area encompassing Buffalo Lake is included in Positive Influences.

Another area important for muskrat is Vale Island; it is described as a large island at the mouth of the K'átł'odeh, and is home to migratory birds, muskrat, squirrels, large spruce trees, and is rich with berries (KFN 2006). In the spring, KFN members go there to set traps for muskrat and hunt migratory birds (KFN 2006).

Members of the Pehdzéh Ki̜ First Nation mentioned the following areas as good for trapping muskrat in the spring and/or excellent muskrat habitat: Pe Fa̜h Feɔǫ Tí, Nohpée K'éo, Tsá Tio Tah, Gotah Tia, Etsııa Tı (Beaver Lakes), Blackwater Lake River, Tǫʔáh Ge Mi̜h Tio, Slim Tıo (Slim Lake), McGern Island, Ts'i Danaghoh Tı, Gotah Tıa, Ehtsua Tı, and Gǫh Shíha Lah Tio (PKFN 2005).

"On the island in the lakes there, there is a whole bunch of lakes around there. Around the pump station area, all the area that Tehk'áa Tí and around there. Around that area is very good hunting area for moose and caribou like that. Not only for big animals but there is beaver ponds all over the place. That's a good area to go moose hunting, beaver hunting, muskrats, ducks, any animals hang back in the lakes." (Fred Williams [PKFN] in PKFN 2005: 59)

"Along the west side of Dehcho, Épi̜h Shíh Tia, Endaa Deha (Olson Creek) and Tǫʔáh Ge Mi̜h Tío are a few of the lakes and rivers harvesters travel to during the spring for harvesting beavers and muskrats. Across the river from here, Endaa Deha, there are four beaver dams close to the mouth of the Mackenzie.... Also Épi̜h Shíh Tia, there is lots of muskrats on the lake. The muskrats on the lake are bigger than usual." (George Tale [PKFN] in PKFN 2005: 60)

Tłı̜chǫ/Wek'èezhìı

Within the Wek'èezhìı boundary the Marian River and Hislop Lake areas are considered good habitat for muskrat and/or muskrat harvesting (Olson *et al.* 2012). The Dinàgà Wek'èhodì area (formerly Kwets'ootł'àà) is also important for muskrat; they are found throughout the area, which is located along the northeast and southwest boundaries adjacent to Tłı̨chǫ lands (CWS 2011; Dinàgà Wek'èhodì Candidate Protected Area Working Group 2016). Marten Lake has also been mentioned as a place with numerous muskrat lodges throughout the region that is widely hunted during spring (Jacobsen 2011; Tłı̨chǫ Government 2013).

Some areas near K'ıchıì (Whitebeach Point) and K'àgòò tı̨lıì Deè (the study area for the Tłı̨chǫ Highway) were also noted as good for muskrat and several sites were mapped for beaver and muskrat in both of those studies (2015a, b). The river Tsotìdeè and its many small lakes are described as being of central importance for Tłı̨chǫ land use activities such as fishing and hunting for ducks, moose, muskrat, and beaver (TRTI 2015b).

Traditional knowledge studies conducted by the Tłı̨chǫ Research and Training Institute (TRTI) identify several lakes named for muskrat including: Dzǫtì, Dzǫtìtso/ Dzǫtìcho, and Dzǫtìtsoa; Tawoòmı̨h'è (TRTI 2014). These areas were noted as good areas to hunt both beaver and muskrat (TRTI 2014). Other areas good for muskrat include: the entire length of the river Tsotìdeè from Whatì to ʔı̨hdak'ètì (Marian Lake), the area from Bòts'ıtì to Nàı̨lı̨ı̨t'ì, ʔehtł'ètìtsoa, ʔehtł'ètìdaà, ʔehtł'ètìtso, Tsigaàtì and Tsigaàtìdeè – the entire water system is well known as beaver and muskrat habitat and harvesters trap along these shores every year. From ʔehtł'ètì trappers follow numerous small lakes and the river ʔehtł'ètìdeè towards Tsigaàtì.

"We usually follow the streams and rivers. There are muskrat pushups in all of them. This is ʔehtł'ètı ̀ (James Lake), there are lots of muskrat there. Many rivers flow into it. We traveled all over here hunting muskrat. It's a big lake." (Robert Mackenzie [Behchokǫ̀] in TRTI 2015b: 32)

Numerous lakes and ponds around Kayeti (K'àyedeè) and Łıetì (the region between Whatì and Fort Providence) have also been noted as preferable trapping locations (TRTI 2015b).

"We just took our time hunting beaver and muskrat then in the evening we dried the skins. We would shoot twenty or thirty muskrat and skin them. There were hardly any groceries so we would prepare and smoke all the fat beaver and muskrat meat to eat and to take along on our trips. When we shot beaver we would pack lots of fat beaver meat, beaver tails. So it was good to get all that meat but then we did not travel fast." (Robert Mackenzie [Behchokǫ̀] in TRTI 2015b: 33)

Akaitcho Territory

Łutsël K'e Dene (Denesǫłıne)

In a traditional ecological knowledge study done by the West Kitikmeot Slave Study Society (WKSSS) for the Kaché Tué area, muskrat is listed as a species in the Katthınëne area, in habitat described as wetland / 'treeline marsh' (WKSSS 2001). No further information was found in IK/CK sources for muskrat in Łutsël K'e Dene (Denesǫłıne) areas.

Yellowknives Dene

In her work with Yellowknives Dene regarding the landscape around the Giant Mine, Amanda Degray noted the importance of Duck Lake as a site for muskrat trapping (2020). Participants in that study also reported trapping muskrat around Wįìlįìcheh (Yellowknife Bay), however, due to the limited geographic scope of the research, it is not clear if these locations would be considered key habitats for muskrat; the author noted that due to mining activities and the settlement of non-Indigenous people in present-day Yellowknife, many former trapping and land use areas were no longer accessible to Yellowknives Dene (Degray 2020).

North Slave Métis

Some areas that are good muskrat habitat and/or good for harvesting muskrat were documented as part of environmental assessments done by the North Slave Métis Alliance in 2009, 2011, 2012 and 2013 (INAC 2009; CWS 2011; NSMA 2012). Large areas are good for beaver and muskrat around Whatì, Gamètì, Marian Lake, and the North Arm of Great Slave Lake (including Dinàgà Wek'èhodì) (INAC 2009; NSMA 2012). In addition, the area between Behchokǫ̀, Whatì, and Gamètì is used in the winter and is generally good for trapping (NSMA 2012).

Overall, North Slave Métis trap 'opportunistically' in most bays and up rivers, but people more regularly use Beaulieu River, Blachford Lake, and Blanchet Island than some other areas (NSMA 2013b).

"Of course, all the areas mentioned as good for harvesting would also be good habitat for the species harvested. In addition some special habitat areas were highlighted. Lac La Martre, Marian Lake, the North Arm, and Rae Lakes were mentioned as good habitat for beaver and muskrat." (NSMA 2012: 16)

Vuntut Gwitchin First Nation

The importance of grassy lakes and available feed as especially good muskrat habitat was also stressed by Vuntut Gwitchin First Nation knowledge-holders from Old Crow, Yukon.

"Well food, very important is food.... [Muskrats] go portage, search around, well that's what my grandfather said to me. And then when they find lots food, that's where most of the rats go to. That's why you see some lakes with less rat house on it, and some lakes with a lot of rat house. Food.

Some lakes you get a moss, bottom that's not very good to a lake. For a rat. You gotta have to have food, muskrat [food], the muskrat root. Rat root.

They go to their own place so they know what lakes are good. Which means good food, deeper water...

It's, they got good vegetation there, that's why there's so much muskrat around there." (Unidentified knowledge-holders [Old Crow] in Brammer 2017: 70)

Similar to Gwich'in observations in the NWT, local experts in Old Crow reported the importance of lake depth and its connection to productivity:

"It's good so the deep lakes are the ones that's holding the muskrat I'm pretty sure. They got more food and better growth I think.

Lots of water is good for them, in the fall when they're cut off. They don't have to make too deep a tunnel if it's high water. And right now water is low so they have to dig that tunnel probably deeper.

In the fall, you know those dry [lakes] where there's lot of grass and shallow water, there's lots of muskrat in the fall. Then damn muskrat they head to big deep lake in the winter, they know it [will freeze to the bottom]... you see that slough back there, there's no rat house in it

Since I was grown up a lot of people were talking about deep lakes were the best lakes to go trapping." (Unidentified knowledge-holders [Old Crow] in Brammer 2017: 71)

Peace, Athabasca, and Slave River Basins

Few information sources were found regarding important habitat for muskrat in this area. One source mentioned two formerly important areas – Stan's Prairie and Ring Lake – but those areas are now described as drying out and/or inaccessible (Pembina Institute 2016a). Muskrat distribution was otherwise described as throughout the Slave River Delta, with the greatest concentrations on small Delta tributaries with abundant vegetation (see sources *in* Pembina Institute 2016b).

Habitat Requirements

As mentioned earlier, the muskrat population tends to be more concentrated in lakes with lots of vegetation (Ryan McLeod [Inuvik] *in* Benson 2024).

"You know there's some lakes that, in the past, people they know where's going to be lots [of muskrats]. Because it's a grassy lake. Called grassy lake; that's where all the muskrats are. And they know, people that have rat camps in the Delta, they know which lake is going to be good. They know. Because it's always that way." (Abraham Stewart [Fort McPherson] in Benson 2024: 79)

Large lakes with grassy shores tend to have more muskrat pushups and dens than lakes with cutbanks (Brammer 2017; Walter Vittrekwa [Fort McPherson] *in* Benson 2024). In general, good lakes provide food, shelter and safety; they need to have aquatic and terrestrial vegetation and be the right depth – lakes that are too shallow can freeze to the bottom, and if a lake is too deep, muskrat cannot access their food (Donald McLeod [Inuvik], Peter Ross [Tsiigehtchic] *in* Benson 2024).

"If it's lots and lots of muskrat, they would use those little lakes I guess. But they prefer the big lake. If it's not too many." (Unidentified knowledge-holder [Old Crow] in Brammer 2017: 72)

Lakes that are good for fish are usually too deep to be good for muskrat (Gwich'in Elders 1997; Abe Wilson [Fort McPherson], Robert Alexie Sr. [Fort McPherson] *in* Benson 2024). If a lake is deep, muskrat houses are only found at the shallow ends (Gwich'in Elders 1997).

Lakes that are good muskrat habitat require good inflow and outflow (Benson 2024; Parks Canada 2024). If water is not entering a lake, muskrat will run out of food quickly (Gwich'in Elders 1997). Annual spring floods also create appropriate conditions for the plants that muskrat need by freshening the water (George Vittrekwa [Fort McPherson] *in* Benson 2024) and lakes tend to be better for muskrat the year following a good high flood (Abraham Stewart [Fort McPherson] *in* Benson 2024). Similar results were found in collaborative research in the Peace-Athabasca Delta (PAD), where flooding and lake depth were identified by both locals and biologists alike as important factors in providing adequate water and vegetation that muskrat rely on (Straka *et al.* 2018).

"The presence of water following spring ice-jam floods is the main driver of muskrat abundance in the PAD [Peace-Athabasca Delta]. However, trappers note that responses of muskrat abundance to water levels or ice-jam flooding is likely mediated by responses of vegetation to flooding, frequency of flooding, hydrology of basins (e.g., connectivity to other basins, flow, and depth), disease, water quality, and abundance of predators...

The mechanism by which flooding affects abundance of muskrat is more complex than an increase in depth of water at the time of fall freeze-up. Elders and trappers provided several potential explanations for why muskrat might prefer habitat with an 'ideal' range of water depths and may not use basins if water is too deep or too shallow. Basins that are too deep tend to have less vegetation available for muskrat food, while basins that are too shallow freeze completely to the bottom, which makes it difficult for muskrat to feed in the winter. IK holders further noted that muskrat respond to diminishing water levels by retracting ranges to secondary habitat on banks of rivers or channels, persisting as 'bank rats.' These 'bank rats' can then rapidly disperse and multiply during flood events, moving back to preferred habitat in shallow basins (Messier and Virgl, 1992). Factors such as dispersal of muskrat and connectivity of basins are likely important in determining the density of muskrat houses in a particular basin." (Straka et al. 2018: 224)

Inuvialuit trappers have reported that lakes with a large variation in water levels, due to spring floods and summer water level drops, are not very good for muskrat (ICC *et al.* 2006). These fluctuating water level conditions make it difficult for muskrat to survive because a certain level of water is required to sustain consistent vegetation for muskrat to feed on (ICC *et al.* 2006). This problem is made worse when lakes break open into a river and then drain; several interviewees state that this is happening more and more due to climate change and erosion (ICC *et al.* 2006). More on the impacts of climate change on muskrat habitat is included in *Threats.* Further information on other changes affecting muskrat habitat is included in *Habitat Trends and Fragmentation*.

Seasonal Habitat Requirements

Even though muskrat move several times in the year, travelling from lake to lake, they mostly search for and stay in the grassy lakes mentioned above (Andrew Koe [Fort McPherson] *in* Benson 2024). In a study with Vuntut Gwitchin First Nation knowledge-holders, trappers frequently discussed the relationship between depth and productivity of muskrat lakes; their knowledge suggested there could be seasonal shifts in optimal depths, that is, muskrat select shallow lakes for summer use before dispersing to deeper lakes for overwintering (Brammer 2017).

"[T]his little slough back here, because the water will be in there first [in spring], it's shallow and lots of grass, muskrat will go to there from other places ... And then the fall time, it work absolutely the other way. In the fall…muskrat they head to big deep lake in the winter, they know it… because if they stay in [the slough]… a lot of that will freeze straight to the bottom. That rat, you know it, he take long range weather forecast." (Unidentified knowledge-holder [Old Crow] in Brammer 2017: 81)

In addition, both local knowledge and scientific monitoring indicate that there is a combined importance of depth and open water, meaning that evaporation could significantly influence lake suitability for muskrat over the summer months, as lake water levels can vary substantially (Brammer 2017).

"[Before it] finished melting ... and the water is level with the [beaver] dam and it stays that way all summer. Now all summer the water evaporates and pretty soon you are down." (Unidentified knowledge-holder [Old Crow] in Brammer 2017: 83)

Spring and Summer

"If I could take that Pokiak [across the channel from Aklavik] for an example, there is lakes on both sides of it all around, and there will be rats gathering up there all during break up, before the ice goes. And then, as soon as the ice goes, ... the water drops, [and] there will be little white grass growing on the shore and that is what they are after. Then they portage back, and they come back, some of them…make a hole in the riverbank, and they stay there all summer. But after June you don't see them hardly, because they got young ones, and they are tending their young ones, so you don't see very many of them around. Around July, then you'll see the little ones start swimming around." (Allen Koe Sr. [Aklavik] in Benson 2024: 66-67)

Muskrat dig holes to make dens under the banks of lakes where they have their young in spring/early summer (Gwich'in Elders 1997; Abe Wilson [Fort McPherson], Joan Nazon [Tsiigehtchic], and others *in* Benson 2024). Muskrat dens are often in the same areas where cranberries and soft moss grow (Gwich'in Elders 1997).

"Seem like it always be around where is cranberry, where you pick cranberry, soft moss and everything." (Mabel English [Inuvik] in Benson 2024: 86)

Muskrat can also make a nest on grassy spots on lakes or on stumps and logs to have their young – this is possibly in areas where there are no suitable banks for a den (Bertha Francis [Fort McPherson], Allen Koe Sr. [Aklavik], and others *in* Benson 2024). During times of high-water, muskrat cannot live in their dens and instead stay back from shore in the willows and logs for nesting (Gwich'in Elders 1997; Ellen Firth and Marilyn Maring [Inuvik] *in* Benson 2024). They are also seen piling grass and/or mud on stumps and sitting there to eat it, sometimes two or three muskrat at a time (Ian McLeod [Aklavik], Mary Kendi [Aklavik] *in* Benson 2024).

Fall and Winter

Although muskrat live in and/or make use of channels or creeks in the spring and summer, they typically return to lakes in the fall to build pushups and overwinter (Allen Koe Sr. [Aklavik], Bertha Francis [Fort McPherson] *in* Benson 2024).

"Sometimes there is so many rats they use the creeks too, but the creek freeze right to the ground, so they quit doing that and they go back to the lakes." (Mary Kendi [Aklavik] in Benson 2024: 64)

Lakes are also preferred over creeks or rivers as overwintering habitat because water levels are more consistent; fluctuating water levels cause ice to drop which has the potential to damage or destroy pushups (Brietzke 2015).

Before lakes freeze, muskrat are seen diving for their food (Abraham Stewart [Fort McPherson] *in* Benson 2024). They prepare for winter by bringing grass inside their pushups for both food and insulation (Gwich'in Elders 1997). In the fall, it is possible to see hundreds of pushups on a frozen lake (Gwich'in Elders 1997).

Muskrat also excavate dens and tunnels in the banks of the lakes, which provides safety from predation (Alfred Semple [Aklavik] *in* Benson 2024). Muskrat are seen to build houses in deeper water of lakes and the outer Slave River Delta in the fall (Pembina Institute 2016b).

Habitat Trends and Fragmentation

In many areas of the NWT, knowledge holders and community members are observing changes to the aquatic habitat of muskrat. These changes are complex and are often tied to climate change; they are observed as changes in water flow, precipitation, and water levels as well as changes to the seasonal timing of events related to these indicators (GNWT 2022). Table 3 includes a summary of information found in IK/CK sources by region; the impacts of climate change on muskrat habitat are considered further in *Threats and Limiting Factors*.

Table 2: Documented knowledge of observed changes to muskrat habitat.

Observation	Impact	Sources Cited
Mackenzie Delta		
Lakes and creeks are drying out	• Lake/creek beds are draining and being covered with willows and grasses • Tree stumps can be seen in dried out areas; trees ran out of water and died • Trapping/hunting muskrat in these areas is not as good as it used to be • Seasonal pools or ponds are now dry	• Unidentified knowledge-holder [Inuvialuit, Aklavik] in ICC *et al*. 2006: 11-100 • Unidentified knowledge-holder [Inuvialuit] in ICC et al. 2006: 11-98 • Abraham Stewart [Fort McPherson] in Benson 2024: 115-116
Ice jams and floods are happening less often	• Floods help vegetation; without floods there is less food for muskrat and their population goes down • Ice jams used to cause flooding; but now it pushes through and melts to nothing	• Ryan McLeod [Inuvik], Peter Kay [Fort McPherson], and others *in* Benson 2024 • Abraham Stewart [Fort McPherson] in Benson 2024: 115-116
Beaver activity has increased	• Beaver displaces muskrat • Beaver changes the way ice freezes and may cause more overflow • Overflow floods muskrat pushups	• Rachel Villebrun [Fort McPherson] *in* Benson 2024
Snowfall has changed	• Snowfall changes the way ice freezes and may cause more overflow • Overflow floods muskrat pushups	• Rachel Villebrun [Fort McPherson] *in* Benson 2024
Permafrost is changing	• Permafrost used to be just below the moss; but now it is much deeper • Thawing permafrost causes stream banks to erode and landslides	• Billy Cardinal [Tsiigehtchic] in Mustonen and Tsiigehtchic Elders 2004: 172
Spring melt is different	• Melting snow used to pool on top of ice; now when the snow melts it just disappears (evaporates) • There is less melt water	• Dale Clark and Billy Cardinal [Tsiigehtchic] *in* Mustonen and Tsiigehtchic Elders 2004
Spring break up is happening earlier	• People used to drive dogs on the lake in June; that is not possible anymore • *Breakup is different. …A long time ago it used to be cold!*	• Billy Cardinal [Tsiigehtchic] *in* Mustonen and Tsiigehtchic Elders 2004 • Abraham Stewart [Fort McPherson] in Benson 2024: 115-116
Ice conditions are changing	• There is less ice in rivers and lakes than there was 20 years ago • The ice is not as thick	• Dale Clark, Noel Andre, and Billy Cardinal [Tsiigehtchic] *in* Mustonen and Tsiigehtchic Elders 2004 • Abraham Stewart [Fort McPherson] in Benson 2024: 115-116

Observation	Impact	Sources Cited
Sahtú Settlement Area		
Water levels are changing	• Changing water levels causes declines in muskrat abundance	• SRRB 2024
Tłı̨chǫ/Wek'èezhìı		
Spring melt is rapid	• unknown impact to muskrat	• Chief Daniels [Tłı̨chǫ] in Olson et al. 2012: 41
Weather is warmer and drier	• unknown impact to muskrat	• Jacobsen 2011
Wind patterns have changed	• Stronger winds blow the snow off of muskrat pushups which makes them vulnerable to predation	• Jacobsen 2011 • Pembina Institute 2016a
Old Crow, Yukon		
More frequent thaw slumps, lakes draining, overflows of water on ice, increasing shrub growth and shifting timing and patterns of ice formation	• Increased concern among knowledge-holders – unknown impact to muskrat	• Brammer 2017 • Unidentified knowledge-holders [Old Crow] in Brammer 2017: 84
Earlier spring thawing	• The melt is quicker; May is warmer and sometimes the snow is gone by the end of May • Potentially advantageous for muskrat	• Unidentified knowledge-holders [Vuntut Gwitchin First Nation] in Brammer 2017: 68 • Unidentified knowledge-holder [Old Crow] in Brammer 2017: 72
Peace, Athabasca, and Slave River Basins		
Ice jams and floods are happening less often	• Seasonal spring flooding in the Peace-Athabasca Delta caused by natural ice jams on rivers during break-up is beneficial to the muskrat as it replenishes the wetlands where they build their houses • Ice jams and floods are now happening less often due to climate change and upstream flow regulation by hydro dams • Some wetlands in the Peace-Athabasca Delta have dried up or are in the process of drying up; this has reduced the amount of wetland habitat available for muskrat	• Mikisew Cree First Nation 2014 • Straka *et al.* 2018 • Parks Canada 2024
Widespread drying of the Slave River Delta	• Drying destroys muskrat habitat; in one area named 'Big Rat Slough', the water has declined so low that there are no longer any muskrat there	• Pembina Institute 2016a

Observation	Impact	Sources Cited
The Peace River has experienced a reduced incidence and intensity of flow reversals	• Before regulation, the Peace River contributed some reverse flow to the delta lakes each year during the open-water period. After regulation, more than half the years did not experience any reversal and those that did were characterized by much smaller events. • The reduced reverse flows have led to reduced flooding of the perched basins.	• Mikisew Cree First Nation 2014
Concerns about pollutants in the water associated with activities related to oil sands development	• Release of pollutants to the Athabasca River and watershed.	• Mikisew Cree First Nation 2014; Kelly *et al.* 2009

Dropping water levels in the Mackenzie Delta have been noted by many residents as a potential reason behind declines in local muskrat populations (ICC *et al.* 2006; Turner *et al.* 2018; Benson 2024). Changes in water levels and patterns may drain or dry up lakes, making them unsuitable for muskrat (Turner *et al.* 2018). The high spring floods typical of the Delta are also not happening like they used to (Mustonen and Tsiigehtchic Elders 2004; Neil Snowshoe and Abe Wilson [Fort McPherson], and others *in* Benson 2024). Some of these changes are also occurring in other parts of the NWT and Yukon.

"You go to the Delta now, lots of lakes dried out, there's creeks there, they just dry right out! Break right through. I know we cut trail down through the Delta a number of years ago… But we came upon lots of lakes, but no water. Just willows growing in them. Those used to be good trapping lakes. And I know that because Neil Snowshoe, he's an old trapper, he told me. He said 'all them lakes used to be really good trapping lakes for muskrat.' And…little George—George Vittrekwa—told me the same thing! So I know that there's lots of lakes in the Delta that went dry. Johnny Charlie's got big country, and you go through there you see big stumps all over. They ran out of water, it ran out. And…for maybe a few years…we never had flood you know? A flood, I mean the whole Delta, never flood. [The] water was low. So, old-timers said that if we don't get freshwater in the lake, then the muskrat wouldn't live very long. …That's why when it always floods, the next year you have really good growth in the lake, good vegetation. That's what they say, they know it, these old people. And we never had water for long time." (Abraham Stewart [Fort McPherson] in Benson 2024: 115-116)

"These observations have been echoed in the Old Crow area. [S]he said the water is dropping, and then I heard that there's a lot of water been losing from lakes and muskrats not coming out like normal… One day I came across a tree, with these lines on it and I marked that water level, next 2 years I came back and it got much lower.

[T]hat lake in 2 years it was… just dry, we could just go cross in skidoo, just grass! Now it's just dried right out, and now what's going on there?

So then we, that last time about two, three years ago we went there [to the lake]…. Water drop and water drop, and that two big island in front of there never used to be right there.

And then these last two lakes to river, they both dried out. They were big lakes too. They were really good for rat, [now] they [are] both dried out." (Unidentified knowledge-holders [Old Crow] in Brammer 2017: 84)

Some Sahtú Dene and Métis women in a recent harvesting workshop said that changing water levels around Fort Good Hope may have cause a decline in muskrat abundance (SRRB 2024), and climate change research conducted amongst Tłı̨chǫ Elders documented observations that starting in the 1960s-1970s the weather began to get warmer and drier, and changes to wind patterns and snow and ice conditions were impacting hunting patterns (Jacobsen 2011). Increased beaver activity and changes to snowfall could be creating overflow on lakes, this causes pushups to flood, which forces muskrat to move elsewhere (Rachel Villebrun [Fort McPherson] *in* Benson 2024). Billy Cardinal noted a clear connection between the impacts of the melting permafrost and eroding stream banks and landslides, stating that the Delta habitat is changing faster because the permafrost is melting (Billy Cardinal [Tsiigehtchic] *in* Mustonen and Tsiigehtchic Elders 2004).

There are observations regarding changes in seasonal thawing and freezing patterns, as well as the timing of freeze-up and break-up (Billy Cardinal [Tsiigehtchic] *in* Mustonen and Tsiigehtchic Elders 2004). Changes in seasonal patterns that could be impacting muskrat are also noted by Tłı̨chǫ knowledge-holders.

"I noticed just due to the climate… things are changing. Most of these lakes are connected to streams. And that means -- I've noticed anyways that the melt has been thawing -- it's getting -- do you say rapid -- this year -- a little more. It's not like before. Before natural thaw or this year -- last year -- it seemed a little faster…" (Chief Daniels [Tłı̨chǫ] in Olson et al. 2012: 41)

"In the olden days, you know, it used to thaw and freeze at night slowly but now it stays cold for long and all of a sudden snow does melt night and day… we used to go out to trap line and wait till morning that freeze, ah that crust, traveling on frozen snow, ah you get around. You never see that no more now." (Dale Clark [Tsiigehtchic] in Mustonen and Tsiigehtchic Elders 2004: 172)

According to Elders from Tsiigehtchic, when snow started melting in the spring in the past, there would be a lot of water on top of the ice; today the snow just melts and disappears, so there is much less melt water around and a notable change in ice conditions in the GSA (Dale Clark and Billy Cardinal [Tsiigehtchic] *in* Mustonen and Tsiigehtchic Elders 2004).

"It melts and it evaporates, they don't leave no water on the lake, nothing. The lake is just like this clear and no big drifts of snow and after it melt, you don't see it around, nothing. And we used to see all that water melt that used to run into the rat houses, the rat holes (muskrat). Water in it,

you don't see that anymore." (Billy Cardinal [Tsiigehtchic] in Mustonen and Tsiigehtchic Elders 2004: 172)

Gwich'in participants in a collaborative monitoring initiative most commonly noted the following environmental changes that could impact muskrat: erosion and sedimentation, melting permafrost, changes in vegetation (e.g., increased willow growth), weather and temperature changes, as well as lake drainage (Gill *et al.* 2014). Changing lake conditions can also change the availability of muskrat feed and cause the muskrat populations to decline (Ryan McLeod [Inuvik], Peter Kay [Fort McPherson], and others *in* Benson 2024).

More details are provided in *Threats and Limiting Factors.*

These types of drainage events and the slumping that drives them are increasingly being witnessed by Van Tat Gwich'in in the Old Crow Flats area as well as people in the Peace-Athabasca Delta (Brammer 2017; Parks Canada 2024). Van Tat Gwich'in have reported seeing more frequent thaw slumps, lakes draining, overflows of water on ice, increasing shrub growth and shifting timing and patterns of ice formation (see sources *in* Brammer 2017). In a 2017 study of muskrat population dynamics in Old Crow Flats, researchers found that local knowledge identified advancing ice phenology as a concerning source of environmental change; the concerning climate change observations from the Vuntut Gwitchin First Nation related to thaw dates and open water seasons (Brammer 2017).

"It's a lot quicker melt. Even May is a lot warmer. Snow is gone by the end of May.

The past we used to trap pretty right near to the end of May... on ice. And now it's not really safe anymore. It get rotten quick.

Like the 2010 spring, I went up on May 25th and got up there on May 26 morning, picked up Billy and Joseph I was planning to walk on the ice and shoot some muskrat and here it was clear water. I've never seen that in my life." (Unidentified knowledge-holders [Vuntut Gwitchin First Nation] in Brammer 2017: 68)

Some local experts in Old Crow pointed out that early thawing lakes can be advantageous for muskrat:

"[S]ome lake I think open up early. That's my understanding. When you talk to people, Timber Hill is same. Water come in from mountain early, some lakes get water quick. So they go up there and they get a lot of muskrat. Up here it's like that too... get about four, five hundred rat one night there." (Unidentified knowledge-holder [Old Crow] in Brammer 2017: 72)

Muskrat can be an indicator of ecosystem health because their numbers respond strongly to natural flooding and drying processes in a delta. In northern Alberta, the Peace-Athabasca Delta is a flood-dependent ecosystem and seasonal spring flooding caused by natural ice jams on rivers during break-up is beneficial to the muskrat as it replenishes the wetlands where they build their houses (Mikisew Cree First Nation 2014; Parks Canada 2024). There is broad agreement that spring ice-jam floods are of great ecological importance to the delta ecosystem overall, acting via spilling over banks of major channels, creating flow in channels that are typically dry or disconnected from the main river system, replenishing basins, and temporarily reversing the direction of flow (Straka *et al.* 2018). One environmental concern is that these types of ice jams and floods are now happening less often due to climate change and upstream flow regulation by hydro dams (Parks Canada 2024). As a result, some of the wetlands in the Peace-Athabasca Delta have dried up or are in the process of drying up; this has reduced the amount of wetland habitat available for muskrat (Parks Canada 2024). Indigenous knowledge-holders and scientists alike have observed a general drying trend in the Peace-Athabasca Delta in recent decades (Straka *et al.* 2018).

In the Slave River Delta people have also observed that widespread drying of the delta has destroyed the habitat of some species such as muskrat; in one area named 'Big Rat Slough', the water has declined so much that there are no longer any muskrat there (Pembina Institute 2016a). There are also observations from local residents that water released from the Bennett Dam can create winter flooding that ices over muskrat riverbank homes, preventing them from getting out and causing drowning (Candler *et al.* 2013; see sources *in* Pembina Institute 2016b).

It is unclear whether wildfires affect muskrat, but some Gwich'in knowledge-holders suggested that both the fire itself as well as the smoke could cause muskrat to flee their lakes or hide in their dens (George Vittrekwa [Fort McPherson], Joan Nazon [Tsiigehtchic], and others *in* Benson 2024). On the other hand, fires can renew the landscape, adding nutrients to water systems and promoting new vegetative growth (Donald McLeod [Inuvik], Walter Vittrekwa [Fort McPherson] *in* Benson 2024). Some Elders have also observed that muskrat will not leave their lakes during a forest fire as their food comes from the lake bottom (Gwich'in Elders 1997). Longer wildfire seasons and larger and more numerous fires are predicted to occur in the NWT in the future (GNWT 2022).

POPULATION

Abundance, Population Dynamics, and Changes in Population Size

For most regions of the NWT there was little to no information available on muskrat abundance in the IK/CK sources reviewed for this report. Trends are unclear should be considered an information gap for the Sahtú, Tłı̨chǫ/Wek'èezhìı, Akaitcho Territory, Dehcho Region, and North Slave Métis areas of the NWT. Most of the available information pertained to the Inuvialuit and Gwich'in areas of the Mackenzie Delta.

Pre- to Early 2000s

Amongst most residents of the Mackenzie Delta, there is broad agreement that there used to be a much higher numbers of muskrat in the past (Gwich'in Elders 1997; Mustonen and Tsiigehtchic Elders 2004; Turner *et al.* 2018; Benson 2024).

"I used to listen to my mom; she told me there used to be lots of rats. There was, long ago, some lakes that [had] hundreds. Hundreds of rat houses on them, and big lakes...there used to be so much rat houses on those big lakes, they used to trap them, maybe two, three days, then you set your traps again in another two or three days, and another two or three days...just to get all those rat houses, there was so much on it." (Walter Vittrekwa [Fort McPherson] in Benson 2024: 96)

Many Delta residents state that a large decline in muskrat populations took place in recent decades and there are fewer muskrat today than there were in the 1960s and 1980s (Turner *et al.* 2018).

"I came in this Delta around 1938 and if I remember rightly, there was many many muskrat in this Delta, and in my experience, probably within seven years, you might have two lean years, but there was still muskrat; five years are more than abundant time of the muskrat population within the Mackenzie Delta.

The last time I seen a large population of muskrat in the Mackenzie Delta was the year 1968, and since then I have never seen any population growth, yet that same year, probably in the early part of 1969, seismic crews came in and started working in the Delta, and ever since that time there's never been a population growth whatsoever. I have never seen any more population growth of muskrat since that time." (Sam Arey [Aklavik] in Berger 1975: 122)

People reported that 1918 was a good year for muskrat hunting in the Delta, but that a flood in 1936 killed many (Gwich'in Elders 1997). Changes in muskrat population levels since the 1930s are detailed in Benson 2024. Overall, Gwich'in knowledge indicates that the population was low or crashed in the 1930s; some harvesters felt that the population stayed lower in the 1940s while others suggested muskrat were more plentiful around that time (Mustonen and Tsiigehtchic Elders 2004; Tony Andre [Tsiigehtchic], Alfred Semple [Aklavik] *in* Benson 2024). Van Tat Gwich'in from Old Crow talked about a similar time period of no muskrat in Van Tat [Crow Flats]

(VGFN and Smith 2019). In the 1950s the population was reportedly low or declining, some said they disappeared or moved to another place and didn't start to recover until the 1990s (John Kendo [Tsiigehtchic] *in* Benson 2024). There are mixed reports regarding the muskrat population level from the 1960s to 1990s in the GSA, with some knowledge-holders saying it was low and others saying high (see sources in Benson 2024). One interviewee reported that the muskrat population was affected by disease in the 1980s, saying that the population crashed after that and has not been as high since (Allen Koe Sr. [Aklavik] *in* Benson 2024).

While there are some Gwich'in reports of the muskrat population being high or recovering in the 1990s, there seem to be more observations of muskrat abundance suddenly crashing in the early 1990s (Benson 2024). In 1997 Gwich'in Elders reported that muskrat numbers had decreased considerably after seismic work in the Delta and that numbers had continued to remain low since that time.

"[For 12 years] right until 1992...there was a lot of muskrats. Lots. Because every chance I had, I would go out with somebody and they'd kill muskrat. Kill lots. But then [it] was...terrible, 1994-95 it start. It just—nothing. All of the sudden. Just, no more! That just surprised everybody. Surprised me, because all of the sudden it [was] just [like]—where they went?! And people stopped going [out]. Like every spring, in March, people would go down to their trapping area, for muskrat. And they would stay there until June 15th. That's when the ratting season quits. Like as far as like 1995 [or] about that time. That's when it really [changed], just no muskrat. The whole Delta, there's nothing!" (Abraham Stewart in 2015 [Fort McPherson] in Benson 2024: 99)

"Somewhere before 1990 and 1993, somewhere in there I think, it really went down. There was hardly any muskrats and it's just in the last year, I think, that the rat houses really started coming out on the lakes again." (Bertha Francis in 1995 [Fort McPherson] in Benson 2024: 99)

Some Inuvialuit interviewees from Inuvik reflected this observation that the muskrat population had dropped drastically by about 2000-2005 (ICC *et al.* 2006).

Some knowledge-holders pointed out that the declines in muskrat have not been consistent throughout the Mackenzie Delta but localized.

"Many interview participants asserted that water levels and spring flooding strongly influence muskrat populations, but responses also indicated that changes in muskrat populations have not occurred consistently in all areas of the delta. However, numerous interviewees stressed that recent declines in muskrat numbers have been more extensive and ongoing than declines witnessed in the past." (Brietzke 2015: 529)

Interview results attest to the fact that the rate of decline in muskrat population density has not been spatially uniform, with observations that muskrat largely disappeared from the upper Delta around 2008-2013, but that despite a decline in that area, numbers were "not too bad" north of Aklavik (Eddy McLeod [Aklavik] *in* Turner *et al.* 2018: 5). During a 2024 harvesting workshop, women said that muskrat abundance varies based on where you are (SRRB 2024).

Slow recovery since early 2000s

From around 1995 to roughly 2005-2010, the muskrat population was still described as very low in the GSA, but numbers were starting to recover (Abraham Stewart and Fred Koe [Fort McPherson] *in* Benson 2024). As noted above for the ISR, it might be that muskrat abundances differed locally during that time (Benson 2024). From 2010 to 2015 there are observations that muskrat numbers were slowly increasing, but there was again regional variation reported (Arctic Borderlands Ecological Knowledge Co-op 2015; Fred Koe and Abraham Stewart [Fort McPherson], and others *in* Benson 2024). In its 2019 summary, the Arctic Borderlands Ecological Knowledge Society (ABEKS) reported that Indigenous knowledge-holders in Aklavik said the muskrat population was down compared to the preceding year; declines in abundance were also noted by participants from Fort McPherson, Inuvik, and Tsiigehtchic (ABEKS 2019).

One Inuvialuit study participant reported that there were many muskrat in the Mackenzie Delta at that time, due to the fact that there was a lot less trapping (WMAC-NS and AHTC 2003). Another observed that while there had been none two years prior, muskrat population numbers started to increase in 2002 and by 2003 they were seeing lots of muskrat houses (WMAC-NS and AHTC 2003). However, numbers were likely still relatively low, as results of the assessment done for the proposed Mackenzie gas pipeline around that time indicated then that many harvesters in the community of Tuktoyaktuk were not hunting muskrat; one Elder stated that he had stopped getting muskrat as they are "finished" now, meaning their population is very low compared to what it used to be (ICC *et al.* 2006: 11-96). He said that the muskrat came from the Mackenzie Delta and relocated in some lakes, and that they should be left alone so they can multiply (ICC *et al.* 2006).

In 2016, an Inuvialuit study participant stated that muskrat used to be a lot more plentiful in the past, but they are starting to return (Vazquez 2019).

"The Delta on this side used to be… just full with muskrats. Now there is nothing… But now, they are starting to come back." (Unidentified knowledge-holder [Inuvialuit] in Vazquez 2019: 23)

The recently updated Inuvik Community Conservation Plan noted that muskrat numbers appeared to be on the rise in 2016 and that numbers were considered adequate at that time (Inuvik Hunters and Trapper Committee *et al.* 2016). Muskrat were also reported to be increasing in abundance in the 2016 Aklavik Community Conservation Plan (Aklavik HTC *et al.* 2016). In the Tuktoyaktuk plan however, the population status of muskrat was reported to have declined and to still be in decline in 2016, prompting suggestions to manage for an increase (Tuktoyaktuk Hunters and Trapper Committee *et al.* 2016).

It was noted by Elders that muskrat were once plentiful throughout the Buffalo Lake, River and Trails are but that the population has been decreasing (Green Consulting 2008 *in* Haas 2014).

The latest comments on muskrat population trends were documented in 2023 and suggest that the animals are generally becoming more abundant, as people have been seeing a lot of animals and a lot of pushups (Ellen Firth [Inuvik], Ian McLeod [Aklavik], and others *in* Benson 2024). This increase in muskrat numbers in the Mackenzie Delta has been observed since 2020 (Benson 2024).

Cycles in abundance

Muskrat are known to cycle like some other animals and the cycle is said to be somewhat predictable, happening every five to seven years on average, but perhaps as short as three years or as long as 12 (ICC *et al.* 2006; Inuvik HTC *et al.* 2016; Neil Snowshoe and Abe Wilson [Fort McPherson], and others *in* Benson 2024). Recent research conducted with Van Tat Gwich'in knowledge-holders identified local patterns in muskrat cycles of abundance that ranged from 1.5 to 11 years (Brammer 2017).

"Around 1926, after that… for seven year there were no muskrat. Then seven years later there were muskrat again [Seven year cycle]…. That's what the people lived off" (Charlie Thomas, 2001, in VGFN and Smith, 2019)

"Well, the only changes to them is that they're disappearing for the last few years, they're gone. They say it's the life cycle, again I keep bringing that life cycle up, after seven years they disappear and they come back." (Abe Wilson in 1995 [Fort McPherson] in Benson 2024: 99)

Others suggested it is less of a cycle and more of an irregular but predictable waxing and waning (Robert Alexie Sr. [Fort McPherson] *in* Benson 2024). The ups and downs in muskrat populations may relate to population fluctuations or to muskrat moving to different areas (Gwich'in Elders 1997; Abe Wilson and George Vittrekwa [Fort McPherson], and others *in* Benson 2024).

"…I think it all depends on the feed. You know, sometimes up this way [there] is no rats and, while that, down that way [there] is lots of it… It moves… Because sometimes down that way towards the coast, it's good, and sometimes it's no good there, and its good up that way [up the Delta]. Sometimes it's better around McPherson too, and sometimes it's no good around McPherson…" (Allen Koe Sr. [Aklavik] in Benson 2024: 102)

"Just like lots of rat houses right now around here. But maybe [in] two, three years' time there will be no more rats. Be hard to get rats here and there…[Because] they eat to the ground, right to the ground and that's it." (Tony Andre [Tsiigehtchic] in Benson 2024: 102)

Numerous Gwich'in knowledge-holders have suggested that feed availability impacts muskrat population levels, and that overpopulation and associated heavy feeding can lead to a crash in numbers (Malcolm Firth [Aklavik], Ellen Firth [Inuvik], and others *in* Benson 2024). Again, this can be a localized impact, with muskrat suddenly disappearing or moving to a better place, and abundances differing between different areas (Joan Nazon [Tsiigehtchic], Donald McLeod [Inuvik] *in* Benson 2024). Muskrat are also observed to come back quickly after a population crash, describing their recovery as a 'boom' in some areas (Mabel English [Inuvik] *in* Benson 2024). It tends to be the preferred, grassy lakes that muskrat return to first, then they spread out (Walter Vittrekwa [Fort McPherson] *in* Benson 2024). Some have noted that their natural cycle seems to have been disrupted however, and they are now taking longer to return (Neil Snowshoe and Rosalie Ross [Fort McPherson] *in* Benson 2024).

It is important to point out that because the land and people have changed (due to climate change and forced assimilation), some Gwich'in knowledge-holders say they are having a harder time understanding and predicting things like natural cycles and trends (Benson 2024). Because people spend their time on the land differently than in the past, their observations may not be comparable, and their activities affect the animals differently (Benson 2024).

During a 2024 workshop, Gwich'in participants felt that muskrat are not currently endangered in the Gwich'in Settlement Area and there was no real fear that they would become extinct or endangered (Benson 2024). There was a lot of discussion about whether muskrat fit the Species at Risk criteria for "Threatened" status and a lack of agreement; similarly, participants did not reach consensus as to whether muskrat in the Delta fit the category of "Special Concern" (Benson 2024).

"There was agreement that muskrat had declined dramatically and were only recently coming back, and that they are affected by climate change and other threats in important ways. Some felt the research and monitoring which would happen if the animal were listed as a species of special concern would be suitable." (Benson 2024: 121)

Causes for declines

While many knowledge-holders spoke about muskrat populations cycling between low and high abundances over time, many mentioned that they do not remember population levels staying so low for so long before (ICC *et al.* 2006; Turner *et al.* 2018). There are suggestions that these declines are outside the normal range of variation for muskrat in the Mackenzie Delta (Brietzke 2015; Turner *et al.* 2019; Benson 2024).

"Participants discussed many potential causes of this population decline, including changes to climate, habitat and hydrology, interactions with other wildlife, and shifts in harvesting pressure. The complexity of interactions among these factors makes it difficult for harvesters, researchers, and managers to assess which changes may be contributing most to the observed decline in muskrat abundance." (Turner et al. 2018: 8)

In 2015, the Dzan-Kivgaluk Muskrat Monitoring Project in the Mackenzie Delta was initiated by Dr. Jeremy Brammer, with the Vuntut Gwitchin Government in Old Crow in response to concerns expressed by harvesters in the Mackenzie Delta that muskrat populations had declined and beaver populations had increased (Brammer 2021). Some of the potential causes of the decline noted include:

- Changes in predator populations (e.g., fox, mink, otter) and predation rates on muskrat
- Changes in competitor (e.g., beaver) populations reducing habitat quality for muskrat
- Heavy metal (e.g., cadmium, lead) contamination reducing muskrat health
- Increased parasite loads reducing muskrat health
- Natural fluctuations of muskrat populations
- Changes in temperature and precipitation patterns reducing habitat quality
- Changes in water flow patterns reducing habitat quality
- Changes in shoreline characteristics reducing habitat quality
- Changes in watershed characteristics reducing habitat quality, and
- Changes in harvesting patterns allowing muskrat and predator populations to increase more rapidly (Brammer 2021: 1).

While researchers found little evidence of a decline in muskrat populations of the Old Crow Flats area, it was determined that ice phenology could influence muskrat population densities, and both break-up and freeze-up dates have been changing with warming temperatures in that area (Brammer 2017); more information on how changing hydrological patterns and seasonal timings could affect muskrat are included in *Habitat Trends.*

Participants in a 2012 workshop in Fort Smith stated that it was not clear whether muskrat populations are stable, declining or increasing in the Slave River and Delta area (Pembina Institute 2016a). Nonetheless, an overall decline in muskrat abundance in that area had previously been reported by local Indigenous communities, starting in the late 1970s to early 1980s. Many harvesters said it was increasingly difficult to find muskrat in the Delta since 2005 (see sources *in* Pembina Institute 2016b). The main cause of the decline was linked to an overall decline in water levels and low levels of flooding due to flow regulation (Pembina Institute 2016b).

Documented Indigenous Knowledge observations of changes in wetland cover and riparian forests in the Great Slave sub-basin are limited, however, some Indigenous communities have noted changes in wetland-dependent animal populations, such as increased variability in beaver populations and a continued decline in muskrat abundance (MRBB 2024).

"Muskrat are like the bank for us. If you look back at fur prices you used to be able to go out and trap enough rats in one winter to get yourself a new boat and a motor by spring. Then you could fish for the summer to feed your family and your dog team. You could still do that today, if there were enough rats! In the old days we didn't worry about muskrat because we always knew they were there if we needed them. It was like money in the bank. We're only interested in muskrat now because they're suddenly gone, and it's just one indicator of the bigger picture of what's going on, and what's happening to our water." (Ron Campbell [Mikisew Cree First Nation] in Straka et al. 2018: 220)

Researchers working with Indigenous knowledge-holders in the Peace-Athabasca Delta of Northern Alberta documented a dramatic decline in the relative abundance of muskrat from approximately 1935 to 2014 (Straka *et al.* 2018). The main explanation for the decline was a reduction in suitable habitat resulting from many years of reduced ice-jam flooding on the Peace River (Straka *et al.* 2018). Similar to information recorded in the ISR and GSA, this research found that ice jams can cause flooding of basins within a delta that would otherwise receive no recharge from floodwaters (Straka *et al.* 2018). Collaborative monitoring with Indigenous land users and scientists documented a 10 to 100-fold increase in the density of muskrat pushups in the two years following ice-jam flood events (Straka *et al.* 2018). Conversely, in periods between major floods, pushup density was found to decrease by close to 80% for every year after a significant flood (Straka *et al.* 2018).

Interestingly, it was also discovered that the density of muskrat houses had a non-linear relationship with water depth at the time of fall freeze-up; the highest densities of muskrat houses were in basins with about 60 – 250 cm of water at the time of freeze-up (Straka *et al.* 2018).

"Density of muskrat houses is clearly tied to ice-jam flooding in the PAD [Peace-Athabasca Delta]. However, the local mechanisms by which floods affect muskrat are best understood by Indigenous land users and remain poorly understood by Western science. Indigenous peoples continue to regard muskrat as an indicator of ecological and cultural health of the PAD. This study highlights the value of consistent ecological monitoring that includes Indigenous knowledge." (Straka et al. 2018: 218)

In a 2019 report documenting changes in the Mackenzie Delta based on Inuvialuit knowledge, among the many observed environmental changes was an increase in the beaver population that correlated with the decline in muskrat abundance (Vazquez 2019). As noted in *Relationships within and among Species* as well as *Threats*, many knowledge-holders have indicated that the presence of increased beaver and otter populations can have negative impacts on muskrat and their habitat.

Health

Local trappers in the Mackenzie Delta indicate that muskrat were healthier when more trapping was taking place (Inuvik HTC *et al.* 2016).

Muskrat body condition and overall health fluctuates annually and varies depending on the season. Information from knowledge-holders and harvesters provides insight into the health of muskrat. Healthy muskrat have good fur coats and look plump with a lot of fat (Ryan McLeod [Inuvik] *in* Benson 2024). In this context, the term 'fat' refers to both the general health of the animal, and the actual presence of fat (Benson 2024).

Habitat conditions the previous summer influence the overall health of muskrat (Ryan McLeod [Inuvik] *in* Benson 2024). When habitat conditions are good, healthy muskrat are observed with a lot of 'white' fat in the spring (Neil Snowshoe [Fort McPherson] and Donald McLeod [Inuvik] *in* Benson 2024).

Poor conditions may result in frozen pushups, and in some cases, dead muskrat can be found in pushups or dens (Andrew Koe [Fort McPherson] *in* Benson 2024; Julia Edwards and Malcolm Firth [Aklavik], and others *in* Benson 2024). Young and/or small muskrat are more susceptible to death over winter; however, it is not clear if this is due to lack of food or other factors (Ian McLeod [Aklavik] *in* Benson 2024). Food shortages and periods of starvation can be lethal, especially for younger animals; lack of access to good food is thought to be the main cause of starvation for muskrat with poor health or for smaller muskrat (Mary Kendi [Aklavik] *in* Benson 2024). Lack of food can be due to the conditions of the lakes or as a result of too many muskrat in an area (George Vittrekwa [Fort McPherson] *in* Benson 2024). Muskrat may eat their own kind during periods of starvation (Mabel English [Inuvik] *in* Benson 2024).

Muskrat are in good shape and taste best early in the trapping season when they are living under the ice (Mary Kendi [Aklavik], Rachel Villebrun [Fort McPherson], and others *in* Benson 2024). When the weather starts to warm, they become less desirable for consumption because they are in poorer shape due to mating behaviours (Marilyn Maring and Ellen Firth [Inuvik] and Rosalie Ross [Fort McPherson] *in* Benson 2024). During the mating season, muskrat fight for mates, and this can cause substantial injuries (ICC *et al.* 2006; Benson 2024).

When muskrat are harvested for consumption their body fat and livers are checked to determine if the animal is healthy (ICC *et al.* 2006; Willie Blake and George Vittrekwa [Fort McPherson] *in* Benson 2024). Unhealthy muskrat may have white spots on their livers and generally, people will not eat muskrat with livers that do not look normal (ICC *et al.* 2006; Alfred Semple [Aklavik] *in* Benson 2024).

"Muskrats are in real poor shape, funny liver, sickly. I never trapped them for two years. Two years I never eat muskrat." (Unidentified knowledge-holder [Aklavik] in ICC et al. 2006: 11-100)

Knowledge-holders note that muskrat livers go bad and turn white or get spots on them when there are too many animals and/or food becomes scarce (Gwich'in Elders 1997; WMAC-NS and AHTC 2003). In 2016, people in Aklavik reported that there were more muskrat with poor body and pelt condition/colour as well as more spots on their livers than in the past (Aklavik HTC *et al.* 2016).

In the Slave River Delta area, muskrat were described as generally being in good physical conditions with few signs of parasites or disease in the 1970s (see sources *in* Pembina Institute 2016b).

Rescue Effects

While muskrat lakes are found in many areas, certain lakes are known to be especially important and/or productive, supporting consistently high populations of muskrat; if protected, these lakes could help populate nearby lakes of lesser quality (Benson 2024). When people were trapping and hunting muskrat very heavily in the Delta, taking as many as 60-90 muskrat from a single lake, some found that if they returned to that same lake several days later, there would be just as many muskrat as before. This suggests that muskrat from smaller, nearby lakes quickly move into lakes with good habitat that have fewer or no muskrat (Gwich'in Elders 1997).

Gwich'in interviewees talked about what might happen to the local ecosystem if muskrat were no longer present or were extirpated from an area. Based on participants' input, the author of the study concluded that it might be easy for the muskrat to return, or it might be hard, depending on how the lake changes in their absence (Benson 2024). In some cases, it is likely that muskrat could re-populate the area after some time had passed, as the lakes would not change to such a degree without muskrat that muskrat couldn't make use of the lakes later (Benson 2024). Interviewees noted that muskrat populations do decrease, and some lakes are without muskrat for years, then when the population rebounds, the muskrat are able to make use of these lakes again (Ellen Firth and Marilyn Maring [Inuvik] *in* Benson 2024). Others point out that since muskrat can move so easily between lakes, they could likely move into an area that has experienced extirpation (Ian McLeod [Aklavik] *in* Benson 2024). It was felt that other animals do not make use of the habitat in the same way as muskrat, so it would be unlikely that an absence of muskrat would allow another animal to flourish and make things hard for the muskrat to return (Willie Blake [Fort McPherson] *in* Benson 2024).

Nonetheless, one Gwich'in knowledge-holder pointed out that if muskrat were no longer present in a lake, he could envision how their absence might change the lake conditions substantially.

"…if vegetation just kept growing and growing, every time spring freshet comes through with all the silt, it would just get shallower, shallower. Sooner or later, it may eventually dry the lake right up or make it so low that fish can't be in there anymore for the winter. Everything's so connected. I mean, you take one piece, it's going to change everything eventually." (Ryan McLeod [Inuvik] in Benson 2024: 116)

An Inuvialuit knowledge-holder also reflected on the importance of a muskrat population to a healthy environment and ecosystem.

"And you know, after they left, that is when our water really started dying. Really…and it had some kind of whitish stuff floating. That's happened." (Unidentified knowledge-holder [Inuvialuit] in Vazquez 2019: 23)

THREATS AND LIMITING FACTORS

Climate Change

Indigenous knowledge-holders are reporting changes in the climate that are resulting in aquatic systems draining or drying up (see *Habitat Trends and Fragmentation)*. In the Mackenzie Delta, beavers are also having a negative impact on muskrat habitat; it is not clear whether this is an indirect effect of a changing climate or not.

Some Gwich'in knowledge-holders feel that declines in muskrat numbers seen in the 1990s and 2000s are due to changes in the land caused by climate change (Rosalie Ross [Fort McPherson] *in* Benson 2024). There is growing concern among members of the Vuntut Gwitchin First Nation in Old Crow regarding the effects of global warming on their traditional territory and access to country foods; of particular concern is the impact of climate change on muskrat as they are the focus of the Vuntut spring trapping season (see sources *in* Brammer 2017).

Conversely, one Gwich'in knowledge-holder pointed out that because the muskrat population has recently rebounded, climate change must not be the biggest factor in their population trends (Willie Blake [Fort McPherson] *in* Benson 2024).

Muskrats are known to prefer colder temperatures (Andrew Koe [Fort McPherson]); therefore, a warming climate may push muskrat further north (Ryan McLeod [Inuvik] *in* Benson 2024). Other impacts of climate change noted by Arctic Borderlands Ecological Knowledge Society (ABEKS) participants in the 2019 survey that could impact muskrat include: excessive erosion, landslides and slumps, lower water levels, excessive willow growth, and dried-up ponds (ABEKS 2019). In a collaborative monitoring initiative in the GSA, the most common environmental observations associated with climate change were erosion and thawing permafrost, often seen as large sections of earth caving in or rows of trees falling into lakes and streams (Gill *et al.* 2014). People also noted shrubification or the increase in willow growth, weather changes (e.g., heavy rainfall events), sedimentation in major waterways, warmer temperatures, and lake drainage (Gill *et al.* 2014).

Participants in a workshop regarding the Slave River and Delta also noted how stronger winds have been observed to blow the snow off muskrat pushups, thereby making them more vulnerable to predators (Pembina Institute 2016a). Muskrat are also susceptible to freezing conditions when they travel along the ice and move around in late winter/early spring (Malcolm Firth and Alfred Semple [Aklavik] *in* Benson 2024). Some may freeze their tails or even freeze to death (Benson 2024). Muskrat may lose a limb or part of their tail during trapping, but this is not always fatal, as if they are healthy and vigorous enough, they can sometimes heal even after losing a limb (Gwich'in Elders 1997; Willie Blake [Fort McPherson] *in* Benson 2024).

Reduction in harvest and traditional population controls

As noted in *Relationship with People*, despite muskrat being culturally important throughout their range, there has been a shift and muskrat are not being harvested as often. Hunting and trapping activities can remove unhealthy and/or less vigorous muskrat from the population, allowing healthier animals to make the population more vigorous overall (Willie Blake [Fort McPherson] *in* Benson 2024). Inuvialuit knowledge-holders have also suggested that if people trapped more, there would be more muskrat (WMAC-NS and AHTC 2003; ICC *et al.* 2006; Aklavik HTC *et al.* 2016; Inuvik HTC *et al.* 2016).

"When people were trapping for muskrats, there would always be more the next year. If they aren't trapped, they overpopulate, eat all their foods, and they starve." (Unidentified knowledge-holder [Inuvik] in ICC et al. 2006: 11-99). Muskrat can have large litters and can breed more than once a year, therefore hunting and trapping is not thought to affect their population in a negative way (Julia Edwards [Aklavik] *in* Benson 2024). A contrasting opinion was documented from an Inuvialuit Elder however, who felt that muskrat populations are sensitive to over-trapping, and said "they finish fast", meaning their numbers do decline in response to high harvest levels (Unidentified knowledge-holder [Inuvialuit] *in* ICC *et al.* 2006: 11-97).

Many Gwich'in knowledge-holders have talked about how muskrat populations can be negatively affected when people stop hunting and trapping (Willie Blake [Fort McPherson], Peter Ross [Tsiigehtchic], and others *in* Benson 2024). These traditional activities, especially when done properly allowing muskrat time to have young, can prevent a population boom that could result in disease and starvation (Benson 2024).

"…Long ago, people used to work with them, you know, all spring. They tried to get their population down …kill most of them off…They'd trap them and hunt them. They know they have to; if they don't do it there's going to be too many [muskrats], and then [they may] have the young ones again, then a food shortage—it'll go short and a lot of them die off, like that, because too many at once. So we usually try to kill as much as we could. [Then the] next year, the same thing again—they really come back again. …We never kill it [all off]. … you [take a] break twice, in the summer, from June 15th right back to October. I see them little ones, like, the young ones. All winter they grow up." (George Vittrekwa [Fort McPherson] in Benson 2024: 106)

"Well, my grandpa always says when he was younger, he said there was way more muskrats—like 10 times, 20 times more than there is now. I mean, other Elders too have mentioned it, that muskrats really respond to the hunting pressure. So, you know, back then everybody was hunting them and trapping them and trying to get every last one they could. But every year they'd go back to the same lake and there'd be just as many if not more muskrats than the year before… So when the fur prices dropped out in the…seventies or eighties, everybody stopped hunting and trapping as much as they used to. So a lot of old timers kind of blame that on the decline of muskrats…I know it kind of goes against the regular way of thinking, but especially with muskrats, and wolves

are another one; it's the more you hunt them, the more there's going to be. Kind of strange, but it's actually true." (Ryan McLeod [Inuvik] in Benson 2024: 107)

The negative impacts of reduced harvesting on muskrat abundance were also documented in Turner *et al.* 2018 amongst Inuvialuit and Gwich'in residents of the Mackenzie Delta.

"For a while everybody just quit trapping and there was muskrats everywhere… nobody was trapping and then, after that was no muskrat. So […] maybe they got sick or cleaned the food out." (Eddy McLeod [Aklavik] in Turner et al. 2018: 5)

Harvesters say there seem to be more muskrat with poor pelt/coat condition and colour and 'abnormal lives' with the decline in trapping (Inuvik HTC *et al.* 2016). In contrast, non-Indigenous trappers from other areas may have caused declines in the early part of the 20th century due to not using the same conservation practices as traditional Gwich'in trappers (Mary Kendi [Aklavik] *in* Benson 2024).

Mackenzie Delta harvesters explained that muskrat harvesting decreased due to economic considerations as well as reduced abundances; fur prices declined in the 1980s, costs associated with trapping increased, and many trappers have changed to wage employment to make a living now (Turner *et al.* 2018).

"[a]nd now, it's… a bit harder I guess to make a living doing stuff like that. So a lot of people have taken jobs in town and it's just not as common to see families going out anymore […] People still make time to go out, but […] not for the whole muskrat season right from March till June." (Unidentified knowledge-holder [Inuvik] in Turner et al. 2018)

Many Mackenzie Delta residents have expressed anger, resentment, and sadness at the low muskrat populations and lamented the conditions that made it challenging or prohibitive to trap (Turner *et al.* 2018).

With fewer people on the land, there is a disconnect between those who have knowledge about muskrat harvesting and muskrat habitat and those who make decisions about them (Annie Buckle [Aklavik] *in* Benson 2024). This was also noted by participants in a study in the Mackenzie Delta, who expressed concerns that knowledge development and transfer are being affected by people spending less time on the land (Turner *et al.* 2018).

"At a public meeting in Inuvik, a community member described how people in the past knew about animals and the environment because they spent long periods of time on the land, watching and learning. He lamented how this is changing as people spend more time in communities working wage jobs." (Turner et al. 2018: 6)

"The loss of this time spent on the land together may also affect the transfer of cultural values, including work ethic, respect for the land and other beings, feelings of pride and responsibility for trapping areas, and a willingness and desire to contribute to one's community." (Turner et al. 2018: 8)

Negative Interactions between Muskrat and Other Animals

As noted in *Relationships with Other Species*, an over abundance of beaver in the Mackenzie Delta causes negative changes to muskrat habitat (Peter Ross [Tsiigehtchic] *in* Benson 2024). Delta trappers consistently expressed concerns about increasing beaver populations, noting that beaver can affect habitat conditions and food availability for muskrat, as well as transmit disease or parasites (Turner *et al.* 2018). There is a strong theme from Inuvialuit and Gwich'in residents of the Mackenzie Delta that increasing populations of both beaver and otter are seen as a negative change for muskrat (Aklavik HTC *et al.* 2016; Inuvik HTC *et al.* 2016; Tuktoyaktuk Hunters and Trapper Committee *et al.* 2016; Turner *et al.* 2018; Benson 2024). Otter were described as "extremely efficient predators" of muskrat and were thought to be influencing muskrat populations through predation (Turner *et al.* 2018: 5). Decreasing populations of mink and otter in the early 2020s likely exerted a positive influence on muskrat populations (Ian McLeod [Aklavik] *in* Benson 2024).

A 2016 study involving Inuvialuit fishers also found reports of an increasing population of beaver and related concerns about water quality and travel/access issues due to beaver dams (Vazquez 2019). In addition, many study participants highlighted the rapid drying out of multiple popular fishing sites that resulted from beaver dams (Vazquez 2019). Reducing beaver numbers in areas that are important to muskrat is suggested as a conservation measure in the Aklavik Community Conservation Plan (Aklavik HTC *et al.* 2016).

Increasing predator populations that are thought to be a threat to muskrat mentioned by Gwich'in knowledge-holders in Benson (2024) include marten, otter, mink, and jackfish (Northern pike).

Brammer (2021) identified 10 potential causes of muskrat decline in the Delta that included: changes in predator populations (fox, mink, otter) and their predation rates on muskrats; changes in competitor (beaver) populations reducing habitat quality for muskrats; and changes in harvesting patterns allowing muskrat and predator populations to increase more rapidly. Knowledge holders have described how otters are extremely efficient predators of muskrat that are likely to influence muskrat populations through predation (Turner *et al.* 2018). Participants in that study also said that the population of beaver was expanding, and there are too many in the Delta.

Habitat Change / Disturbance Caused by Human Activities

During the assessment for the Mackenzie Gas Pipeline, Inuvialuit knowledge-holders expressed concerns about the proposed development potentially having a negative impact on muskrat and their habitat (ICC *et al.* 2006). These concerns were intensified by observations of low muskrat populations; apprehensions about development further impacting muskrat populations (ICC *et* *al.* 2006). At that time, harvesters that still depended on muskrat as their only means of income felt that muskrat are so economically important that they should be protected (ICC *et al.* 2006).

Participants in the 2005-2006 study in the ISR also talked about how blasting and seismic work can impact muskrat.

"Underground impacts: when they do blasting, especially close to the river or close to the lakes, animals that burrow [muskrats, mink, etc.] may be affected...

Our muskrats, whaling, fishing and caribou hunting [are] important to protect.... I see a few lakes damaged by seismic work ... it caused a lake to open and dry out ... animals disappear when there is no water." (Unidentified knowledge-holders [Aklavik Inuvialuit] in ICC et al. 2006: 11-105)

Muskrat sensitivity to the underground vibrations or high-intensity pressure waves from air guns used in seismic work and exploration can disrupt or kill muskrat even when it is hundreds of meters away (Berger 1975; Gwich'in Elders 1997; Byers *et al.* 2019). ().

"When I was a kid I used to walk on the lake and on the river along the shore and you can see little fishes swimming under the ice, and if you bang the ice, they will roll over, and the same with the muskrat in the lake. If you are following up on a muskrat in a lake and you bang the ice, they roll over dead." (Frank Elanik [Aklavik] in Byers et al. 2019: 45)

Ice crossings made to support winter seismic work done in the Mackenzie Delta and lower Peel River watershed can also destroy or block creeks due to broken willows (ICC *et al.* 2006). Gwich'in knowledge-holders described how seismic work done in the mid-1990s may have affected muskrat populations through impacts and damage to lakes and creeks (Robert Alexie Sr. [Fort McPherson] *in* Benson 2024).

Water pollution can also affect muskrat (Fred Koe and Walter Vittrekwa [Fort McPherson], and others *in* Benson 2024). The impacts could be direct, such as an oil spill or garbage, or indirect, such as industrial pollution affecting vegetation that muskrat rely on (Benson 2024). Muskrat do not seem to be affected by noises like generators or human activity however (Ellen Firth and Marilyn Maring [Inuvik] *in* Benson 2024).

In a traditional use study conducted in the Tłı̨chǫ/Wek'èezhìı region in the vicinity of a proposed mine, knowledge-holders noted that changes were being seen in both muskrat and migratory birds (Olson *et al.* 2012).

"We saw some dead fish floating and some dead muskrat been floating around, just below the [Ray Rock] mine site. ... There was approximately seven dead muskrats floating on the river." (Charlie Mantla [Behchokǫ̀] in Olson et al. 2012: 41)

The same study suggested that there would be an increase in muskrat mortality due to decreased water quality and loss of habitat associated with a proposed mine site (Olson *et al.* 2012). Concerns regarding impacts to muskrat from industrial spills and pollution during drilling operations were also documented in a 2015 study by the Tłı̨chǫ Research and Training Institute (TRTI 2015a).

Participants in a workshop to assess the vulnerability of the Slave River and Delta ecosystem noted that muskrat are one of the furbearers that is heavily affected by changes in water levels (Pembina Institute 2016a).

Participants in a workshop in Fort Smith expressed numerous concerns about contamination of the Slave River; some of the potential sources named included oil sands operations, agricultural pesticides, contaminants from Uranium City, pulp mills and mines, among numerous other sources of pollution (Pembina Institute 2016a). Collaborative research has been initiated in this area, driven by concerns that changes in winter water levels (fluctuations/flooding) due to power demands at the W.A.C. Bennett Dam in BC are causing an impact to muskrat along the Slave River and delta (Candler et al. 2013); water levels rise in winter as power demands increase with colder temperatures, and it is suspected that some bank muskrat houses get flooded out during this increase (WAEL 1999; Goodman pers. comm. 2024).

Disease and Starvation

As discussed in *Health*, diseases and parasites can threaten muskrat populations particularly during times of food shortages due to environmental conditions or population peaks (Allen Koe Sr. [Aklavik], Peter Kay [Fort McPherson], and others *in* Benson 2024).

Gwich'in trappers have found dead muskrat in their pushups that seemed to have died from starvation (Allen Koe Sr. [Aklavik] *in* Benson 2024). Muskrats occasionally starve due to a lack of food or if lakes freeze to the bottom; this may happen more frequently in smaller lakes (Benson 2024). Muskrat may also freeze inside of their pushups if they are unable to get out safely (Mary Kendi [Aklavik] *in* Benson 2024).

Specific diseases were not mentioned in the available literature. However, in the 1980s muskrats were found to be sick, with spots on their livers and this was accompanied by a population crash (Benson 2024). Similarly, concerning spots on the livers of some muskrat harvested in the Mackenzie Delta were observed in 2011 (Fred Koe [Fort McPherson] *in* Benson 2024: 109).

"This would be in the 80s. That [was] the last time the muskrat was sick quite a bit around that time. Since that time [the 1980s to the mid-1990s] it has never been any good at all. It got scarce after that. Even [if] you never trap them or anything you know, just like around my house I never bother it, for the last 10-12 years now. I just been out there for eating once, just for few even that it is hard to get" (Allen Koe Sr. [Gwich'in] in Benson 2024: 98)

POSITIVE INFLUENCES

Positive trends and future actions that could benefit muskrat populations include sustainable development, land and water protection, waste management, stewardship, and education, among others (GNWT 2022). The three main themes that arose in the IK/CK sources used in this report are presented below.

Traditional Harvesting Methods and Protocols

Traditional harvesters take care of muskrat by not harvesting them when they start having young and by not over-harvesting (Gwich'in Elders 1997; Willie Blake [Fort McPherson] *in* Benson 2024).

"… my dad always say, 'Well, it's about close season for it on the 15 of June.' So my Dad always quit before then, and [he'd] say, when we clean the muskrat there is little ones there. That is why he said, 'We have to use this again next year,' so [we should] quit hunting. But some do it just right to the end of the season, hunting season. That is how come there is no rats in their area next year, [they] kill them off." (Catherine Mitchell [Gwich'in] in Benson 2024: 111)

Trappers also switch locations to avoid over-trapping an area (Walter Vittrekwa [Fort McPherson] *in* Benson 2024). There are rules and protocols that Gwich'in harvesters follow that demonstrate respectful behaviour towards muskrat; not making fun of muskrat, not letting them spoil and not taking more than you need are several examples that were mentioned (Mary Kendi [Aklavik], Mabel English [Inuvik], and others *in* Benson 2024).

"My dad told me a story that when he was pretty young, he said there was no muskrats. Absolutely, for years, just like what's happening now. And his brother, Clement Koe, went out one night and shot 50 rats and some people down the Peel [River], some people heard it, they were mad, and some were happy, because muskrats were coming back. Some of them were mad because these muskrats that he killed could populate for the next year… It was like kind of funny for me how they were mad, and they were happy. So…it's all about like balance for me, like…in order for us to get our muskrats back; don't go out there and kill hundreds. Kill [only] so much at a time so they could repopulate. Like, I'm not going to go down there and set 20 traps; I'll set ten traps. Just practices like that will make things better in the long run… I know those younger generations hunt rats, which is good; that was our living. [But]…just don't go out and kill so much." (Andrew Koe [Fort McPherson] in Benson 2024: 113)

People may also leave the females alone so the population can grow (Elizabeth Greenland [Inuvik], Bertha Francis [Fort McPherson] *in* Benson 2024).

Habitat Protection

Conservation networks safeguard ecosystem services (i.e. food, fuel, medicines, raw materials, air, water, land, wildlife, and forests) that contribute to cultural and economic well-being (ECC

2024). Maintaining the conservation network ensures plants and animals have the time and space to adapt to changes in their environment by protecting important habitats and connections between habitats (ECC 2024).

Due to declines in muskrat abundance in the ISR, the Tuktoyaktuk Community Conservation Plan includes recommended conservation measures to identify and protect important habitat from disruptive land uses (Tuktoyaktuk Hunters and Trapper Committee *et al.* 2016).

In the Tłįchǫ/Wek'èezhìı area, the interim protection and potential establishment of Dinàgà Wek'èhodì Candidate Protected Area could provide benefits to muskrat; furbearers such as marten, mink, muskrat, and beaver are found throughout the area (Dinàgà Wek'èhodì Candidate Protected Area Working Group 2016). In 2019, Dınàgà Wek'èhodì was designated a candidate protected area under the *NWT Protected Areas Act* (ECC 2024). The area includes 790 km² of the north arm of Great Slave Lake and has interim protection through a Land Withdrawal Order under the *Northwest Territories Lands Act* while it is a candidate protected area (ECC 2024).

Ejié Túé Ndáde (Buffalo Lake, River and Trails) is a candidate protected area in the southeastern corner of the Dehcho region that includes the western portion of Ejié Túé (Buffalo Lake) and Ejié Túé Dehé (Buffalo River) (Haas 2014; GNWT n.d). The network of wetland complexes here are important for muskrat, as well as migratory birds, waterfowl, moose, beaver and fish (Haas 2014; GNWT n.d). The people of K'átł'odeeche have long depended on the wildlife in these areas to provide for their families and, as a result, have developed an important cultural and spiritual relationship to the Buffalo Lake area – an experience that is shared with both the Dene and Métis in the surrounding communities (GNWT n.d; KFN 2006). Ejié Túé Ndáde continues to be an important area for hunting, fishing, and trapping (Haas 2014; GNWT n.d).

The Edéhzhíe Protected Area is an Indigenous Protected and Conserved Area in the Dehcho Region that was established in 2018 and covers over 14,000 km² of important wetland, lake, and boreal forest habitat that could be beneficial to muskrat (Dehcho First Nations 2025).

See Figure 30 for protected areas and conservation zones that could benefit muskrat in the NWT.

ACKNOWLEDGEMENTS

The Species at Risk Committee (SARC) would like to thank Elders, harvesters and community members, both past and present, who generously provided their knowledge about muskrat in the NWT. Where possible, names are included in the Authorities Contacted section.

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AUTHORITIES CITED

From Benson 2024:

Project: Gwich'in Environmental Knowledge Project/Gwich'in Words About the Land (1990s)

- Abe Wilson [Fort McPherson]
- Allen Koe Sr. [Aklavik]
- Bertha Francis [Fort McPherson]
- Joan Nazon [Tsiigehtchic]
- Mary Kendi [Aklavik]
- Mary Teya [Fort McPherson]
- Alfred Semple [Aklavik]
- Catherine Mitchell [Inuvik]
- Catherine Semple [Aklavik]
- Elizabeth Greenland [Inuvik]
- Joe A. Vittrekwa [Fort McPherson]
- John Kendo [Tsiigehtchic]
- Julia Edwards [Aklavik]
- Mabel English [Inuvik]
- Malcolm Firth [Aklavik]
- Tony Andre [Tsiigehtchic]

Project: Monitoring Changes in Muskrat Health, Habitat, and Abundance in the Mackenzie Delta: Traditional knowledge and scientific perspectives project (2015-2016)

- Peter Ross [Tsiigehtchic]
- Irene Kendo [Tsiigehtchic]
- Abraham Stewart [Fort McPherson]
- Neil Snowshoe [Fort McPherson]
- Rosalie Ross [Fort McPherson]
- Rachel Villebrun [Fort McPherson]
- Fred Koe [Fort McPherson]

Project: Department of Culture and Heritage/Gwich'in Renewable Resources Board muskrat project (2022-2024) interviews

- Andrew Koe [Fort McPherson]
- Donald McLeod [Inuvik]
- Ellen Firth and Marilyn Maring [Inuvik]

- George Vittrekwa [Fort McPherson]
- Ian McLeod [Aklavik]
- Ryan McLeod [Inuvik]
- Walter Vittrekwa [Fort McPherson]
- Willie Blake [Fort McPherson]

Project: Department of Culture and Heritage/Gwich'in Renewable Resources Board muskrat project (2022-2024) review workshop

- William Charlie [Fort McPherson]
- Peter Kay [Fort McPherson]
- Ryan McLeod [Inuvik]
- Annie Buckle [Aklavik]
- Ellen Firth [Inuvik]
- Marilyn Maring [Inuvik]

From Turner *et al.* 2018:

- Eddy McLeod [Aklavik]

From NSMA 1999:

- Bob Turner

From Straka *et al.* 2018:

- Ron Campbell [Mikisew Cree First Nation, community unknown]

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- Charlie Mantla [Behchokǫ̀]
- Chief Daniels [Tłı̨chǫ, community unknown]

From Berger 1975:

- Abe Ookpik and Sam Arey [Aklavik]

From Mustonen and Tsiigehtchic Elders. 2004:

- Dale Clark, Noel Andre, Billy Cardinal, and Hyacinthe Andre [Tsiigehtchic]

From TRTI 2015b:

- Robert Mackenzie [Behchokǫ̀]

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Other Species Experts

Chanda Turner	Preparer of scientific component of species status report on muskrat for GNWT (SARC) and TK researcher in Mackenzie Delta

BIOGRAPHY OF PREPARER

Janet Winbourne was the sole preparer that compiled the information included in the IK/CK component of this status report. Ms. Winbourne has a BSc. in Wildlife Biology and a Master's degree in Environmental Studies with a specialty in Indigenous Peoples and resource use. She has worked as an ethnobiologist on projects that span marine, aquatic, and terrestrial environments. She specializes in Indigenous and community knowledge systems in Arctic, sub-Arctic, and West Coast cultures and environments. She has worked collaboratively on major projects with federal and territorial governments, Indigenous governance organizations, as well as non-governmental organizations, both as a researcher and as a technical writer.

Ms. Winbourne is experienced with understanding, interpreting, and representing diverse perspectives and sources of information in planning processes at community, regional, and cross-regional scales. Ms. Winbourne has been collaborating on or leading Indigenous and Community Knowledge research projects in the NWT for over twenty years. This is the seventh time that Ms. Winbourne has provided professional services to complete Indigenous and Community Knowledge components for species status reports in the NWT. She also provided services reviewing and revising the NWT Species at Risk TKCK guidelines in 2012/2013.

Ms. Winbourne has served as an Indigenous Knowledge Research Advisor to the Sahtú Renewable Resources Board since 2012, and regularly consults on these topics for other tribal councils and co-management boards, such as the Gwich'in Renewable Resources Board. In 2024 Ms. Winbourne was hired by the GRRB to assist in the preparation of the Gwich'in Traditional Knowledge report focussed on muskrat. She also has good familiarity with most regions of the NWT, having worked cross-regionally as part of collaborative caribou planning for several years.

SCIENTIFIC KNOWLEDGE COMPONENT

ABOUT THE SPECIES

Names and Classification

Scientific name:	*Ondatra zibethicus* (Linnaeus 1766)
Common Name (English):	Common muskrat
Common name (French):	Rat musqué (Adriaens *et al.* 2019)
Population/subpopulation:	Northwest Territories
Class:	Mammalia
Order:	*Rodentia* (rodents)
Superfamily:	Muroidea (Illiger 1811)
Family:	Cricetidae [True hamsters, voles, lemmings, muskrats, and New World rats and mice] (Fischer 1817)
Subfamily:	Arvicolinae (Gray 1821)
Life form:	Animal, vertebrate, mammal, semi-aquatic rodent

Systematic/Taxonomic Clarifications

There are currently 16 recognized subspecies of muskrats: *Ondatra zibethicus albus*, *O.z. aquihnis*, *O.z. bemardi*, *O.z. cinnamominus*, *O.z. macrodom*, *O.z. mergens*, *O.z. obscurus*, *O.z. occipitalis*, *O.z. osoyoosensis*, *O.z. pallidus*, *O.z.ripensis*, *O.z. rivalicus*, *O.z. roidmani*, *O.z. spatulatus*, *O.z. zalaphus and O.z. zibethicus* (Laurence *et al.* 2011). The designation of subspecies has historically been based on morphological and colour differences (Boyce 1978). The subspecies is not always specified in recent scientific literature, except for studies specifically on genetic diversity (e.g., Laurence *et al.* 2011).

Based on genetics using microsatellite data there are at least three genetically distinct clusters of muskrat in Canada: a western group (*O.z. spatulatus* and *O.z. albus*), an eastern group (*O.z. zibethicus*), and a Newfoundland group (*O.z. obscurus*). Muskrats in the NWT are from the western group and include *O.z spatulatus* and *O.z albus* (Laurence *et al.* 2011). *O.z spatulatus* and *O.z albus* lack genetic differentiation indicating a common ancestor, high levels of gene flow, or a combination of both (Laurence *et al.* 2011).

Description

The common muskrat (*Ondatra zibethicus*) is a medium-sized semi-aquatic rodent, well-adapted to wetland ecosystems (Miller 2018). It has a large, blunt head, large flat front teeth, relatively small eyes, and short, rounded ears that are largely obscured by their fur (see Figures 11 and 12) (Kurta 2017; Miller 2018). Adults measure 40-60 cm in length, including a long, narrow, flattened, rudder-like tail that makes up about half their size, and weigh between 0.7 and 1.8 kg (Kurta 2017; Miller 2018). Muskrats have dense, water-resistant fur that is medium to dark brown in colour with a lighter, rust-coloured ventral side (Hjältén 1991; Kurta 2017). Coat colours vary throughout their range and by subspecies (Miller 2018), but muskrats in the NWT (*O.z spatulatus* and *O.z albus*) are primarily the colouring described above (Turner pers. comm. 2025).

Muskrats are strong swimmers and are frequently seen in the water, with only their head and tail visible (Kurta 2017). They are distinguishable from other rodent species in northern ecosystems, such as beavers (*Castor canadensis*) or voles (*Microtus* sp.), by their size (larger than voles but smaller than beavers), tail shape (flattened laterally), and aquatic adaptations (Kurta 2017). They can look very similar to beavers when swimming if one cannot see their tail or tell their size (Turner pers. comm. 2025).

Figure 11. Common muskrat (*Ondatra zibethicus*), Niven Lake, Yellowknife, NWT. Photo credit: Liam Cowan.

Life Cycle and Reproduction

In North America, muskrats generally live around 3-4 years, and up to a maximum of five years (Kurta 2017). Data are not available for lifespans in the NWT or northern North America specifically, but hunting and trapping, high predation rates, disease, parasites, fighting with other muskrats and environmental pressures often limit their lifespan to 1-2 years (Miller 2018).

Adult males measure approximately 40-60 cm in length (including their tail, which accounts for about half their body length) and weigh on average 1.1 kg, ranging between 0.7 and 1.8 kg (Miller 2018). Males are, on average, slightly larger than females, though some females may outweigh males just before giving birth (Miller 2018). Within groups, smaller individuals (under 500 g) are primarily juveniles and are most numerous during the summer, while larger individuals (over 1 kg) are typically yearlings and adults who stabilize the population through winter (Miller 2018; Kurta 2017). Additionally, body size in both males and females positively correlates with habitat suitability and the availability of resources (Boyce 1978; Melvin 2024). There has been a general assumption that body size increases with latitude, but Simson and Boutin (1993) found that the muskrats they studied in the Old Crow Flats, Yukon (YT) were smaller than muskrats in Tiny March, Ontario (ON), and Boyce (1978) asserts that latitude cannot on its own predict differences in body size.

The sex ratio in North American muskrat populations is typically close to 1:1, however slight variations may occur due to differential survival rates between males and females, predation, or localized environmental factors (Stevens 1953; Hawley 1968). Results from live and kill trapping for research in the Mackenzie Delta in the 1940s to 1960s revealed averages like 1:1 ratio, with slightly more males in some studies, likely due to higher dispersal rates for males at the time of year the trapping was undertaken (Stevens 1953; McEwan 1955; Hawley 1968). Population age structure is often skewed toward juveniles, particularly during the peak breeding season, when they make up approximately 40–50% of the population (Virgl and Messier 1992). Yearlings and adults represent the remaining 50-60%, with adults becoming dominant after juvenile dispersal (Virgl and Messier 1992). Juvenile mortality rates are very high, with an average of 60% dying before the end of their first year (Miller 2018). These rates appear to be higher in the northern parts of the muskrat's range in North America than in the southern regions (Miller 2018), though this cannot be quantified for the NWT because of a lack of data.

Adult and juvenile muskrat often coexist in family groups, particularly during the breeding season (Stevens 1953) and early in the summer before juveniles disperse (Stevens 1953). Muskrats can be territorial, especially as the May-June breeding season nears (Brammer 2017). During this time, the strongest individuals take control of the best areas (Brammer 2017). The timing of the breeding season is correlated to air temperature and is limited to the ice-free season (Olsen 1959). In the Mackenzie Delta the peak breeding season was estimated to be mid-

June (Stevens 1953). Muskrat harvesting regulations in the NWT are indicative of the timing of the breeding season in different regions in the territory: closing dates are set to ensure there is no harvest during the breeding season and vary from May 31 to June 15 (see Positive Influences – Conservation Measures).

Muskrats typically reach sexual maturity at 10-12 months, although pregnant females as young as 6-8 weeks have been observed in some southern parts of their range (Louisiana; Miller 2018). The gestation period is between 25 and 30 days and each litter may produce 3-8 kits, with litters being larger (4-8 kits) and less frequent (1 to 2 litters per year) in the north and smaller (3-4 kits) and more frequent (2 to 6 litters per year) in the south (Boutin and Birkenholz 1987; Miller 2018; Melvin 2024). Muskrats are mostly monogamous, but the male does not take part in rearing the kits (Melvin 2024). Young are weaned after about four weeks (Melvin 2024) and females are able to quickly re-enter estrus (Boutin and Birkenholz 1987; Miller 2018; Melvin 2024). In the Mackenzie Delta, studies done in the 1940s-1960s indicated they are more likely to have only 1 to 2 litters per year with an average of 7-8 kits per litter (McTaggart Cowan 1948; Stevens 1955; Hawley 1964; EPEC Consulting Western Ltd. 1977); this is consistent with the overall trend of fewer and larger litters in the north reported by Boutin and Birkenholz (1987).

Muskrats, like other rodents, are prolific reproducers and their populations erupt under good conditions (Brammer pers. comm. 2025). "Eat-outs" are common in southern areas where muskrats quickly populate an area beyond their carrying capacity and completely remove the vegetation, which can take several years to recover (Miller 2018). Miller (2018) states that this eruptive population growth does not typically reach doubling of the population and is only possible when muskrats are colonizing new areas, though fur harvest records from periods of intensive trapping in the Mackenzie Delta and Old Crow Flats, YT would indicate that populations in these areas increased at a rate greater than doubling (Brammer 2017; McTaggart Cowan 1948). High reproductive rates allow a relatively small number of animals to quickly multiply and occupy an area (Sadowski and Bowman 2021).

Physiology and Adaptability

The demographic characteristics of muskrat, including high reproductive output and high dispersal ability, allow them to rebound relatively quickly making them resilient to harvest and other population pressures (Sadowski and Bowman 2021).

Muskrats are highly adapted to aquatic environments. They have stiff hairs along their toes that act like webbing in their hind feet and a laterally flattened tail that aids in swimming, with smaller front feet that are adapted primarily for digging and feeding (Miller 2018). Muskrat fur is dense and water-resistant, with a soft undercoat and coarser guard hairs, adapted for insulation and maintaining body heat in cold aquatic environments (Figure 12; Hjältén 1991).

Their ability to store oxygen in their muscles and blood allows them to stay submerged for up to twenty minutes (MacArthur 1990).

Figure 12. Common muskrat (*Ondatra zibethicus*) in cold aquatic environment, NWT. Photo credit: Vicki St. Germaine.

Muskrat dwellings or shelters generally include bank burrows, houses, and pushups. Construction and use of these dwellings appear to be associated with season, water level, and/or habitat type or region (Pembina Institute 2016). Muskrats excavate bank burrows (dens) along the banks of lakes and rivers when the slopes steep and when water levels are low (MRBC 1981 *in* Pembina Institute 2016; Kurta 2017; Figure 13). These bank burrows have entrances underwater and lead upwards to an underground chamber above the waterline (Kurta 2017). In marshes and other shallow-water environments with gradual banks, they build above-water structures commonly called houses out of nearby emergent vegetation and mud (Pembina Institute 2016; Melvin 2024). Houses are built in the fall in deeper water; they have underwater entrances and walls that can be 30 cm thick (Kurta 2017), and likely thicker in northern environments (Turner pers. comm. 2025). Houses are more difficult to identify than other types of muskrat shelters (MRBC 1981 *in* Pembina Institute 2016). In the fall, muskrats construct pushups which are vegetation mounds on the ice surface that serve to provide insulation and preserve air holes that they access for feeding, breathing and resting throughout the winter (Brammer 2017; Turner 2018). Once spring arrives and the ice melts, these structures sink into the lake (Stevens 1955; Turner *et al.* 2020). Muskrats in the Slave River Delta are more adaptable in their construction of shelter as compared to populations in other regions; for example, muskrats in Peace-Athabasca Delta use almost solely pushups, and those in the Mackenzie Delta use almost solely bank burrows (MRBC 1981 *in* Pembina Institute 2016).

Figure 13. Muskrat emerging from a bank burrow, Yukon. Photo credit: John Meikle, iNaturalist.ca

Stable water levels are important for maintaining healthy muskrat populations (Ward and Gorelick 2018). Muskrat numbers fluctuate under natural conditions in response to variable water levels (Ambrock and Allison 1972 *in* WAEL 1999); however, prolonged drought and drawdown may have significant impacts on the ability of muskrats to successfully recolonize newly flooded areas (WAEL 1999). Fluctuating water levels can increase the risk of predation by flooding or stranding shelters and impact the growth of vegetation by drowning or drying plants leading to nutritional stress on muskrat (Bellrose and Brown 1941; Errington 1963; Donohoe 1966; Clark and Kroeker 1993; Virgl and Messier 1992; Brammer 2017). These changes can reduce survival and reproduction (Bellrose and Brown 1941; Errington 1963; Donohoe 1966; Clark and Kroeker 1993; Virgl and Messier 1992; Brammer 2017). However, even in wetlands with stable water conditions, muskrat population densities can vary widely (Clark and Kroeker 1993). This variation is often influenced by the availability of preferred vegetation (Danell 1978; Clark 1994), the type of banks where they build their burrows (Jelinski 1989), and local populations of predators (Jelinski 1989).

Interactions

Muskrats play an important role in their ecosystems, feeding on aquatic plants throughout the year and influencing the density and composition of the plant communities they forage upon (Virgl and Messier 1992). Muskrats also serve as prey for various carnivores (Stevens 1953; Virgl and Messier 1992; Higgins and Mitsch 2001; Mott *et al.* 2013; Turner *et al*. 2020). In Yukon, bison have been observed foraging on muskrat pushups (Clark *et al.* 2016). Forage associated with pushups may provide important nutrients for bison in late-winter (Jung *et al.* 2019).

Muskrat densities are influenced by water levels, making them a valuable indicator species for monitoring changes in wetland ecosystems (Weller 1981; 1988; Straka *et al.* 2018; Turner *et al.* 2020).

Forage

During the summer, muskrats consume emergent shoreline vegetation and some submerged macrophytes (Stevens 1955). These species vary in different parts of the muskrats' range; cattails (*Typha spp.*), for example, are a preferred emergent food source when they are available in southern habitats (Melvin 2024). In winter, when ice covers their habitats, muskrat diet is restricted to the nutrient-dense roots and rhizomes of submerged macrophytes on lake bottoms beneath the ice (Jelinski 1989; Melvin 2024). Significant food sources in the Mackenzie Delta and likely other parts of the NWT include emergent vegetation *Equisetum fluviatile* (horsetails) and *Carex spp.* (sedges), and submerged macrophytes *Potamogeton spp.* (pondweeds) and *Myriophyllum spp.* (water milfoils; McTaggart Cowan 1948; Brammer 2017). While plants are the primary food source of muskrat, they may occasionally eat frogs, molluscs, insects and small fish (Errington 1939; Miller 2018).

Predators

Muskrats are eaten by a variety of predators across their range, including American mink (*Neovison vison),* red fox (*Vulpes vulpes*), North American river otter (*Lontra canadensis*), bears (*Ursus* sp.), eagles, owls and other birds of prey, Northern pike (*Esox lucius*), fisher (*Pekania pennanti*), wolverine (*Gulo gulo*) and American marten (*Martes americana*; Greer 1955; Stevens 1955; Poole 1991; Miller 2018; Melvin 2024).

Muskrat populations can fluctuate in cycles, a pattern that may be influenced by predation pressure from mink (Elton and Nicholson 1942; Erb *et al.* 2003; Haydon *et al.* 2001; Brzeziński *et al.* 2009; Estay *et al.* 2011; Brammer 2017). Erb *et al.* (2003) hypothesize that red fox may also drive muskrat population cycles in Subarctic-Arctic ecozones. The mechanisms that drive the relationship between predator and prey populations are density dependence and lagged responses of predators to prey abundance (Ahlers *et al*. 2021). Muskrats are thought to be particularly vulnerable to mink when stressed (Errington 1963; Shier 2007), though the influence of any predator on muskrat populations is shaped by regional environmental factors, including prey availability and the presence of other predators (Erb *et al.* 2001). A recent study of fur auction returns in the US and Canada from 1970-2011 indicated that the linkage between mink and muskrat populations may not be as strong as previously documented, especially in southern parts of the muskrat's range (Ahlers *et al.* 2021). Shier and Boyce (2009) found that muskrats make up less of mink's diets when prey diversity is higher, but that prey diversity does not explain changes in the interaction between mink and muskrat populations.

No studies have been done in the NWT to determine if muskrat populations cycle in relation to predator populations, although broader-based studies do indicate this coupling is usually tighter in western and northern regions of North America (Erb *et al.* 2003). In the NWT, muskrats are prey to a suite of generalist predators; the high diversity of predators reduces the likelihood of a highly correlated cycle among muskrat populations and the population of any one predator, which promotes more stable populations (Brammer pers. comm. 2025). Considerations of interacting population cycles of muskrat and predators over time in the NWT are discussed in *Threats: Predation.*

Predation by mink has been observed in the open-water season in the Mackenzie Delta (Hawley 1964), and predation by foxes was observed to be greatest in October and April (Stevens 1953). Hawley (1964) also noted that bank burrows were frequently dug up by black bears and entire litters were preyed upon by both bears and mink. However, in a recent study in the Mackenzie Delta region, muskrats were not a significant prey source for otters, mink, or fox trapped from November to February (Brammer 2021), although this only indicates that muskrats were not a major prey species during the winter for these predators (Brammer pers. comm. 2025; Turner pers. comm. 2025). Stevens (1955) hypothesizes that climatic conditions in northern NWT likely far greater impact on survival than that of predation and thus, predation is likely not a regulating factor of muskrat populations in the region (Mackenzie Delta).

Human influence through harvest is discussed below (see *Interactions with Humans*).

Other Interspecific Interactions

Muskrats are known to harbour parasites and disease even in healthy populations, and disease is often a factor thought to contribute to population cycles in the species (Erb *et al.* 2003). Some studies in the NWT have looked at parasite loading and disease in muskrat, but no pathogenic impacts have been detected (McTaggart Cowan 1948; Brammer 2021). Pathogens are discussed in more detail in *Threats: Pathogens*.

Beavers and muskrats are competitors in wetlands, however, they are also known to cohabitate within beaver lodges, living together without conflict (CBC News 2013). Mott *et al.* (2013) characterized this relationship as exploitative on the part of the muskrat, as beavers in this situation experience a greater rate of competition from muskrats and no apparent positive inputs from the muskrats within their lodge. Demonstrating the positive effects for muskrats, recent muskrat translocation efforts in Minnesota report that the muskrats using beaver lodges had greater weekly survival probabilities (Matykiewicz *et al.* 2021). However, it is less clear if the beavers experience negative impacts from muskrat occupying their lodges; the relationship may be commensal, or even mutualistic, if muskrats are providing additional heat and predator awareness (Brammer pers. comm. 2025).

Interactions with Humans

Humans have historically influenced muskrat populations through harvesting, primarily for their fur, which has long been highly valued in the fur trade industry, and their meat as a source of food (Turner *et al.* 2018). For many Indigenous peoples, muskrat trapping and hunting holds deep socio-cultural significance, providing not only sustenance and economic resources but also opportunities for intergenerational knowledge transmission and connection to the land (Turner *et al.* 2018). Harvest in the NWT has declined considerably since the mid-century peak, and significantly again from the 1990s onward (Table 4; Figures 14 and 15; GNWT unpubl. data 2025).

Muskrat harvest in the Inuvik Region (Figure 14) declined significantly from the earlier part of the century (1931-1946, average: 149,053 muskrats/year) to the mid-century through 1980s (1967-1989, average: 91,668). It also declined by an order of magnitude in the 1990s to present (1990-1996 and 2000-2023, annual average: 5,575). There are many causes of the declining harvest numbers; in the Mackenzie Delta (Inuvik Region) these include the high cost of gas and groceries, participation in wage labour, and low fur prices (Turner *et al.* 2018; Turner pers. comm. 2025). Muskrat harvest across the NWT (Figure 15) shows a similar decline from the mid-century to 1980s (1967-1989, annual average: 111,181) and the 1990s to present (1990-1996 and 2000-2023, annual average: 8,398).

Table 3. This table includes annual muskrat harvest data based on fur returns from 1931-1946, 1967-1989, 1990-1996, and 2000-2023 (GNWT unpubl. data 2025).

Time Period	Average annual number of muskrats harvested:	
	Inuvik Region	NWT
1931-1946	149,053	N/A
1967-1989	91,668	134,545
1990-1996 and 2000-2023	5,575	8,944

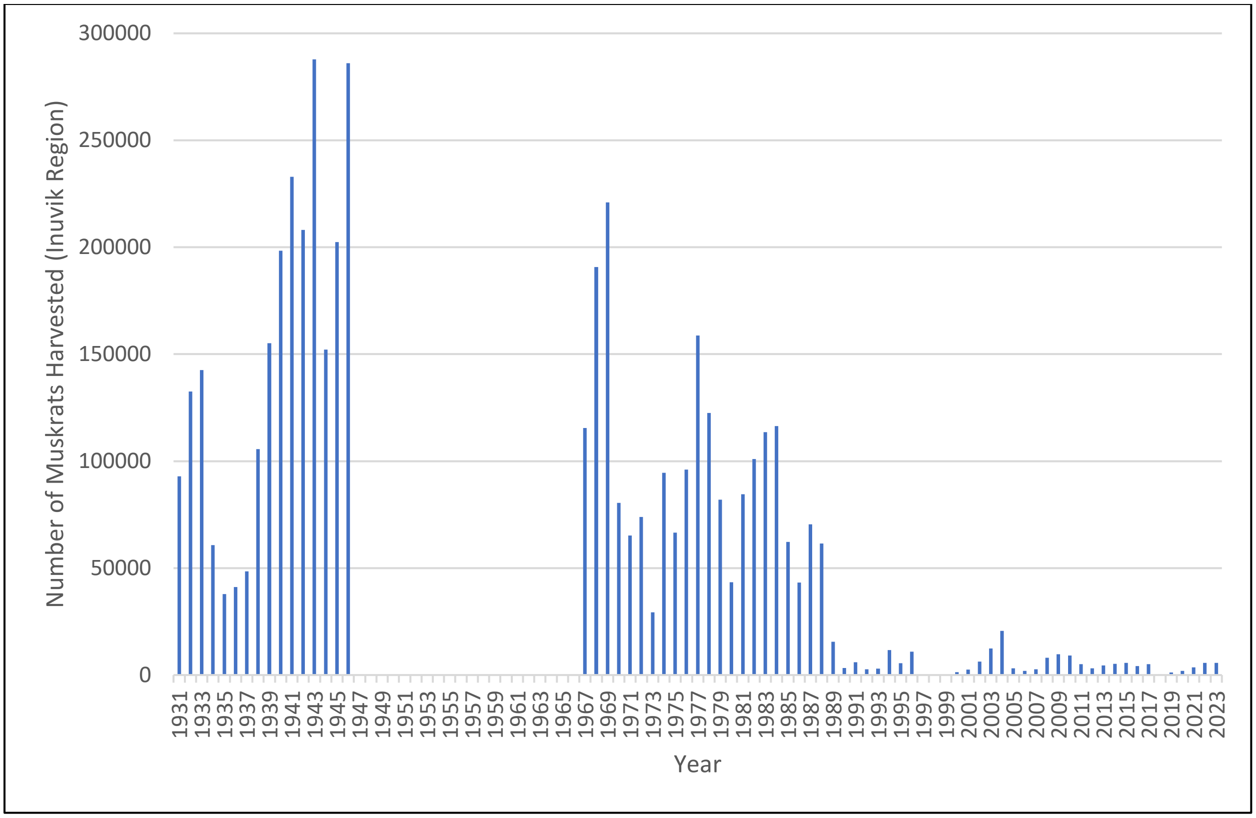

Figure 14. Muskrats harvested in the Inuvik Region[1] from 1931-1946, 1967-1996, and 2000-2023. No data for 1947-1966 and 1997-1999. Data from McTaggart Cowan (1948) and ECC-GNWT (unpubl. data 2025).

[1] Communities included in the Inuvik Region varied through time. From 1931-1946, the data are from only Aklavik and Fort McPherson. From 1967-1996, the data are from Aklavik, Fort McPherson, Inuvik, Tuktoyaktuk, and Tsiigehtchic. However, data from Aklavik and Fort McPherson from 1931-1946 would have been comparable to the expanded group of communities in the later data, as Inuvik did not exist in the earlier timeframe, and pelts harvested in Tsiigehtchic and Tuktoyaktuk were small in number and did not appreciably change the numbers for years 1967-1996. From 2000-2023, data are included from Aklavik, Fort McPherson, Tuktoyaktuk, Tsiigehtchic, Paulatuk, Sachs Harbour, and Ulukhaktok. There is no harvest of muskrats in the coastal and island communities in the Inuvialuit Settlement Region that were added to the dataset. This difference in communities among the different timeframes does not bias the dataset, especially as the trend is so strong.

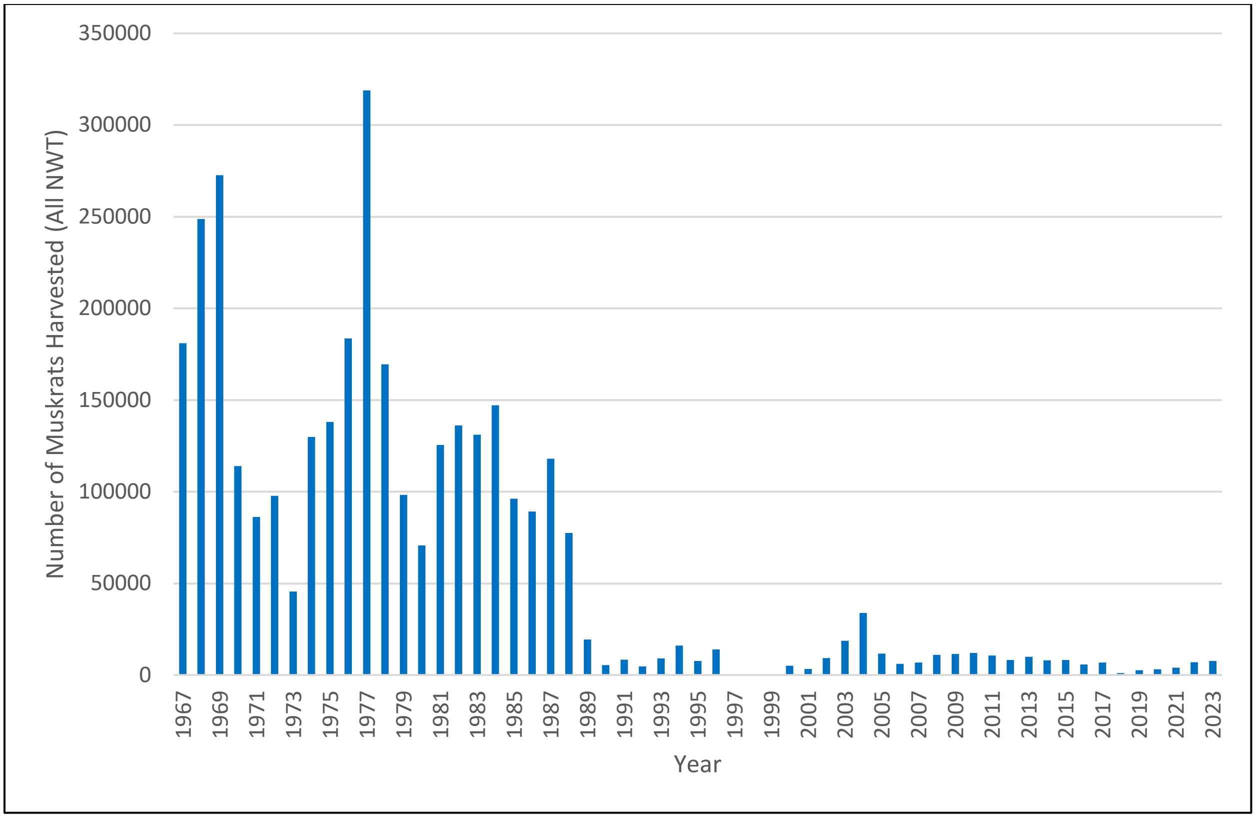

Figure 15. Muskrats harvested in all NWT from 1967-96 and 2000-2023. No data for 1997-1999. Data from ECC-GNWT (unpubl. data 2025).

The number of muskrat pelts harvested in the NWT have declined by orders of magnitude since the mid-20th century (see Figures 14 and 15 in *Interactions with Humans*) and have not exceeded 10,000 since the 1980s (Figure 15; GNWT unpubl. data 2025). Even when harvest numbers were tens to hundreds of thousands of animals per year for multiple decades in the northernmost part of their range in the NWT (McTaggart Cowan 1948), harvest was sustainable over many years. (see also *Population Dynamics*).

In some southern parts of North America and much of their European range, muskrats are often considered a pest and are subject to management measures designed to reduce or eradicate their populations (Bos and Ydenberg 2011; Miller 2018). Negative impacts of muskrats can include damage to agricultural areas and crops, dyke failure due to muskrat digging, and impacts to natural ecosystems (Bos and Ydenberg 2011; Skyriené and Paulauskas 2013; Miller 2018). Methods of population control include shooting, trapping, and rarely, toxicants (Miller 2018). None of the sources reviewed indicate mortalities of muskrat by humans other than harvest in the NWT.

PLACE

Distribution

World, Continental, or Canadian Distribution

Muskrats are native to North America and are found throughout the northern hemisphere (Figure 16), and have recently been reported as far north as 72 degrees (Siberia) (Поспелов 2020) and as far south as 29 degrees (Texas; Cong 2019). They were introduced to Bulgaria in 1905, with subsequent introductions and/or spreading occurring throughout Europe (including Czech Republic, Scandinavia, France, Denmark, Ukraine, Greece; Skyrienė and Paulauskas 2013). Muskrat was also introduced to Russia in 1928 (Danell 1996) and Asia around 1967 (including Mongolia, northeast Korea, Japan and Chinese territory; Skyrienė and Paulauskas 2013; Otgonbaatar *et al.* 2018). Muskrat have since been naturalized across large regions of Europe and Asia (Cassola 2016). Muskrats were also introduced to islands in southern Chile and Argentina in 1946 (not included in the range map; Musser and Carleton 2005; Skyrienė and Paulauskas 2013; Crego *et al.* 2016).

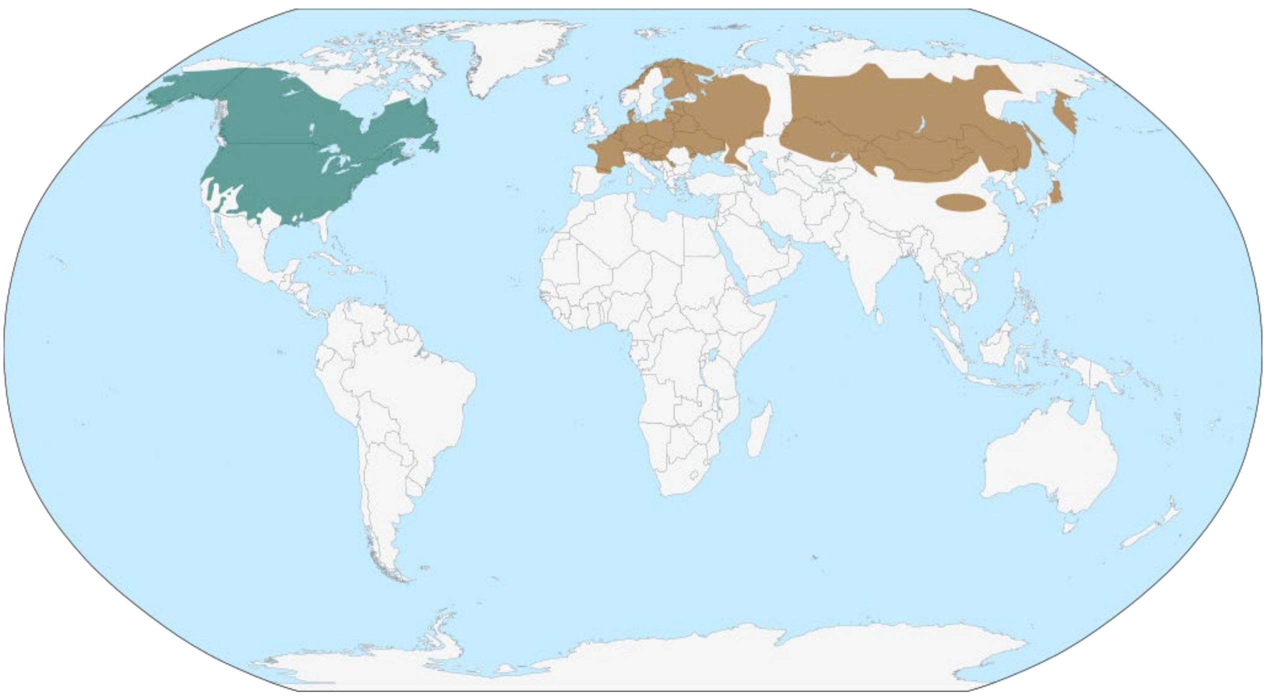

Figure 16. World distribution of muskrats. The continental range of muskrats native to North America are shown in teal; the range of muskrats introduced to Eurasia are shown in brown. Not included here are introduced population of muskrat to Tierra del Fuego Island, southern Chile in 1946 and to adjacent areas in Argentina (Crego *et al.* 2016). Figure from M. Bitton, reproduced with permission.

NWT Distribution

There has been no NWT-wide study of muskrat distribution. However, as shown in Figure 17, the common muskrat occurs, or is expected to occur, throughout the NWT except for the Level II Ecoregion of the Northern Arctic (Arctic Islands; ECG 2013) and parts of the Southern Arctic Level II Ecoregion in the Tundra Plains (including Level IV Ecoregions Point Upland, Contwoyto Uplands, Healy Upland, Hambury Plains, Baillie Plain, Clarke Uplands, and Dubawnt Plain; GNWT 2022a). For a large part of the territory, muskrats are likely present in localized areas where wetland habitats are favourable, but they are not likely found in all water bodies throughout the territory. They have not been documented on any of the Arctic islands in the NWT (Turner pers. comm. 2025).

There are, however, sources of distribution data from specific projects in some regions, notably the Slave and Mackenzie River Deltas (Figure 17; Haas 2014; Cott *et al.* 2016a; Turner *et al.* 2020; Brammer 2021).

It is unclear from these spatially-limited data whether the distribution of muskrats in the NWT is continuous or fragmented, however the high mobility and dispersal of muskrats into suitable habitat indicates that it is more likely to be continuous than fragmented (Turner *et al.* 2020; see *Movements* section). Large distances between water bodies, if there is a lack of suitable wetland habitat in between, may be a limiting factor for the continuity of muskrat distribution (Turner pers. comm. 2025).

Recent reported observations from iNaturalist (2024), the GNWT Wildlife Management Information System (WMIS 2025), the Global Biodiversity Information Facility (GBIF 2025) and Dedats'eeda: Tłı̨chǫ Research & Training Institute (2024) identify areas of muskrat presence in the territory (Figure 17). Muskrats have been recorded along the Mackenzie River, with high concentrations in the Mackenzie Delta and adjacent areas (McTaggart Cowan 1948; Turner *et al.* 2020; Brammer 2021). They are also known to be in the Slave River watershed (Cott *et al.* 2016a). There are many muskrat observations around Yellowknife and in the Nahanni region (iNaturalist 2024), however this data is likely skewed as these are areas with high human activity.

The records presented in Figure 17 from iNaturalist (2024), GBIF (2025), and WMIS (2025) are opportunistic, and the absence of observations in other parts of the range is an artifact of few studies or documentation, not the confirmed absence of muskrat in these parts of the territory. Muskrat occurrence in the NWT has largely been documented by Indigenous and community knowledge and information from these sources will have more spatial coverage than scientific records.

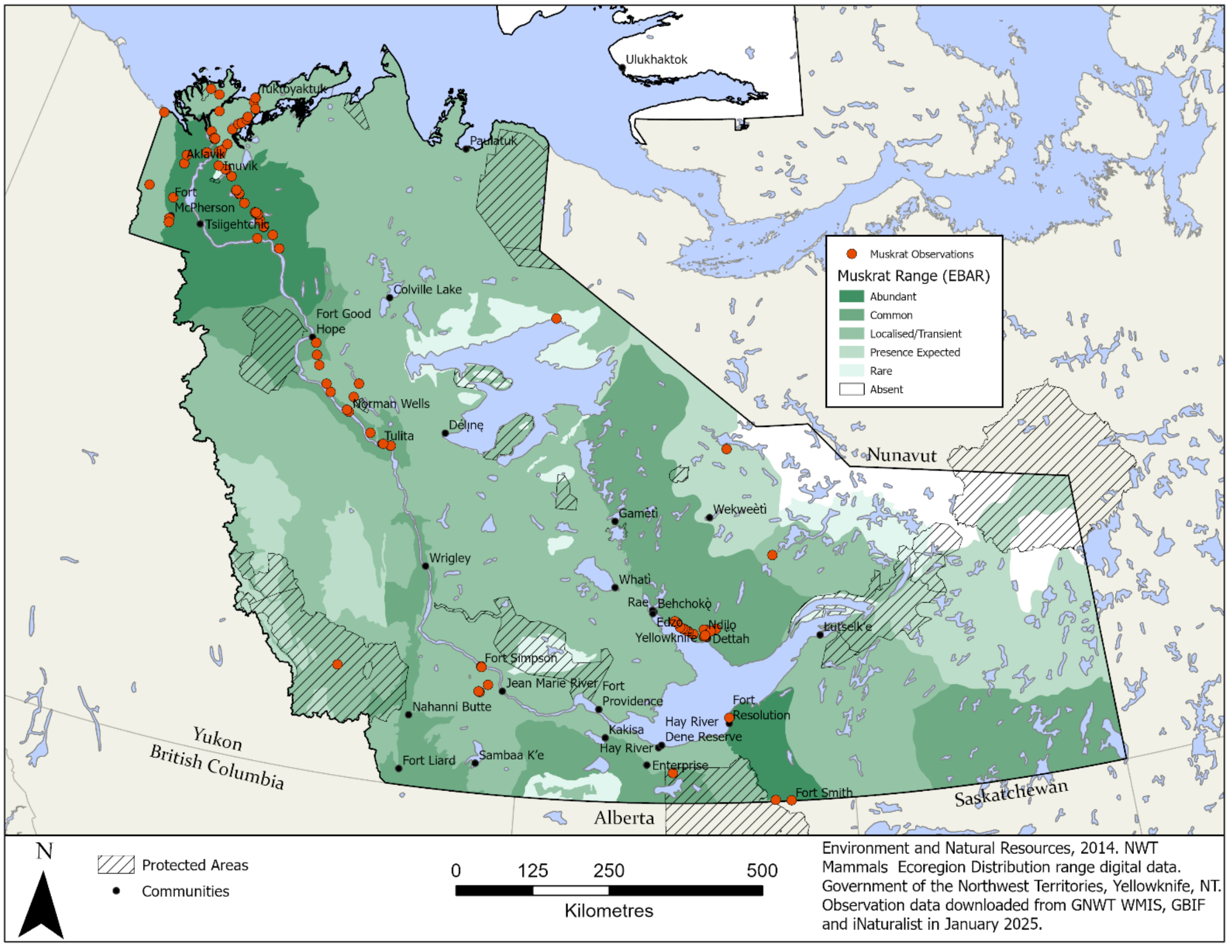

Figure 17. Approximate distribution of common muskrat (*Ondatra zibethicus)* and locations of observation records (individuals and pushups) in the NWT. Distribution is depicted using the Ecosystem-based Automated Range (EBAR) mapping method, where ecological regions (ECG 2013) are categorized based on documented site data from the NWT ecoregion distribution range digital data (ENR 2014). Species abundance categories[2] include: abundant, common, localized, presence expected, rare, and absent. Observation records (red dots) include data points derived from: Dedats'eeda: Tłı̨chǫ Research & Training Institute (2024), GBIF (2025), iNaturalist (2026), WMIS (2025) as well as studies by Cott *et al.* (2016), Turner *et al*. (2020) and Brammer (2021). Map courtesy N. Wilson and E. McHugh, ECC.

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[2] Species Abundance Definitions: **Abundant** (high populations widespread across the entire ecoregion; usually able to occupy most of the larger habitats or a diversity of habitat types). **Common** (occur in most of the ecoregion; may be widespread but dispersed unevenly across diverse habitats; may also be concentrated mainly in a few of the larger or most common habitat types). **Localized** - Localized in some habitats (metapopulation usually comprised of subpopulations restricted to a few habitats or enclaves; sedentary species may be scattered or patchy; colonies may be isolated or disjunct). **Presence Expected** (occurrence may not be confirmed, but is expected because of favourable ecological indicators and presence in adjacent ecoregions; may have been present in the past). **Rare** (sparse or sporadic populations persist). **Absent** (no evidence of presence; found elsewhere in the NWT; possible ecological barriers to use of range, or may be able to use range; may have been present in the past).

Extent of Occurrence/Area of Occupancy

The NWT Species at Risk Committee (SARC) defines 'extent of occurrence' as 'the area included in a polygon without concave angles that encompasses the geographic distribution of all known populations of a species' (SARC 2020). The extent of occurrence for common muskrat was calculated using the EBAR range shown in Figure 17 and was estimated at 857,695 km^2 in the NWT not including large lakes and rivers (scale 1:5,000,000). The range includes ecoregions where the common muskrat is abundant to rare and omits ecoregions where there is no evidence of presence (absent).

The index of area of occupancy (IAO) is a measure that aims to provide an estimate of area of occupancy that is not dependent on scale. The IAO is measured as the surface area of 2 km x 2 km grid cells that intersect the actual area occupied by the wildlife species (i.e., the biological area of occupancy) (SARC 2020). For common muskrat the IAO using observations only is 332 km^2 for the NWT only. However, this method is artificially low as the occurrence records are based on limited studies of pushups and sparse opportunistic observations along roads and waterways. Using the entire NWT range, based on the distribution outlined in the Ecosystem-based Automated Range (EBAR) map (Figure 17), the IAO is 893,404 km^2.

Locations

SARC defines 'location' 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 2020).

Muskrat requires adequate year-round water levels (Messier *et al.* 1990); fluctuations in water levels are the most influential variable in determining muskrat abundance (Perry 1982 *in* Cott *et al.* 2008). Water level fluctuations have the potential to cause declines in muskrat populations (Messier *et al.* 1990). Low water levels change wetland areas and are detrimental to muskrat populations limiting access to food (directly or through intraspecific competition) and to dwellings, in turn exposing them to predation or freezing conditions (Messier *et al.* 1990; WAEL 1999; Pembina Institute 2016; Straka *et al.* 2018). These changes, whether natural (e.g., flooding or drought) or anthropogenic (e.g., climate change or water diversion/drawdown), are likely the most serious plausible threat to muskrat populations in the NWT.

There are at least two locations for muskrat – the Mackenzie Delta and the Slave River and Delta – that may be defined based on water level threats and as areas known to have high densities of muskrat. However, it is unlikely that a single threatening event involving water levels would rapidly affect more than half of all individuals in the NWT; especially considering that muskrat do not congregate but are distributed across a very large range. Therefore, it is not possible to count locations for common muskrat in the NWT.

Search Effort

As stated above, there has been no systematic effort to document muskrat across their range. There are sources of data from specific projects in the Slave and Mackenzie River Deltas (Haas 2014; Cott *et al.* 2016a; Straka *et al.* 2018; Turner *et al.* 2020; Brammer 2021) that are based on surveys of muskrat pushup presence in parts of these areas. Community observations are recorded in some literature as well of areas that are known to have high densities of muskrat or areas that are good for hunting and trapping muskrat (Wilson and Haas 2012; Benson 2024). There are also some limited reported observations from iNaturalist, the Global Biodiversity Information Facility and the GNWT Wildlife Management Information System (iNaturalist 2024; GBIF 2025; WMIS 2025). As noted above (see *NWT Distribution*), these observations are opportunistic and do not represent a comprehensive picture of the distribution of muskrat in the NWT.

Distribution Trends

It is difficult to comment on the overall changes in distribution in the NWT when there are knowledge gaps regarding muskrat distribution. There are no reported places where muskrats are no longer seen where they have been previously. There is a strong possibility that muskrat distributions may be expanding further north into the Tundra Plains ecoregion (ECG 2013), based on observed and predicted changes in climatic conditions and associated ecosystems (Brammer pers. comm. 2025; Turner pers. comm. 2025), as well as documented range expansion in the Inuvialuit Settlement Region in the northern part of the NWT by a similar species, North American beaver (Tape *et al*. 2018). This can be characterized as range expansion rather than a range shift, as there is no concurrent contraction from the south of the range (Brammer pers. comm. 2025).

Movements

Muskrats are semi-aquatic rodents that typically occupy home ranges the size of the water body they reside in, staying within 30-100 m of their home bank burrow or floating house (Stevens 1955; Miller 2018). Riparian corridors (i.e. rivers and creeks) allow for dispersal over distances much greater than home ranges would suggest: Ward *et al.* (2021) found related individuals over 40 km apart in the Peace-Athabasca watershed. In the spring, when water levels are high (as is typical in river, delta and wetland ecosystems), they are highly mobile and exhibit strong dispersal abilities and are transported by floodwaters (McEwan 1955; Miller 1994; Sadowski and Bowman 2021; Ward *et al.* 2021).

During the open-water season, muskrats forage on emergent shoreline vegetation and some stay in one area while others, typically juveniles, disperse to nearby water bodies (Hawley 1968; and see Life Cycle and Reproduction). In the ice-covered season, muskrats are confined to the water body they inhabit, which is commonly a lake or marsh (Kurta 2017) but may also be a river channel (Pembina Institute 2016).

A study in the Mackenzie Delta found that muskrats frequently move into and out of lakes that are within 1 to 1.6 km away from each other (Hawley 1964). This high mobility was observed using live-trapping and marking muskrats to record re-captured individuals. Muskrats live-trapped and shot in the springtime and early summer had higher male:female ratios, which may indicate that males are more actively dispersing than females, and they also tend to leave their dens earlier (Hawley 1964).

Turner *et al*. (2020) suggested that the Mackenzie Delta, which is very dense with lakes and channels, is continuous habitat for muskrats, as their presence in lakes is explained more by the quality of the habitat in the lake they occupy for the winter (e.g., available underwater biomass), and less by variables describing the configuration of lakes in the landscape (i.e., distance from nearest other water body). This pattern suggests that muskrats seek the highest quality habitat and are not deterred by having to travel overland to more desirable habitat (Turner *et al.* 2020). Stevens (1955) also describes overland travel in the Mackenzie Delta. Other studies also corroborate their ability to disperse across land effectively: in more southerly areas, where muskrats are often considered a pest, they effectively move and spread across landscapes that are not primarily water (Miller 1974). The naturalization of muskrat to northern Europe and Asia after their introduction for fur farms and subsequent attempts to manage their expansive populations also demonstrates their high mobility (Artimo 1960; Bos and Ydenberg 2011).

Habitat Requirements

Muskrats are adapted to a variety of climates across the northern hemisphere. They are found in freshwater and brackish wetlands, including running water (creeks, rivers, streams), lakes and smaller water bodies like ponds or pools (including man-made water bodies), bogs, marshes, and swamps (Cassola 2016). While they are found in running water, muskrats prefer slow-moving water (Crego *et al.* 2016; Kurta 2017).

In the NWT, much of muskrat yearly cycle is spent under ice within a single water body after the ice has formed (Jelinski 1989; Brammer 2017; Turner 2018). To survive the long ice-covered winters characteristic of lakes in the NWT, muskrats must have access to deeper water that does not freeze to the bottom and to an abundance of submerged macrophytes for food (see *Forage* for more details; Jelinski 1989; Stevens 1955; Turner *et al.* 2020; Miller 1994). A study in northern Sweden found that most muskrat houses were within 1 m of water depth; the mean water depth at the house sites was 0.2 m (Dannel 1978; Cott *et al.* 2008). Survival is hindered when underwater entrances to dwellings freeze in shallow areas or during extreme cold events, forcing them to forage above ground (Melvin 2024) and exposing them to cold air temperatures and predation (Stevens 1955; Brammer pers. comm. 2025). As discussed in *Physiology and Adaptability*, muskrat houses are usually built in the fall in deeper water and are found on the lakes and outer Delta (Pembina Institute 2016). During winter, muskrats live in bank burrows (dens) on the edge of the water body and eat and breathe at holes in the ice kept open by vegetation mounds that they construct for this purpose, called pushups. In the spring and summer some muskrats may occupy bank burrows, especially when they have young, while others temporarily occupy shallow habitats without the construction of bank burrows or houses (Stevens 1955). All muskrats must move to deeper water and bank burrows to survive the winter (Stevens 1955). The importance of bank burrows, pushups, and houses can vary among different regions in the NWT, and may also change due to environmental conditions like changing water levels (Pembina Institute 2016).

Muskrat habitat quality is largely determined by the amount of available forage (Proulx and Gilbert 1984; Pembina Institute 2016), which includes emergent and submerged vegetation (Messier *et al.* 1990). In northern climates such as the NWT, muskrats rely on the submerged macrophytes and roots, shoots and rhizomes on the bottom of the water body in which they are overwintering for the duration of the winter (Messier *et al.* 1990; Turner *et al*. 2020). Sufficient shoreline is required for muskrats to have enough emergent vegetation for feeding and enough space to construct bank burrows (Brammer 2017). Sufficient water depth is necessary to ensure that the water body does not freeze to the bottom in the winter which would prevent access to food sources (Turner *et al*. 2020; Pembina Institute 2016).

Relatively constant water levels are required to enable muskrats to access food and construction materials during periods of ice-cover (Glass 1952 *in* Cott et al. 2008). Fluctuations in water levels can negatively impact muskrats. For example, muskrat pushups and houses are subject to freezing over if there is an overflow event in the winter, where water flows over the ice subsequently freezing vegetation mounds and the breathing holes within them (Pembina Institute 2016; Brammer 2017). Factors that can contribute to overflow events include changes to upstream flow, snowmelt or precipitation events, and air temperatures (Sladen *et al.* 2017; Turner pers. comm. 2025).

Reduced winter precipitation as snow fall can also negatively impact muskrat. A lack of insulating snow can cause pushups to freeze over, which forces muskrats out of their overwintering habitat leading to greater rates of predation, exposure, nutritional stress, and often death (Messier et al. 1990; Turner 2018).

Habitat Availability

The Mackenzie and Slave River Deltas are part of the greater Mackenzie River Basin, which covers 1.8 million km² including six sub-basins (Athabasca, Peace, Liard, Peel, Great Slave, and Mackenzie-Great Bear) across five provinces and territories (Figure 18; GC 2025; MRBB 2026). These basins and deltas provide habitat for aquatic species including muskrat.

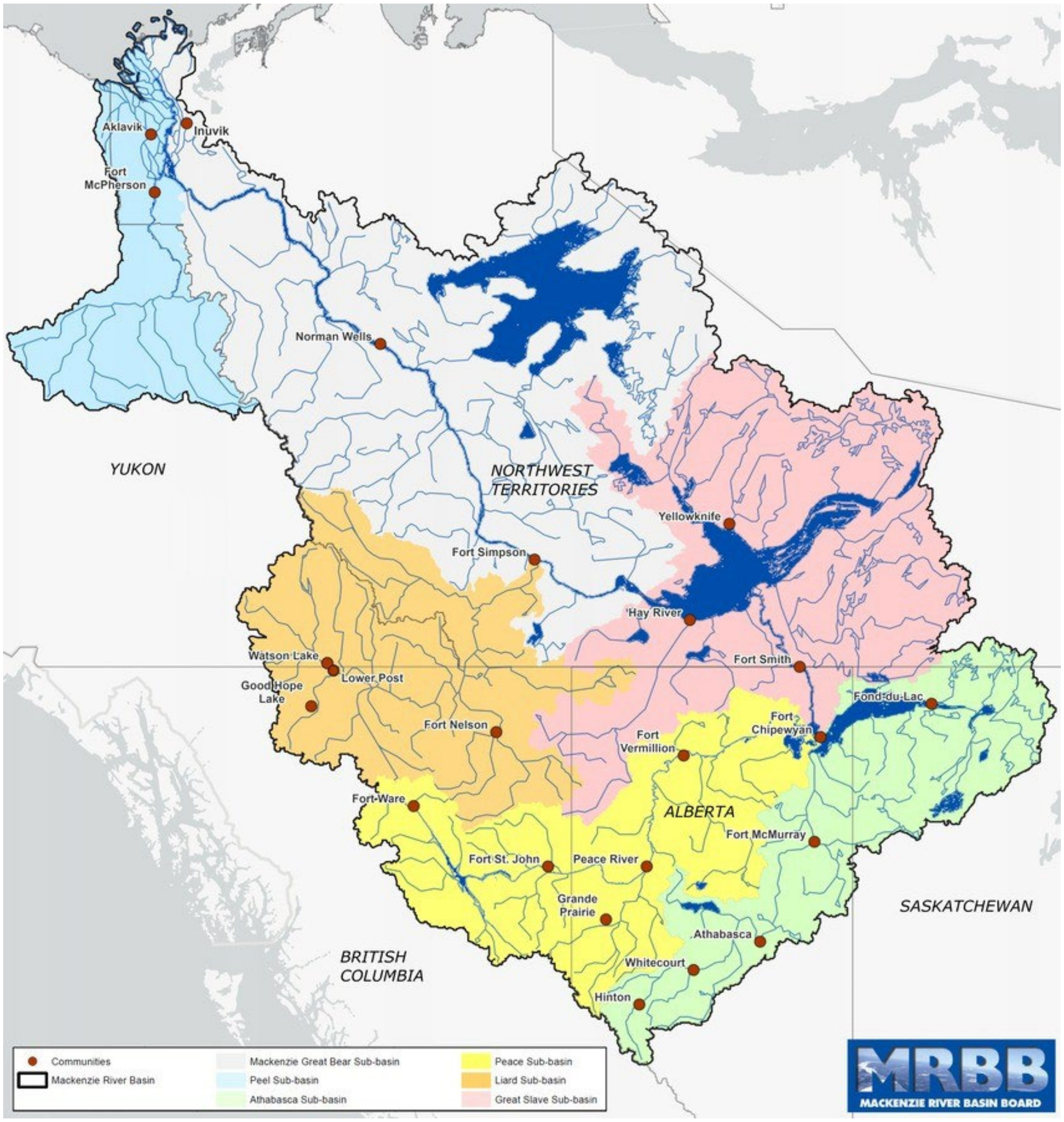

Figure 18. The Mackenzie River Basin covers about 1.8 million km² and includes portions of five provinces and territories. The rivers in the basin cross multiple boundaries including the Mackenzie River, nine lakes and three large deltas. Figure from GC 2025.

Suitable habitat for muskrat consists of a mosaic of viable riparian habitat regions (Ward *et al.* 2021). Delta habitat provides periodic flooding and drawdown to ensure the production of large areas of marsh habitat important for muskrat (WAEL 1999). In the NWT, muskrat occurs in high densities in the Slave River and Delta (Pembina Institute 2016) and the Mackenzie Delta (Turner *et al.* 2020). The presence of muskrat in these areas is evident through trapping success and/or numbers of pushups/houses (Pembina Institute 2016; Turner *et al.* 2020).

Within the Mackenzie Delta, locations that support a high density of muskrat and/or areas known to be good for trapping muskrat were identified as Important Wildlife Areas (Wilson and Haas 2012). These include the inner Mackenzie Delta, specific small areas between the Arctic Red River (Tsiigehtchic) and the Peel River, and two areas to the east of the Mackenzie Delta (Figure 8; Wilson and Haas 2012). The inner Mackenzie Delta is a very important traditional area for trapping muskrat in the spring; it has excellent muskrat habitat that supports a high density of muskrat (albeit with fluctuating numbers; various sources *in* Wilson and Haas 2012). The area identified as *Muskrat Concentration Area A* includes portions of land between the Peel and Arctic Red Rivers. This area has productive habitat for muskrat yielding high densities and are good trapping areas (various sources *in* Wilson and Haas 2012). Muskrat Concentration Area B is known to have many muskrat pushups and is a good area for trapping, however, this area has also been classified as poor for muskrat (various sources *in* Wilson and Haas 2012). This inventory of important wildlife habitat did not include the southeast part of the NWT. A survey of muskrat pushups conducted along the Slave River from north of Fort Chipewyan to Great Slave Lake in 2013 found that there were more muskrat pushups in the Slave River Delta compared to the other areas of the Slave River surveyed (Cott *et al.* 2016a). The study also found that muskrat abundance was higher in wetland-dominated areas of the river compared to the drier side (Cott *et al.* 2016a).

Although delta habitats tend to yield higher densities of muskrat, it could be expected that most shallow wetland areas in the NWT outside of deltas are good habitat for muskrats, and almost all ecoregions have areas of wetland habitat (Figure 8).

Habitat Trends

Aquatic habitat trends in the NWT are complex with many contributing factors. Muskrats are widely distributed across the NWT; changes in the freshwater ecosystems across the territory occur at different rates and directionality (Pembina Institute 2016; Singer and Lee 2021; GNWT 2022b). Therefore, some areas may become better habitat for muskrat while others may be negatively impacted (Straka *et al.* 2018; Brammer 2021).

Another complicating factor to understanding habitat changes are global atmospheric oscillations such as El Niño-La Niña. Oscillation events occur every few years to decades causing changes that influence weather patterns and in turn, wet and dry conditions as well as temperatures (GNWT 2022b). These oscillations can amplify the effects of a changing climate and, in some years, can rapidly affect environmental conditions in the NWT (i.e., record early spring thaws have occurred due to strong El Niño phase events; GNWT 2022b).

Extreme fluctuations and unpredictability of water levels and regimes are factors contributing to changes in the aquatic habitat of muskrat in the NWT, and across their range (Ahlers and Heske 2017; Sadowski and Bowman 2021; Melvin and Bowman 2026). Water levels function within a normal range of natural variation, however anthropogenic disturbances can cause extreme fluctuations that can surpass the adaptability of many species (Coops *et al.* 2003; Cott *et al.* 2008). Despite the ability of muskrat to rebound from short-term die offs, localized declines in muskrat populations have been linked to changes in water levels and these habitat changes are a plausible mechanism for those declines (WAEL 1999; Straka *et al.* 2018; Turner *et al.* 2019; Ward *et al.* 2021; Melvin and Bowman 2026).

In the Mackenzie Delta, surveys indicate that changes in muskrat habitat from the mid-1900s to present may be positive in some areas and negative in others (Brammer 2021; see also *Population – Trends and Fluctuations*). Water quantity (flow and level) in the NWT is monitored through the NWT Hydrometric Monitoring Network, which is a partnership between Environment and Climate Change Canada (ECCC) and the Government of the NWT (; GNWT 2022b). In the *Northwest Territories State of the Environment Report* (2022b), GNWT reports that water flow in small and medium watersheds in the NWT has increased since the 1970s, at a rate of 1.3 mm/year and 1.0 mm/year, respectively. Flow in the large Mackenzie River watershed is increasing as well, though at a much smaller rate of <0.1 mm/year (GNWT 2022b).

Unlike increases to flow in the Mackenzie River watershed, the Slave River is experiencing an overall decline in water flow of 0.4 mm/year over the period of record from 1960-2017 (GNWT 2022b). The Slave River is fed by the Peace River, which encompasses the site of the W.A.C. Bennett Dam and Williston Reservoir, constructed in 1967 and filled from 1968-1971, and more recently, the Site C Dam and Reservoir, which was filled between August 2024 and November 2024 (B.C. Hydro 2024; GNWT 2024). The Peace-Athabasca hydrological system is also dependent on seasonal and annual fluctuations in water level, which are influenced by upstream snowmelt and rainfall (Macmillan 1996; WAEL 1999). Substantial impacts of the Bennett Dam to the hydrology of the Peace River and Peace-Athabasca Delta are evident through changes in spring flooding regimes and winter overflow conditions (WAEL 1999; Straka *et al.* 2018). Muskrat abundance in the region responded to these changes (see *Population – Abundance* and *Trenda and Fluctuations*).

Water levels across NWT were below (Hay River, Liard River, Slave River) or well below (Great Slave Lake, Mackenzie River) average in February 2026 (GNWT 2026). Low water levels are the result of extreme drought conditions that began in the summer of 2022 and have persisted through 2023, 2024 and 2025 (GNWT 2026). Water levels have shown limited recovery since 2022 (GNWT 2026). Extreme variation in water flow and levels are becoming more common despite an overall increasing trend in water flow in many watersheds over the long-term. Further years of data and analysis of different timeframes would be required to quantify whether these changes are likely to affect muskrat habitat if they persist or become more frequent.

The timing of water flow, especially spring peak flows, also affects muskrats as it is important for their dispersal, life cycle, and replenishing lakes with nutrients and other inputs (Straka *et al.* 2018; Turner *et al.* 2020). GNWT (2022b) documented observed changes to the timing of spring and fall/winter flows from the period of 1975-1996 to 1997-2017 in all watershed sizes. Changes were not consistent across rivers and watershed sizes (GNWT 2022b). In watersheds across the NWT, water flow is increasing especially in the winter; the cause is complex, but factors include thawing permafrost, precipitation, extended open-water season, and human influences on water regimes (i.e., dams, consumption and industrial use; GNWT 2022b). Reduced frequency of flooding due to ice-jams in the spring can reduce peak water levels, resulting in some water bodies perched above the flood zone not getting replenished by water or the nutrients it carries (Straka *et al.* 2018; Turner *et al.* 2020). This contributes to a cycle of drying out, leading to insufficient or lower quality habitat for muskrats (Straka *et al.* 2018; Turner *et al.* 2020).

Changes in water flow and associated habitat are also influenced by changes in precipitation. Areas of the NWT have experienced significant changes in precipitation since 1955, although not all areas are experiencing the same changes (GNWT 2022b). For example, there is no significant trend in rainfall at Hay River, but a significant decrease in snow water equivalent (SWE) between 1955 to 2018, whereas Yellowknife has seen no significant change in SWE but a significant increase in rainfall (GNWT 2022b). Overall, increased precipitation is expected across the north, but there is a great deal of uncertainty in seasonality and regional variation (GNWT 2022b). As these trends and predictions are so variable, it is difficult to interpret how changes in precipitation may impact muskrats. Ahlers *et al.* (2015) documented changing muskrat distributions correlated to changes in summer precipitation in Illinois: muskrat occupancy increased with summer precipitation and decreased with drought conditions. There are several different processes affecting water levels in the NWT, including decreased precipitation, unpredictable water flow, and increased permafrost melt (GNWT 2022b), which further complicates interpretations of observed and predicted changes in water levels.

Other changes to habitat are also difficult to quantify trends for, as they are reflective of local-level processes and weather conditions. For example, Dagg (2016) reports an observed decline in muskrat populations on the Slave River around Fort Smith, which was explained by local trappers to be caused by very specific weather conditions: "early snow melt followed by a cold snap, which can lead to water flowing into pushups and freezing inside, preventing entry, and a rapid, early freeze-up when shallow pools would freeze solid, preventing access to vegetation under the ice" (Pembina Institute 2016, p. 48). While this population decline was also linked to the longer-term changes in flooding regimes in the region due to the Bennett Dam flow regulation upstream (Pembina Institute 2016; Straka *et al.* 2018), there may not always be a concurrent larger process affecting muskrat habitat. Information on fine-scale changes in annual weather, water levels and flow, and their possible impacts on muskrat habitat as well as direct observations of changes in muskrat habitat in specific lakes or trapping areas are well-documented by Traditional and Community Knowledge (e.g., Straka *et al.* 2018; Benson 2024); little scientific evidence or analysis exists thus far.

Other changes in regional weather that can impact muskrat habitat annually include less snow and/or strong winds in the winter. These conditions may remove insulating snow from pushups and increase both their vulnerability to predators and the likelihood of them freezing over (McTaggart Cowan 1948; Stevens 1953).

Other changes in habitat that may impact muskrats are changes in vegetation. Significant shifts in the distribution of the average climatic conditions associated with ecological communities (cliomes) in the NWT are projected over the next 30 years for even the most optimistic climate scenarios (Singer and Lee 2021). This shift in cliomes is already impacting vegetation communities in the most northern parts of the muskrats range in the NWT, in the Mackenzie Delta and surrounding tundra (Myers-Smith *et al.* 2011). Changes in other wildlife distributions have also been documented, for example in grizzly bears (WMAC-NWT *et al.* 2023), beavers (Tape *et al.* 2018), and otters (Stevens 1953; Hawley 1968; Brammer pers. comm. 2025; Turner pers. comm. 2025). However, muskrats occupy wetland environments in an extremely broad range of climatic conditions, so this shift may result in some areas becoming more suitable habitat for muskrats.

Muskrat habitat selection in the NWT is somewhat seasonally dependant, as as muskrats may use different areas in the summer (shallower waters) and winter (deeper waters that will not freeze to the bottom and provide access to sufficient food resources; Jelinski 1984). These habitats may be found within the same home range and accessed from a year-round burrow (Brammer pers. comm. 2025); alternatively, muskrats in the Mackenzie Delta use different burrows in the summer and winter months (Jelinski 1984). The timing of ice coverage is another factor in assessing muskrat habitat. The extent and timing of ice cover is changing in the NWT, with longer open water seasons in freshwater ((GNWT 2022b; Turner pers. comm. 2025). Increased water turnover and extended evaporation periods can lead to more unstable water levels (Labrecque *et al.* 2009), which can increase exposure to predators (Brammer 2017) and negatively impact muskrat populations (Errington 1963; Virgl and Messier 1996). However, it has also been hypothesized that increases in the open water season could increase primary productivity and therefore food availability for muskrats, which could increase their reproduction (Simpson and Boutin 1993). In contrast, Brammer (2017) found a surprising correlation between longer open water seasons and reduced muskrat density and body condition in the Old Crow Flats, YT.

Habitat Fragmentation

Muskrat habitat is naturally somewhat fragmented by the interfaces of land and water, both of which they rely on. However, Turner *et al*. (2020) suggested that the Mackenzie Delta, which is very dense with lakes and channels, is continuous habitat for muskrats. Muskrat presence in lakes was not explained as well by the configuration of patches (lakes) among land, as would be expected if the land was a semi-permeable barrier, but more by the quality of the habitat in the lakes (patch composition), suggesting they simply disperse to the best habitat across equally permeable land and water (Turner *et al.* 2020).

The average muskrat home range is roughly 0.25 ha, but can vary widely from as little as 15 m to 230 m from dwellings (MacArthur 1980; Melvin and Bowman 2026). Muskrats are also able to disperse across land effectively when water bodies are less dense, as evidenced by research and the general status of muskrats as a pest in southern parts of North America and across Europe and Asia (Miller 1974; Brzeziński *et al.* 2009; Laurence *et al.* 2013). In the Mackenzie Delta, muskrats frequently moved into and out of lakes that were within 1 to 1.6 km away from each other (Hawley 1964).

Recorded observations of muskrats in the NWT are primarily along the Mackenzie and Slave rivers (Figure 17; see also Figures 1 and 2). It is likely that most or all muskrat populations in the NWT have a high degree of connectivity within this watershed because riparian corridors and floodwaters offer effective dispersal (Ward *et al.* 2021), though distance or landforms such as mountains may be a limiting factor for dispersal (Laurence *et al.* 2011).

Changes to climatic and habitat factors introduced in *Habitat Trends* are unlikely to cause habitat fragmentation unless the water levels and flow in major waterways, such as the Mackenzie River, dry up a considerable amount as to restrict the movement of muskrats along such waterbodies. Even then, the high mobility of muskrats over land as described in the *Movements* section would likely mitigate changes in water levels and flow.

POPULATION

Abundance

There is no empirical population estimate for muskrats in any region of the NWT. Efforts have been made to look at relative abundance over time in some regions, like the Mackenzie Delta, but data are spatially and temporally limited within variable landscapes. There are many parts of the NWT where muskrats are likely to occur that have not been surveyed historically or currently, and certainly not systematically.

Lines of evidence that have been used to produce abundance estimates for muskrats include measuring pushup abundance (Table 4, Table 5 and Figure 19) or density through aerial surveys and/or field surveys (McTaggart Cowan 1948; Stevens 1953; Hawley 1968; Turner *et al.* 2020; Brammer 2021), fur returns (Erb *et al.* 2000; Brammer 2017), and more qualitative measures from Indigenous and local land users (Pembina Institute 2016; Wilson and Haas 2012).

Harvest data are not necessarily reliable indicators of muskrat abundance (Hawley 1968). Annual and longer term variation in trapping effort can be influenced by costs of gas and supplies, fur prices and demand, and changes in other socio-economic and cultural factors; therefore harvest data is not always a good proxy for muskrat populations (Roberts and Crimmins 2010; Brammer 2017; Turner *et al.* 2018). Ahlers and Heske (2017) posited that they removed the bias of changes in fur prices that affect harvest numbers, and subsequently suggested there are substantial declines in muskrat abundance across the United States. However, the report preparer and her colleague are not convinced that all factors contributing to declines in fur returns were adequately considered, including the drastically reduced demand for fur during a period of strong advocacy against furs by some environmental and animal rights organizations and the growth of wage labour opportunities over the time period considered (Brammer pers. comm. 2025; Turner pers. comm. 2025).

Calculating the density of muskrat pushups is another method of estimating muskrat abundance that is not dependent on the activities of harvest (Brammer 2017). Pushup structures are constructed annually on ice in the winter and are destroyed each spring when the ice melts (Brammer 2017). However, pushup densities are not entirely reliable at estimating population size because the number of muskrats using a single push-up is variable (Simpson *et al.* 1989; Brammer 2017). But they do offer an estimate of relative muskrat abundance across habitats and between years (Cott *et al.* 2016a; Brammer 2017). The correlation between pushup densities and muskrat abundance is monotonic, meaning that more pushups equal more muskrats (Brammer 2017). The number of muskrats per pushup has been estimated (Table 4) from previous live trapping studies with outcomes of 2.1 (Ruttan 1974 *in* Brammer 2017), 2.2 (Simpson *et al.* 1989 *in* Brammer 2017), and 3.4 in the Old Crow Flats (Martin 1974 *in* Brammer 2017); and

1.0 (Stevens 1955 *in* Brammer 2017), 1.7 (EPEC Consulting Western Ltd. 1977 *in* Brammer 2017), 2.4 (Hawley 1964*a*, *b in* Brammer 2017), and 2.9 in the Mackenzie Delta (McEwan 1955 *in* Brammer 2017).

In the Dehcho region, an intensive study was conducted in 2010 to understand the relative distribution of winter muskrat habitat, and relative abundance over time of muskrats in the Buffalo Lake, River, and Trails study area where the Whitesand and Yates Rivers flow into Buffalo Lake (Haas 2014). The survey found an estimated 1.1 pushups per square kilometer for a study area of approximately 390 km^2 (Table 5). Within this study area, Muskrat Lake had the highest relative density where 22% of muskrat pushups were observed (Haas 2014). The number of muskrat pushups observed was similar to numbers observed during previous studies in the Peace-Athabasca delta. In 1999, muskrat pushups observed in various basins in the delta ranged from 0-320, with a mean of 62 push-ups per basin (WAEL 1999 *in* Haas 2014).

An aerial survey of pushups in the Slave River and Slave River Delta (Table 5) was completed in Spring 2013; the survey found the highest densities of pushups in the Slave River Delta (2.16 pushups per square kilometer) as compared to along the Slave River (0.10 to 0.65 pushups per square kilometer; Cott *et al.* 2016a). The survey did not produce abundance estimates and has not been repeated to assess for changes as of 2026 (Goodman pers. comm. 2024, 2026).

A study in the Pickhandle Lakes of the Yukon investigated the relative abundance of muskrat using pushup densities (McLeod 2011). The study found 1,314 muskrat pushups within the 51 km^2 survey area, giving a density of 24.3 push-ups per km^2. In February 1978 surveyors (Beak Consultants 1978 *in* McLeod 2011) counted 1,138 push-ups (21.1 push-ups) per km^2. Slough and Jessup (1984 *in* McLeod 2011) found 20.2 push-ups per km^2 in 1982 and 11.7 push-ups per km^2 in 1983.

Table 4. A summary of estimated numbers of muskrats per pushup. The number of muskrats per pushup is highly variable. Attempts have been made to estimate the monotonic relationship (more pushups = more muskrat) based on live trapping studies in the Old Crow Flats, Yukon and the Mackenzie Delta, NWT. See various source *in* Brammer 2017 below.

Region	Number of Muskrats per Pushup	Source (*in* Brammer 2017)
Old Crow Flats	2.1	Ruttan 1974
	2.2	Simpson *et al.* 1989
	3.4	Martin 1974
Mackenzie Delta	1.0	Stevens 1955
	1.7	EPEC Consulting Western Ltd. 1977
	2.4	Hawley 1964*a*, *b*
	2.9	McEwan 1955

Table 5. Muskrat pushup densities from various surveys completed in the NWT and Yukon including Pickhandle Lakes, Yukon (McLeod 2011), Mackenzie Delta, NWT (various sources in Brammer 2021), Buffalo Lake, NWT (Haas 2014), Muskrat Lake, NWT (Haas 2014), and Slave River, NWT (Cott *et al.* 2016a).

Location	Year of Study	Site Description	Pushup (pu) Count	Block Area (km^2)	Density (pu/km^2)
Pickhandle Lakes, Yukon (McLeod 2011)	1978 (Beak Consultants 1978)	n/a	1,138	54	21.1
	1982 (Slough and Jessup 1984)	n/a	n/a	54	20.2
	1983	n/a	n/a	54	11.7
	2010	n/a	1,314	54	24.3
Mackenzie Delta, NWT (various sources *in* Brammer 2021)	1948	n/a	n/a	n/a	>500
	1960-1980	n/a	n/a	n/a	~25 to 250
	2014-2018	n/a	n/a	n/a	~2 to 50
Buffalo Lake, NWT (Haas 2014)	2010	n/a	436	390	1.1
Muskrat Lake, NWT (Haas 2014)	2010	n/a	94	1.43*	65.7*
Slave River, NWT (Cott *et al.* 2016a)	2013	1	55	356	0.15
		2	34	335	0.10
		3	159	367	0.43
		4	57	253	0.23
		5	109	340	0.32
		6	215	329	0.65
		7	204	338	0.60
		8 (Slave River Delta)	1,417	656	2.16

*Denotes values that were determined/calculated outside of the original study.

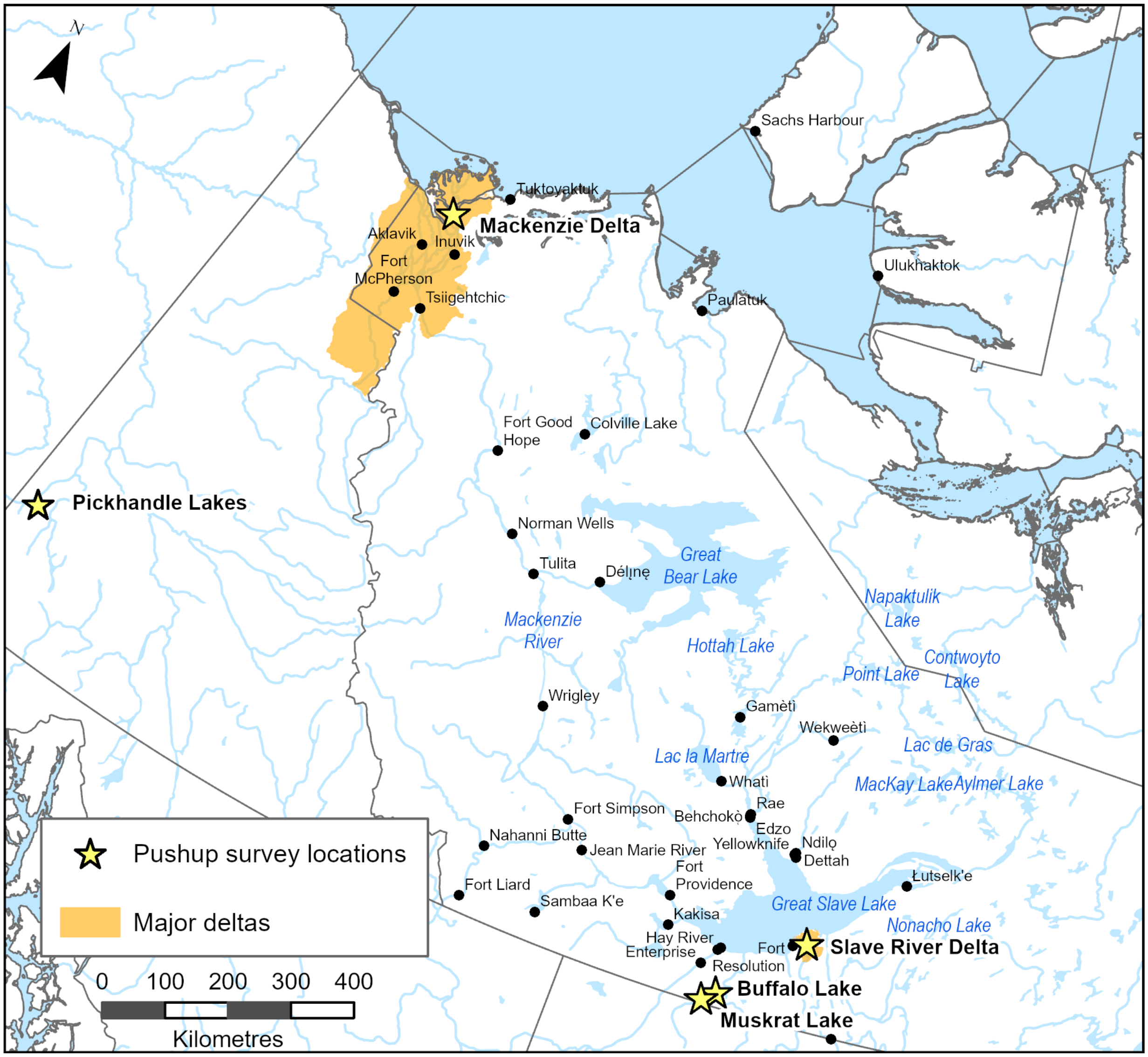

Figure 19. Areas where muskrat pushups surveys have been completed in the NWT including Pickhandle Lakes, Yukon (McLeod 2011), Mackenzie Delta, NWT (various sources in Brammer 2021), Buffalo Lake, NWT (Haas 2014), Muskrat Lake, NWT (Haas 2014), and Slave River, NWT (Cott *et al.* 2016a).

In the absence of direct estimates of muskrat populations, muskrat researchers in the NWT and adjacent regions estimate that the number of muskrats in the NWT is in the range of hundreds of thousands to the low millions (Brammer pers. comm. 2025; Turner pers. comm. 2025). This estimate is based on fur return data from the 1950-51 season when 300,000 to 500,000 were trapped in the NWT (Natural Resources Canada 1957). The NWT Species Infobase also estimates the muskrat population in the millions based on annual harvest data between 1957 to 1999 (NWT Species Infobase 2024). The data do not exist to make a finer-scale population estimate.

Trends and Fluctuations

Muskrat populations in the NWT, as elsewhere, fluctuate in a sometimes-cyclical manner, though the period varies in different areas and at different times (Erb *et al.* 2003; Brammer 2017). Abundance estimates must be continuous over a long enough time to capture the cyclicity of the population to be able to accurately capture the trend. No such datasets exist for the NWT. However, a study of historic time series for muskrat from boreal, taiga, and southern Arctic regions of Canada found an overall mean period length that ranged from 3.7 to 8.6 years (Erb *et al.* 2000; Sadowski and Bowman 2021).

Across North America, there have been suggestions that muskrat populations have been declining since the early 2000s (Sadowski and Bowman 2021). Many of these declines are evident from reduced muskrat harvest. As the top harvested furbearer in North America of the 20th century, correlations between harvest levels, pelt prices and muskrat abundance are well studied (Sadowski and Bowman 2021). More recently, the harvest dynamics of muskrat are no longer showing a strong relationship between harvest levels and pelt prices (Sadowski and Bowman 2021). This lack of periodic fluctuation, as compared to historical data, suggests widespread population declines (Roberts and Crimmins 2010 *in* Sadowski and Bowman 2021). Acknowledging that relying on harvest data to extrapolate population trends can be problematic, these apparent declines across their range are concerning.

As there are no muskrat abundance estimates, either historical or modern, for any areas of the NWT, defining trends is not possible. A series of examples of trends in specific areas of the NWT and adjacent regions (Old Crow Flats and Peace-Athabasca Delta), both historical and modern, are included to characterize what may be happening in the territory overall. The Old Crow Flats in the Yukon have a similar climate as the Mackenzie Delta in the NWT, which can offer insights into non-delta systems within the NWT, and information from the region will be considered here for that reason. The Peace-Athabasca Delta, which is located just upstream of the Alberta-Northwest Territories border, has regional conditions similar to the Slave River and Delta, and will be considered here for that reason.

Declines in muskrat abundance have been observed by harvesters in the Peace-Athabasca and Slave River and Delta regions when water levels declined and flooding patterns changed after the Bennett Dam was constructed (WAEL 1999; Pembina Institute 2016; Straka *et al.* 2018). When the Williston Lake reservoir was filled between 1968 and 1971, the water-surface area was reduced by approximately 36-38%; over the same period (1966 to 1972) muskrat harvest fell from 144,000 to 2,000 pelts (WAEL 1999; Cott *et al.* 2008). Muskrat populations increased between 1972 and 1976 in response to flooding that restored basin water levels, but declined again between 1976 and 1979 as a result of further drying of basins (WAEL 1999). These results indicate that muskrat densities across an entire delta can be negatively affected by changes in water flow and timing, and that recovery can be favourable when flooding conditions resume (Straka *et al*. 2018).

Hawley (1978) reported a population decline of muskrats in 1963 in the Mackenzie Delta to approximately 10% of the previous year's population, based on aerial and ground pushup surveys. Hawley further reported that the population had recovered to nearly 1962 levels by 1967. Hawley (1978) did not determine the cause of this decline, although it was stress and overcrowding were hypothesized to have been factors, as other muskrat scholars have noted (i.e. Errington 1954; Erb *et al.* 2001). Muskrat population declines have been reported by harvesters in the Mackenzie Delta since the 1990s to 2010s (Chetkiewicz and Marshal 1998; Turner *et al.* 2020), from the 1970s-early 1980s to the 2010s in the Slave River and Slave River Delta (Pembina Institute 2016), and in the Old Crow Flats, Yukon (Brammer 2017).

Little scientific analysis has been attempted to quantify these observed declines in the NWT, except by Brammer (2017, 2021). Brammer used aerial pushup surveys conducted in the spring to compare pushup densities from 1984-1986 to densities from 2006-2015 in the Old Crow Flats. He found little evidence of a population decline based on these surveys (Brammer 2017). Methods differed among time periods and may have influenced results.

Brammer (2021), in a collaboration between ECCC and the Gwich'in Renewable Resource Board (GRRB), also sought to document muskrat population changes caused by changes to muskrat habitat (i.e., drying up) reported by local harvesters in the Mackenzie Delta. Brammer collected data from all past pushup density surveys in the Mackenzie Delta and conducted additional aerial surveys from 2015-2019. The study found a significant decline in muskrat pushup densities from the period of 1948-1976 to the period of 2015-2019, with the latter period having densities of on average only 40% of those in the earlier period. However, it should be noted that the sample sizes, methods and conditions of pushup surveys varied considerably over this timeframe, and this introduces some uncertainty to the analysis.

The spatial variation between the two surveyed time periods was also striking, with muskrat densities in the lower delta, further north and towards the coast of the Beaufort Sea, increasing in more recent years, while densities in the upper delta (south) had decreased dramatically (Figure 20). This shift may be related to climate-induced changes in vegetation (Myers-Smith *et al.* 2011), water flow (GNWT 2022b), or other changes in habitat as discussed in *Habitat Trends*.

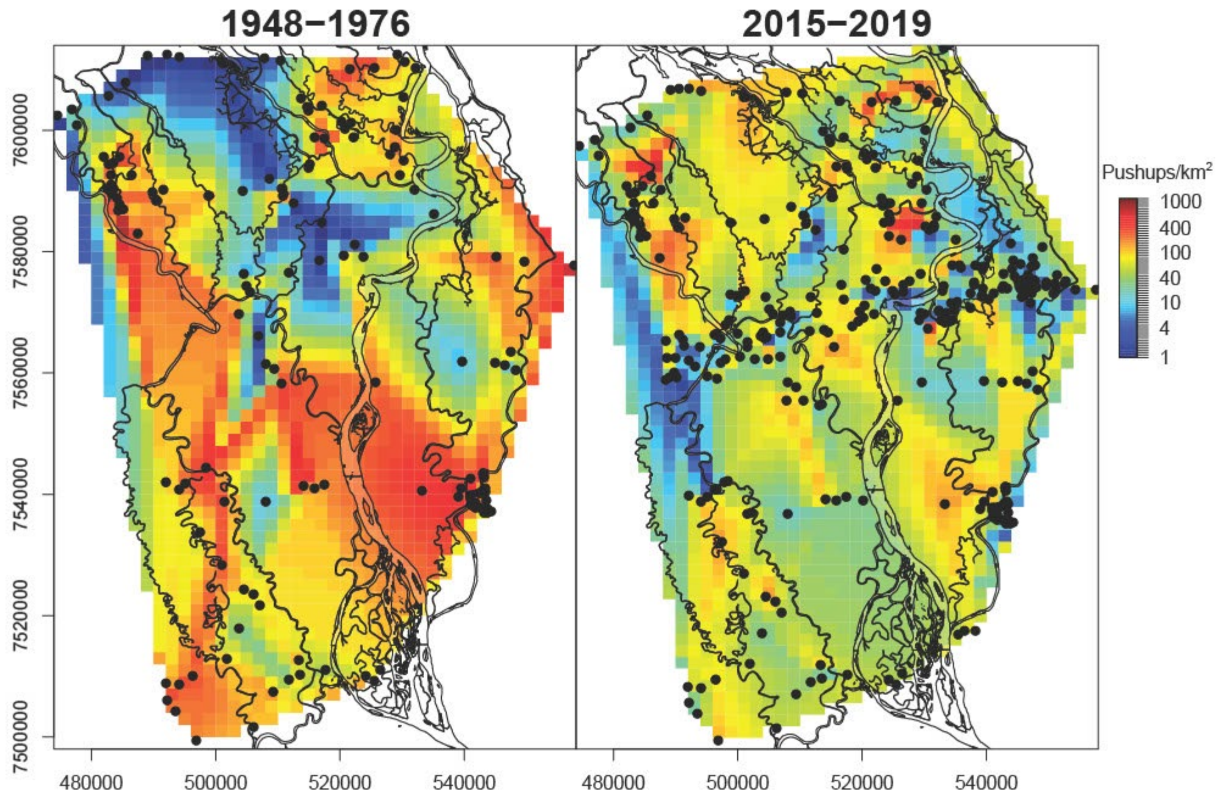

Figure 20. A heat map of muskrat pushup densities across the Mackenzie Delta that was calculated using all surveys between 1948 and 1976 in the left panel and all surveys between 2015 and 2019 in the right panel. Red colours indicate higher densities; blue colours indicate lower densities. Black points mark survey lakes. Density colours in areas without survey lakes are estimated using linear interpolation. Reproduced from Brammer 2021, with permission.

Brammer also led ground surveys of pushups with a combination of kill trapping and live-trapping and tagging programs in one area of the Mackenzie Delta from 2016-2019. The objective was to collect information on how many muskrats use a pushup and how many pushups are used by a muskrat, which could inform an abundance estimate from the pushup surveys (Brammer 2021). However, not enough years of data exist to provide an estimate of abundance (Brammer 2021; Turner pers. comm. 2025).

Further studies, including follow up studies on pushup densities, would help fill knowledge gaps related to muskrat abundance.

Population Dynamics

Studies in the mid-20th century characterized muskrat birth and recruitment rates in the Mackenzie Delta with litter sizes of 6-8 kits (McTaggart Cowan 1948; Stevens 1955; Boutin and Birkenholz 1987). Muskrats this far north tend to reproduce 1-2 times per year and have larger litters, whereas in other populations they may reproduce up to three times per year with fewer kits per litter (Boutin and Birkenholz 1987). Survival rates varied from lake to lake, depending on whether there was active harvest. Immigration and emigration rates were not calculated, but researchers observed that there was a high degree of dispersal between adjacent lakes (Hawley 1968). Brammer (2021) initiated a live-trapping study in the Mackenzie Delta to collect updated information on some of these metrics, but there are not enough years of data to report on them at this time.

Muskrats are able to populate suitable habitat through their high reproductive output and high dispersal ability, so much so that they are considered pests in many areas and successfully colonized nearly all of northern Europe and Asia after being introduced to, and subsequently escaping from, fur farms (Skyriené and Paulauskas 2013). Muskrat populations are also able to sustain intensive harvest pressure (Sadowski and Bowman 2021), though Simpson and Boutin (1989) indicate that this may be through immigration and not compensatory reproduction in northern systems like the Old Crow Flats, YT. This immigration is at a local level, as dispersal and recruitment rates from nearby lakes where they were not trapped were sufficient to repopulate lakes that were intensively trapped (Simpson and Boutin 1989). Fur records from the Mackenzie Delta from 1930-1946 (McTaggart Cowan 1948) indicate that intensive harvesting with yields of tens to hundreds of thousands of muskrats each year was sustainable over many years. Stevens (1953) and Hawley (1978) also noted dispersal from untrapped to trapped lakes in this region. Muskrat populations in the Slave River and Delta also sustained intensive harvesting pressure in the 1930s (Pembina Institute 2016).

There has been no consistent monitoring of body condition, size, age, recruitment, or mortality of muskrats in the NWT or any other associated metrics that could speak to how populations may be changing.

Possibility of Rescue

If muskrats were extirpated from parts or all the NWT, repopulation from adjacent populations would be likely. Muskrat have high dispersal capabilities and do not appear to be limited in their ability to move across the landscape (e.g. Simpson and Boutin 1989; Turner *et al.* 2020), especially in areas with dense water bodies (see *Movements* section). In neighbouring regions, muskrat populations are ranked between Apparently Secure to Secure (NatureServe 2026). In Alberta, muskrats have been assessed as secure every 5 years from 2005 to 2020 (Government of Alberta 2024), in Yukon they are considered Apparently secure/Secure (Government of Yukon 2024), and in both Saskatchewan and Manitoba they are ranked as Secure (Manitoba Conservation Data Centre 2024; Saskatchewan Conservation Data Centre 2024; NatureServe 2026). British Columbia had an estimated 3-4 million muskrats in 1979, and the species is currently on the yellow list, which indicates that they are secure (B.C. Conservation Data Centre 2024). In Nunavut, muskrat are ranked as Apparently Secure despite their limited numbers and smaller range (NatureServe 2026).

Some parameters indicate that muskrat populations are not as productive in the NWT as in populations further south (Hawley 1968; D'Entremont 2014), but no specific adaptations have been identified that are required for their persistence in the NWT. Populations are likely continuous from the provinces into the NWT, and along the Mackenzie watershed to the Beaufort Sea. While an individual muskrat is not going to travel from Alberta to the northern coast, dispersal of muskrats across this range would be possible over many generations unless connectivity was severely disrupted in a way that is not projected or likely to happen. As explored in the *Habitat Trends* section, there will likely be an abundance of muskrat habitat in the NWT even if significant climatic and ecological shifts take place, as it is at the northern edge of their range and some conditions may become more favourable.

The relatively undeveloped land base and high density of wetlands in the NWT may make the territory a refugia for muskrats if they are impacted in regions further south, as is true for species like grizzly bear (WMAC-NWT *et al.* 2022).

THREATS AND LIMITING FACTORS

There are several potential threats to muskrat populations in the NWT. These threats cannot be quantified as there have not been sufficient studies in the region. The studies that have been done, usually in more southerly parts of the muskrats' range, describe mechanisms that impact muskrats, but it is difficult to determine how they apply to population-level dynamics and in different environments (Brammer pers. comm. 2025). There may be data on the effects of a specific interaction, or how one area of habitat is changing, but not how each one of those mechanistic factors applies to a broader range. Similarly, studies from the southern parts of North America need to be interpreted with caution when extrapolated to the NWT due to various differences such as body size, fewer litters but more kits per litter, seasonality in habitat use. As such, information on the mechanism and then the specific knowledge from the NWT are presented below.

Habitat Loss or Degradation

Changes to Wetland Ecosystems

A number of studies indicate that water-level regulation systems have had a negative influence on muskrat abundance, and that drying wetland habitats are a primary driver for the decline of muskrats (Sadowski and Bowman 2021). Water levels that are excessively high or periods of drought are the greatest selection pressure affecting muskrat (Greenhorn *et al.* 2017; Toner *et al.* 2010; Ward and Gorelick 2018 *in* Sadowski and Bowman 2021). As discussed in *Habitat Trends*, anthropogenic disturbances can cause extreme fluctuations that can surpass the adaptability of many species (Coops *et al.* 2003; Cott *et al.* 2008).

Relatively constant water levels are required to enable muskrats to access food and construction materials during periods of ice-cover along with spring flooding events to replenish water and nutrients to perched areas of habitat (Avakyan and Podol'skii 2001 *in* Cott et al. 2008; Glass 1952 *in* Cott *et al.* 2008). Significant and sustained declines in water levels and flooding regimes have been observed to negatively impact muskrat abundance in the Peace-Athabasca Delta in Alberta (Straka *et al*. 2018), and in the Slave River and Delta (Pembina Institute 2016), which is linked to changes in habitat availability. Unstable water levels can increase muskrat vulnerability to predation, as they may be forced out of their safe habitats, either by flooding or by their homes freezing over (Cott *et al.* 2008; Pembina Institute 2016). Additionally, as water levels change during freeze-up, muskrats are further threatened by the formation of thick ice and the challenges of surviving harsh winter conditions, leading to higher overwinter mortality (Brammer 2017). Under fluctuating water conditions, these factors result in muskrats being more susceptible to predation and nutritional stress (Errington 1963; Clark 1994; Virgl and Messier 1996; Brammer 2017).

Low or unstable water levels that alter wetland ecosystems are a threat to muskrat populations (Brammer 2017; Straka *et al.* 2018; Turner *et al.* 2020). While water levels in the NWT do not show a trend towards declining or drying from the 1970s to 2010s (GNWT 2022b), extreme drought conditions in many areas of the NWT have persisted since 2022 (GNWT 2024) and may cause enough drying in wetland ecosystems to impact muskrat populations by reducing the availability of overwintering habitat that does not freeze to the bottom. Further, if the length or frequency of drought conditions increases, these impacts could become more severe. Other changes in the timing and quantity of water flow in NWT watersheds, such as decreasing floodwaters and increased winter flow, may have negative impacts on muskrat populations. These can include pushups freezing over when there is flow over the ice in fall, winter, or spring (Pembina Institute 2016) and lakes not receiving inputs of water and organic matter necessary to sustain conditions and food resources suitable for muskrat survival (Turner *et al*. 2020). Increased year to year variability in water regimes can also decrease muskrat population densities because of increases in nutritional stress and predation risk (Brammer 2017).

The open water season is increasing in at least the Mackenzie Delta region of the NWT and likely more broadly throughout the territory as temperatures rapidly warm (GNWT 2022b). This and other changes in weather conditions and timing (e.g. heavy snow loads) can cause fluctuations in water levels and may result in frozen pushups or houses in the winter, lakes freezing to the bottom and a lack of available winter habitat, or reductions in the availability of emergent vegetation or submerged macrophytes for feeding (see *Habitat Trends*), all of which would have detrimental effects on muskrats. Increased open-water seasons also increase predation risk for muskrat (Brammer pers. comm. 2025).

Observed changes water chemistry, like increases in alkalinity and organic carbon, changes in chloride levels and turbidity, and warmer waters (GNWT 2022b) may impact muskrats. Organic matter in lake sediment is one of the primary drivers of edible biomass productivity in the Mackenzie Delta, which in turn drives muskrat presence (Turner *et al.* 2020).

Human Water and Land Use Activities

Landscape changes by human activity are estimated to occur on about 0.1% of the NWT land base (GNWT 2022b). Changes include linear developments (i.e., roads, seismic lines, pipeline rights-of-way, and telephone or other transmission lines) as well as non-linear disturbances (i.e., communities, commercial development and resource exploration and extraction activities).

Dams constructed to produce electricity can alter muskrat habitat by changing the timing and amount of water flow, affecting processes like spring flooding that have important roles in creating and sustaining muskrat habitat in downstream wetlands (see *Locations* and *Habitat Trends*; Straka *et al.* 2018; Turner *et al.* 2020). As previously discussed in *Habitat Trends*, muskrat population declines have coincided with changes in spring flooding regimes and winter overflow conditions impacted by the Bennett Dam on the Peace River and Peace-Athabasca Delta (WAEL 1999; Straka *et al.* 2018). See also *Population – Abundance* and *Trenda and Fluctuations*).

Seismic exploration and the use of controlled explosions to locate oil and/or gas have the potential to impact wildlife. Results of a 1976 study in the Mackenzie Delta found that muskrats exposed to seismic blasts showed signs of middle ear and lung damage particularly when bank burrows were within 6 m from shot holes or were submerged in water 15 m from shot holes (EPEC Consulting Western Ltd. 1977). The same study also found that the proportion of active pushups was much larger at distances greater than 180 m from seismic lines and there was a 53% decrease in the number of visits to a pushup per 24-hour period (EPEC Consulting Western Ltd. 1977).

Environmental Contamination

Environmental contamination may present another threat. Muskrats are known to be carriers of contaminants and their role in aquatic ecosystems causes them to be susceptible to exposure and bioaccumulation of contaminants that are often transported and stored by aquatic ecosystems (Ganoe *et al.* 2020). Muskrat individuals and populations can be affected by heavy metals (particularly mercury, cadmium, lead, and arsenic), agricultural-related contaminants (pesticides, herbicides, and insecticides), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) (Ganoe 2019; Ganoe *et al.* 2020). Ganoe *et al.* (2020) did not find evidence of any of these contaminants causing population-level impacts on muskrats, but some studies suggested impacts to individual muskrat health by certain contaminants, including dieldrin (a synthetic organochlorine pesticide used in agriculture) and PAHs.

Few studies on contaminants in muskrats have been undertaken in the NWT. A study in the Slave River area in 1999 found that PCBs, dichlorodiphenyltrichloroethane (DDT), organochlorines and cadmium levels in muskrats were very low or not detectable (Kennedy 1999) and were similar to other wildlife (Pembina Institute 2016).

Brammer (2021) looked at metal contamination in Mackenzie Delta muskrats. Livers from harvested muskrat were analyzed for concentrations of 31 elements (Table 6). The concentrations were similar to those found in muskrats collected from across Canada (Brammer 2021).

Table 6. The concentration of elements in muskrat livers collected in the Mackenzie Delta (Brammer 2021).

Element	Concentration in Muskrat Liver (95% confidence intervals)
Mercury (Hg)	0.009 ± 0.002 µg/g
Cobalt (Co)	0.16 ± 0.02 µg/g
Arsenic (As)	0.39 ± 0.09 µg/g
Selenium (Se)	1.17 ± 0.08 µg/g
Cadmium (Cd)	0.109 ± 0.032 µg/g
Lead (Pb)	0.09 ± 0.05 µg/g

A study of muskrats in the Slave River Delta and contaminants was conducted in 2013 that compared concentrations in furbearers over a 25-year period between the early 1990s and 2013 (Cott *et al.* 2016b). The concentrations of mercury, cadmium, arsenic, lead and chromium were very low in the muscle tissue of muskrat, snowshoe hare, mink and beaver, and mercury concentrations had decreased in the livers of muskrat and hare over the last 25 years (Cott *et al.* 2016b).

Muskrat have also been observed occupying and persisting in habitat with historic contamination including arsenic concentrations well above the water quality guidelines for the protection of aquatic life (D'Entremont 2014). Baker Creek is a small watercourse that passes through the Giant Mine Remediation Site in Yellowknife, NWT. Muskrat persists in Baker Creek despite elevated levels of arsenic (70.0 µg in 2001) in the environment above the water quality guidelines of 5.0 µg (D'Entremont 2014). Physiological data were not collected during this study and the impacts of arsenic contamination on muskrat health are not known. Research in other areas have also demonstrated muskrat persistence and population stability despite high levels of environmental contamination, although there is an impact on individual animal condition (Halbrook *et al.* 1993).

Predation

Predators influence muskrat population cycles and mink are considered the most important predator of muskrats (McDonnell 1983 *in* Sadowski and Bowman 2021). The amount of predation by mink and other predators and possible impacts to muskrat abundance in the NWT have not been quantified, however it seems likely that there is a relationship (see *Predators*).

In Canada, the approximate 10-year cycles in muskrat show a close relationship with mink numbers (Erb 2000). Mink is considered a generalist predator, but muskrat is an important prey species and studies have noted that mink predation increases during drought when muskrat is weakened (Errington 1943; Erb 2000). Although voles or lemmings are a primary prey source for foxes, they may switch to muskrat as an alternative prey species when vole/lemming populations are lower (Erb 2000). These factors change the nature of predation on muskrat populations.

Harvest records of muskrat and mink in the NWT from 1931-1946 and 1967-1996 offer insight into the relationship between their populations (GNWT unpubl. data 2025). These data are presented in Figure 21, but have not been statistically analyzed for interactions between the two populations.

Another known factor that influences the number of harvested animals is the price of furs, which are presented for muskrat, mink and fox in Figures 22, 23 and 24, respectively, and show a clear relationship although no statistical analysis has been completed.

In the Inuvik region, harvest of fox and mink, two important muskrat predators, declined significantly over the period from 1931-1996 (Figure 25). Across the NWT, harvest numbers of these two predators also decreased, at a slower rate, from 1967-1996, but trends past 1996 are unknown (Figure 26; GNWT upubl. data 2025). Harvest of all muskrat predators across the NWT has increased from 1967-1996, largely driven by high numbers of marten taken in the 1980s (Figure 27; GNWT unpubl. data 2025). However, marten have not been reported as a common or prolific predator of muskrat in the NWT (Turner pers. comm. 2025), so the declining trend of fox and mink harvest is likely more pertinent for discussing predation of muskrats. Decreased harvest of predators could result in increased predator abundance and higher predation pressure on muskrat populations (Brammer pers. comm. 2025).

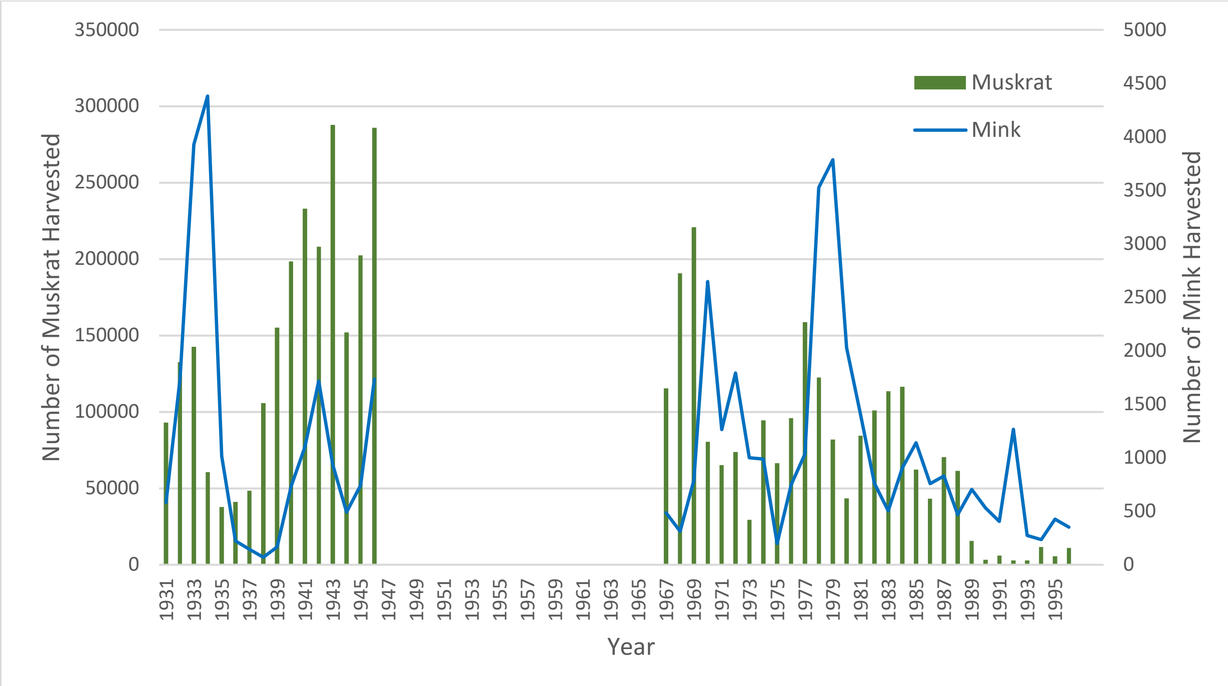

Figure 21. Muskrat and mink harvest numbers based on fur returns in the Inuvik Region for 1931-1946 and 1967-1996. There is no fur return data for 1947-1967, which is indicated by the red vertical line. Y-axes are at different scales for each species to better show variation. Data are from GNWT fur harvest records (GNWT, unpubl. data 2025).

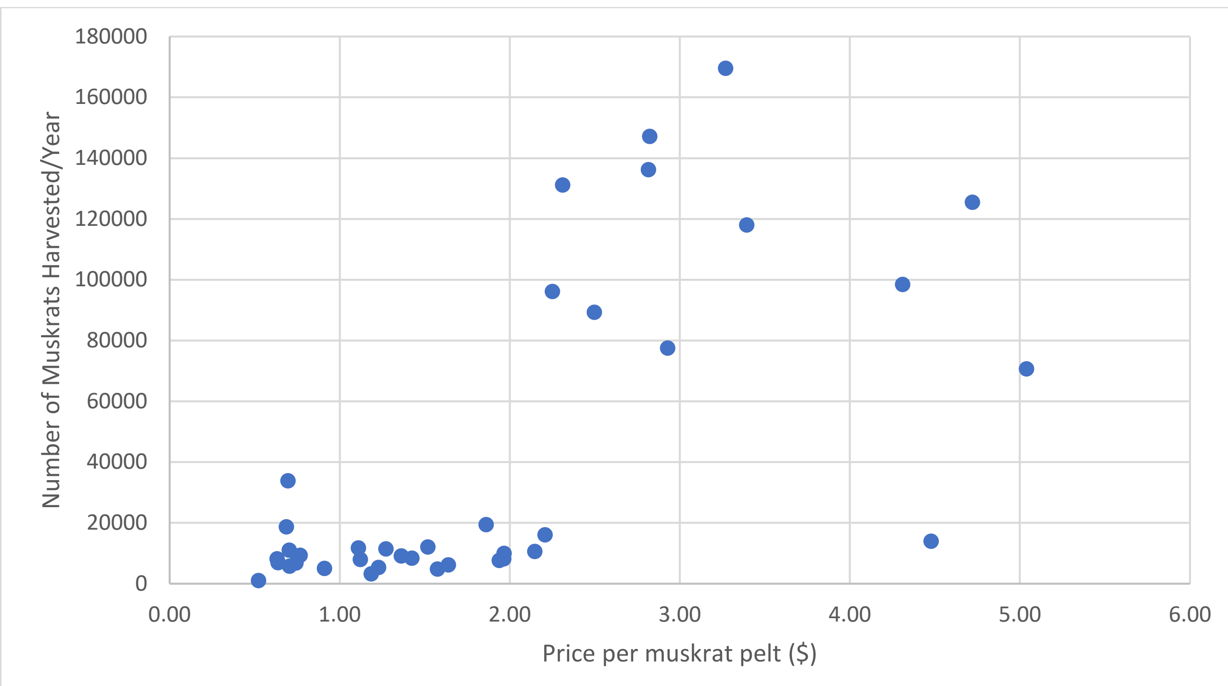

Figure 22. Harvest of muskrat per year plotted against price per muskrat pelt ($) for the same year (data span 1978-1996 & 2000-2018). Data are from GNWT fur harvest records (GNWT, unpubl. data 2025).

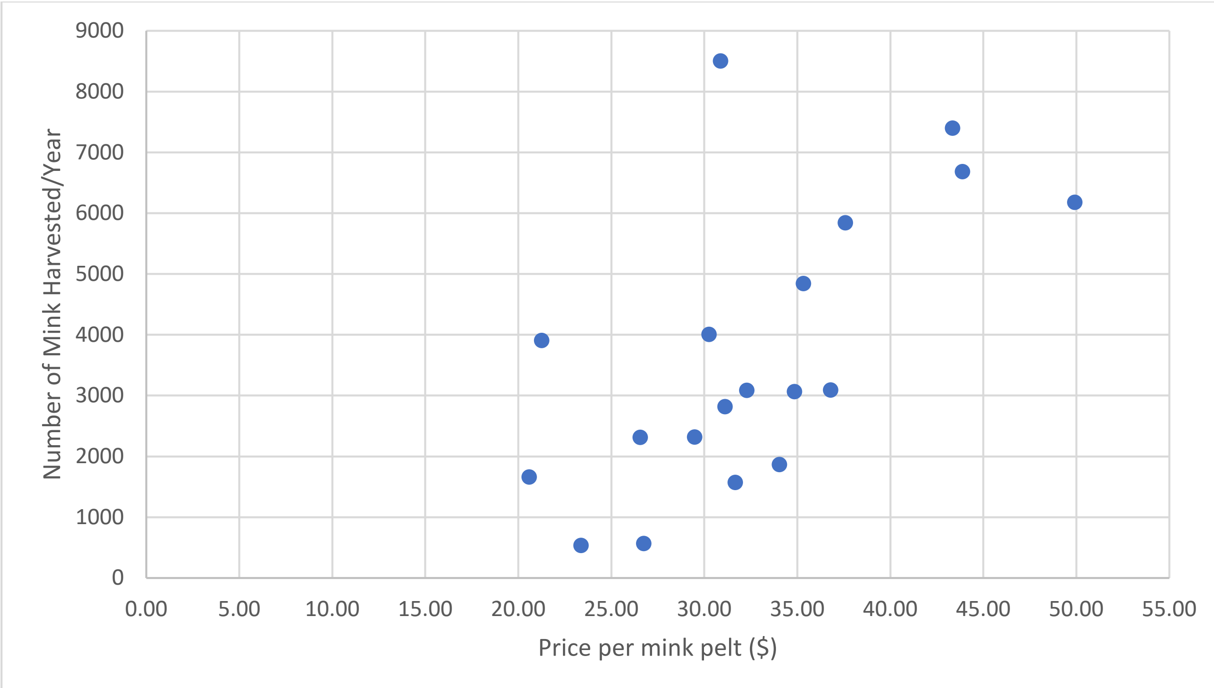

Figure 23. Harvest of mink per year plotted against price per mink pelt ($) for the same year (data span 1978-1996). Data are from GNWT fur harvest records (GNWT, unpubl. data 2025).

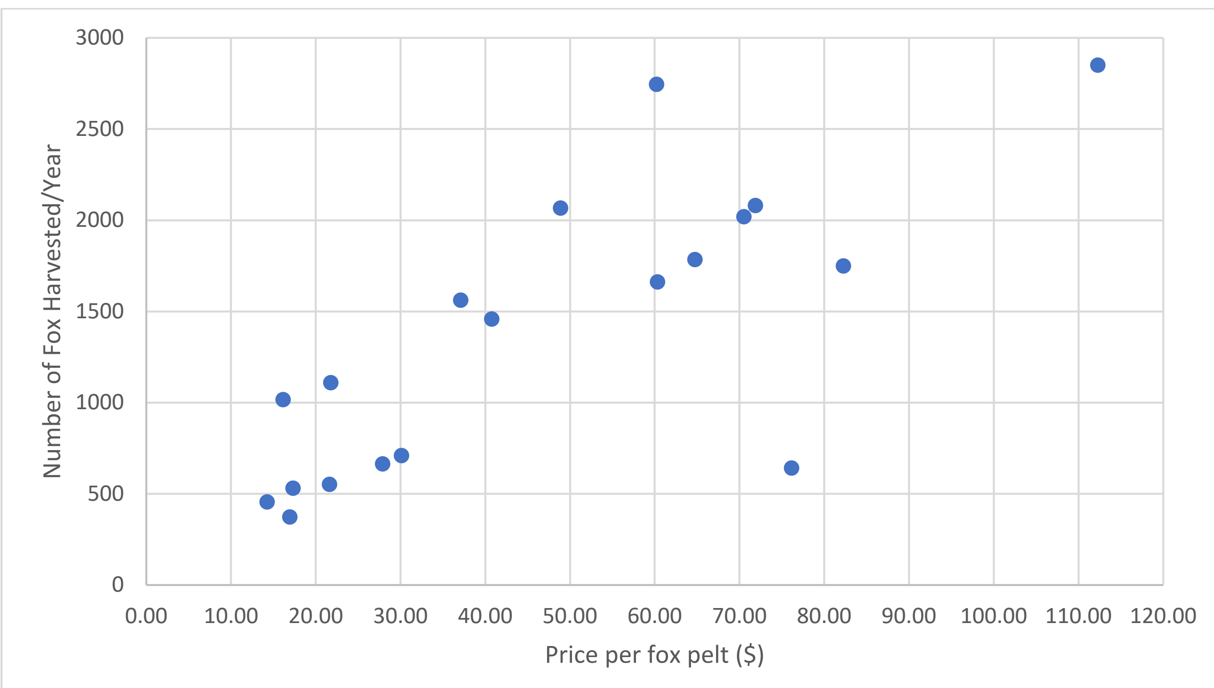

Figure 24. Harvest of fox per year plotted against price per fox pelt ($) for the same year (data span 1978-1996). Data are from GNWT fur harvest records (GNWT, unpubl. data 2025).

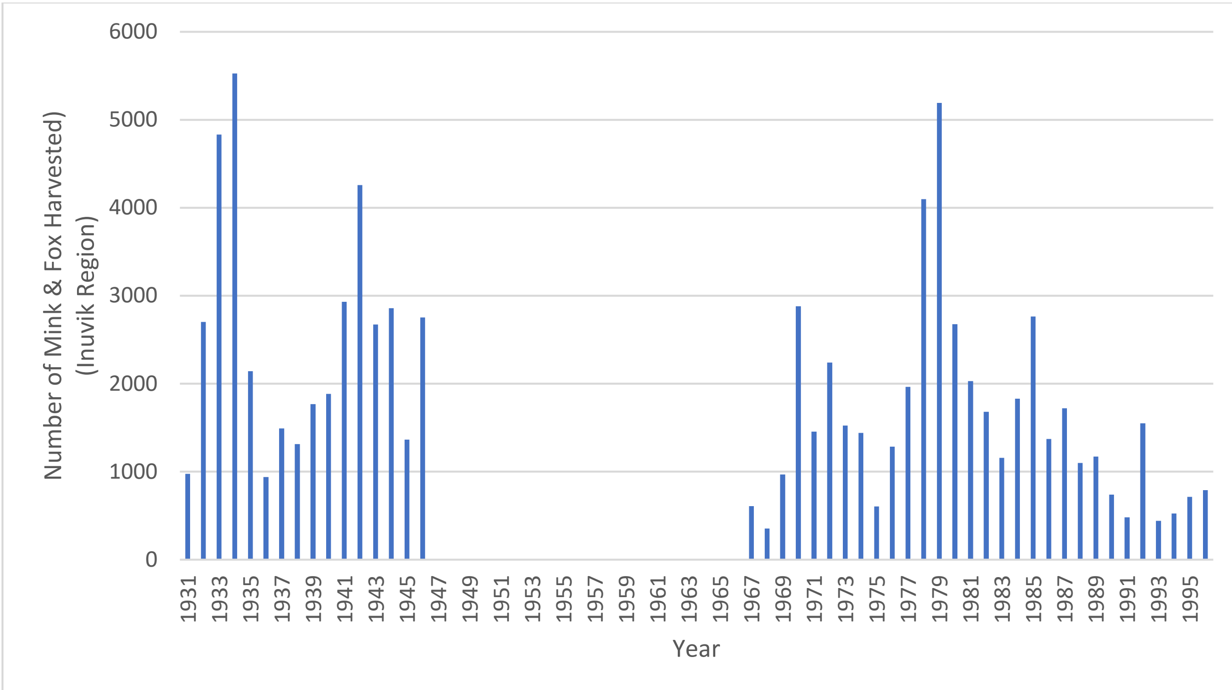

Figure 25. Harvest of fox and mink in the Inuvik region from 1931-1946 and 1967-1996. Red line denotes discontinuity in data from 1947-1966. Data are from GNWT fur harvest records (GNWT, unpubl. data 2025).

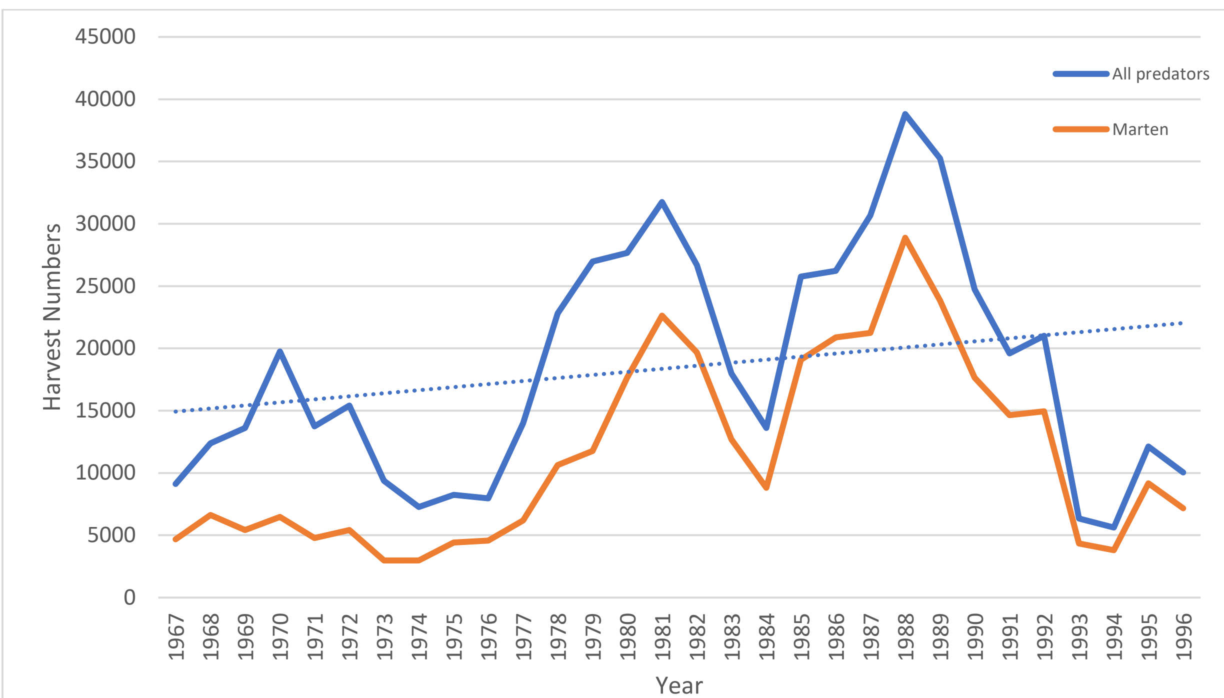

Figure 26. Harvest of all predators (fox, lynx, marten, mink, wolf, wolverine) and just marten in the NWT from 1967-1996, with trendline. Data are from GNWT fur harvest records (GNWT, unpubl. data 2025).

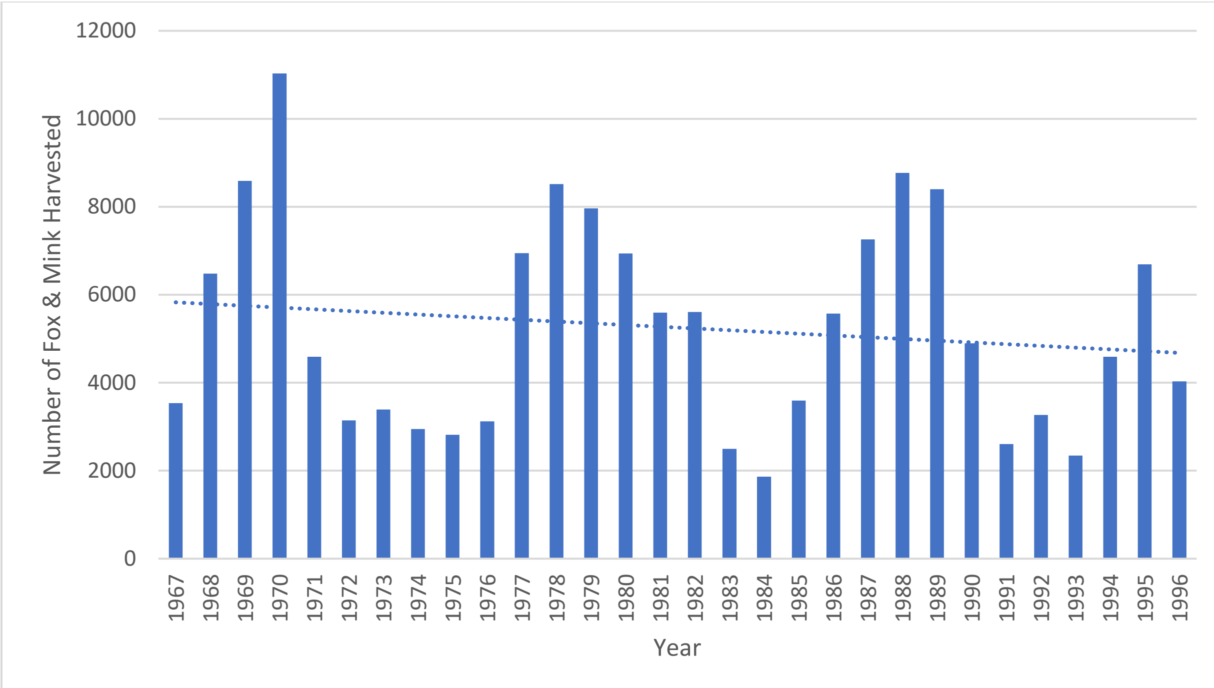

Figure 27. Harvest of fox and mink in the NWT from 1967-1996, with trendline. Data are from GNWT fur harvest records (GNWT, unpubl. data 2025).

In addition to changes in the harvest of predators, predation on muskrat may also be influenced by northward range expansions of predatory species and increased population densities in the northern parts of their range (i.e. grizzly bear [WMAC-NWT *et al*. 2023]. Otters may be a new and increasing predator of muskrat, at least in the Mackenzie Delta. Previous studies in the area that commented extensively on predators (Stevens 1953; Hawley 1968) reported no otter predation, but there is now evidence of otter predation in the Mackenzie Delta in recent years (Brammer pers. comm. 2025).

Pathogens and parasites

Muskrats are exposed to many pathogens (bacteria, fungi, viruses and parasites) across their range worldwide (Skyriené and Paulauskas 2013; Ganoe *et al.* 2020). Ganoe *et al.* (2020) completed a review of all pathogen and contaminant exposure to muskrats across North America to characterize their potential impact on muskrat populations. Most pathogens reported in the literature do not cause mortality in muskrats. Bacteria have the most impact; of 24 bacteria species reported in the studies examined by Ganoe *et al.* (2020), six caused mortality, notably *Francisella tularensis*, *Clostridium piliformis*, and cyanobacteria. Bacteria often result in epizootics (outbreaks) that cause or are caused by cascading effects through the ecosystem via other species and persistent bacteria in habitat (Ganoe *et al.* 2020).

Tularemia is caused by *F. tularensis*, which can be carried by a variety of animals or insects such as rodents (e.g., voles, mice, muskrat, beaver, rabbit; GNWT 2017), ticks, fleas, and mosquitos; muskrats (and beavers) serve as the primary host in the aquatic cycle (Ganoe *et al.* 2020). Epizootics (outbreaks) have been reported in Alberta and Ontario (as well as Vermont, USA; Ganoe *et al.* 2020). Tularemia has been diagnosed in animals in the Northwest Territories (Wobeser *et al.* 2009) as well as in humans including two cases in the Mackenzie Delta in 1977 and 33 cases in the Fort Resolution area (Lantis 1981). In the outbreak in the Fort Resolution area, *F. tularensis* was isolated from beaver, but the animal contact in 10 of 12 human cases had been with muskrats (Lantis 1981; Wobeser *et al.* 2009). There has not been a confirmed case of tularemia in humans in the NWT in the last 10 years (Rohit pers. comms. 2026).

C. piliformis causes Tyzzer's disease which is an acute bacterial disease reported in a variety of species including mice and muskrat (Ganoe *et al.* 2020). Shed spores can remain in the environment (e.g., muskrat shelters) for at least five years, reinfecting individuals that re-colonize shelters (Ganoe *et al.* 2020). Tyzzer's disease has been diagnosed in muskrats in Saskatchewan, Ontario and Quebec (Wobester *et al.*2009). Mortalities from Tyzzer's disease have been reported in Saskatchewan and British Columbia (Ganoe *et al.* 2020) – but neither the disease nor spores have been detected in the NWT (Jutha pers. comm. 2026; Elkin pers. comm. 2026).

Cyanobacteria (i.e., blue-green algae) can form toxic algal blooms that have caused muskrat mortalities elsewhere (Iowa in 1952; Ganoe *et al.* 2020). Poisoning can cause mortality directly through exposure in the water or through bioaccumulation through consumption of mussels or clams (Ganoe *et al.* 2020). Muskrat in the NWT have not displayed attributes of exposure to these toxins (Jutha pers. comm. 2026; Elkin pers. comm. 2026). However, cyanobacteria blooms have been reported at low abundance in Great Slave Lake and other southern NWT water bodies (Cederwall and Cott 2025). The impact of cyanobacteria on wildlife should be monitored in the NWT.

Several taxa of parasites affect muskrats, including protozoans, trematodes, cestodes, nematodes, acanthocephalans, pentastomes, and ectoparasites; trematodes and nematodes are prevalent in muskrat populations elsewhere, but cause very few investigated muskrat mortalities and minor impacts to muskrat body condition (Ganoe *et al.* 2020).

Various parasitic protozoan species are prevalent in muskrat but do not appear to have significant health impacts (Ganoe *et al.* 2020). *Giardia spp.* and *Cryptosporidium spp.* have been reported in muskrats in Alberta (Ganoe *et al.* 2020) and the Yukon (Roach *et al.* 1993). The prevalence of protozoan parasites in muskrats in the NWT is unknown.

Muskrats also host several endoparasites including trematodes (i.e., flukes), cestodes (i.e., tapeworms), and nematodes (i.e., roundworms; Ganoe *et al.* 2020). In the NWT, Brammer (2021) found that muskrats in the Mackenzie Delta had liver parasitism rates of 7 to 30%, similar to other studies in the Mackenzie Delta in the 1950s and 1970s. The most commonly observed parasite was the tapeworm *Taenia taeniaeformis*, which causes lesions on muskrat livers (Brammer 2021). These parasites were present in muskrats in the Mackenzie Delta when they were examined, but no pathogenic impacts have been detected (e.g. McTaggart Cowan 1948; Brammer 2021). The level of parasitic infections, particularly from *Taenia sp*., in this study was not particularly high and was considered to fall within the range of levels reported for other wild muskrat populations (Brammer 2021). This species of cestode parasite in muskrats is not considered a human health hazard.

Ectoparasites affecting muskrat primarily include mites (reported in eight U.S. states and in Manitoba), with one flea species reported (Indiana); infestations are not often associated with overt disease outcomes (Ganoe *et al.* 2020). High prevalence (25 to 100%) and burden (811 mites per muskrat) can be cause for concern during winters when fat reserves are crucial to survival (Ganoe *et al.* 2020). More studies are needed to understand the prevalence, burden and impact of ectoparasites on muskrat population in the NWT.

The demographic characteristics of muskrat, including high reproductive rates and high dispersal capabilities, make their populations resilient to negative impacts from pathogens and/or parasites (Sadowski and Bowman 2021). Some of the pathogens and parasites discussed occur naturally with low prevalence, and any recorded outbreaks have been localized (Errington 1963 *in* Sadowski and Bowman 2021). Disease is a natural aspect of muskrat ecology that can affect their abundance over the short term but typically balances out over the long term (Sadowski and Bowman 2021).

More studies are required to fully understand the impacts of many pathogens and parasites and their geographic distribution (Ganoe *et al.* 2020). There is a need for further research and monitoring on the effects of pathogens and parasites on muskrat health.

POSITIVE INFLUENCES

Muskrat Natural History

Muskrats are highly adaptable, mobile, and have a very high reproductive rate, allowing them to colonize new regions at a rapid rate (Skyriené and Paulauskas 2013; Miller 2018). Muskrats have natural resilience to change and variability, provided there is habitat available to support their basic requirements. Muskrats can also have high population densities in human-modified habitats. These features contribute to the adaptability of muskrats to changes in habitat.

To specifically consider mobility as it relates to change, a large portion of the NWT and the muskrats' predicted distribution is within the Mackenzie River watershed (Figure 18). Within the watershed, there is a high degree of connectivity by water bodies for the semi-aquatic muskrat (Ward *et al.* 2021). At smaller scales, muskrat are effective dispersers by land and water and are likely able to move to adjacent water bodies if there are changes in part of a region (i.e., the Mackenzie Delta has over 40,000 lakes and a high degree of connectivity among them [Turner *et al.* 2020]), which could mitigate negative effects of changes such as water level declines on populations.

Habitat Protection

Some areas of muskrat habitat in the NWT are formally protected (Figure 28) by Indigenous Protected and Conserved Areas, National Parks, Territorial Parks, areas protected by Land Claim Agreements, areas conserved through land use planning, and one Wildlife Sanctuary (GNWT n.d.-c). The amount of protected land and water in the NWT is 17.3% (GNWT n.d.-c). Protected areas are varied, but most either prohibit or limit the amount of development within them, and have goals related to ecological and cultural integrity. Muskrats can benefit from regions where ecosystems are protected from degradation through development.

Protection of water is another important conservation measure for the semi-aquatic muskrat. *Northern Voices, Northern Waters: NWT Water Stewardship Strategy* was developed in 2010 by the federal and territorial governments (GNWT n.d.-d). Action Plans have been developed for 5-year periods, with the most recent one for 2021-2025. Goals of the strategy related to aquatic habitat quality include: 'aquatic ecosystems are healthy and diverse' and 'waters that flow into, within, or through the NWT are substantially unaltered in quality, quantity and rates of flow' (GNWT, n.d.-d). Abundant and uncontaminated water is important for muskrat populations to thrive in the NWT, and the Water Stewardship Strategy and its numerous partners contribute to this outcome.

The rivers of the Mackenzie River Basin flow from the Columbia Icefields in Alberta and from snowfields of the upper Peace River in British Columbia, to the mouth of the Beaufort Sea of the Arctic Ocean (MRBB 2026). As such, there are several bi-lateral transboundary water agreements between NWT and Alberta (Alberta-NWT Mackenzie River Basin Bilateral Water Management Agreement 2015), NWT and Yukon (Government of Yukon and GNWT 2022a and 2022b), and NWT and British Columbia (NWT-British Columbia Bilateral Water Management Agreement 2015; GNWT n.d.-b). The Government of Canada, Saskatchewan, Alberta, British Columbia, Yukon, and the Northwest Territories are all signatories to the Transboundary Waters Master Agreement (1997), which created the Mackenzie River Basin Board (MRBB; MRBB 2025). The MRBB brings the parties together to uphold the principles of the Agreement, which relate to sustainability, ecological integrity, consideration for neighbouring and downstream jurisdictions while honouring the authority of each jurisdiction within its boundaries, and providing a space for communication, cooperation and conflict resolution (MRBB 2025).

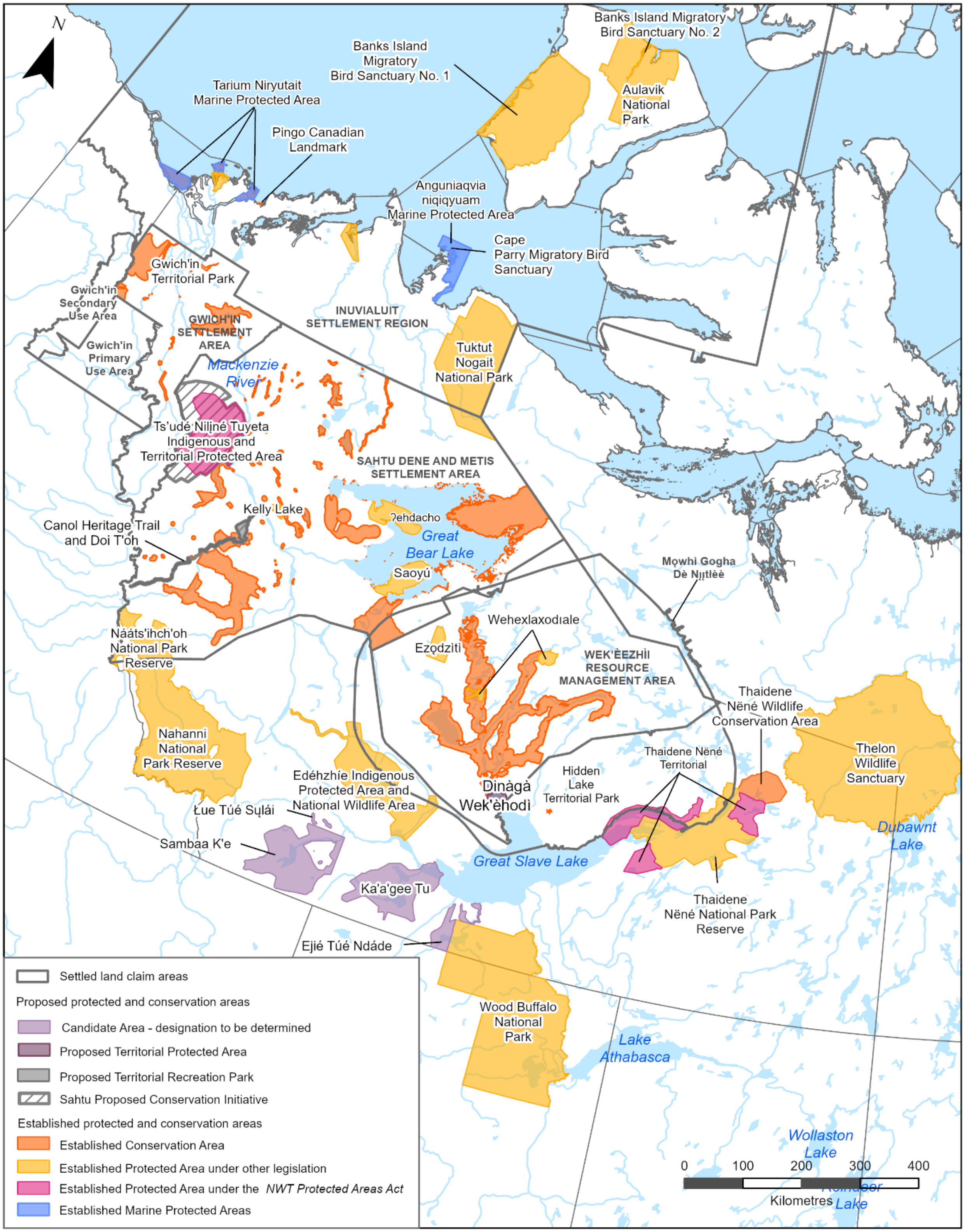

Figure 28. Established conservation areas, protected areas and marine protected areas as well as areas identified as proposed protection areas or candidate areas as of March 2026. Sources: GNWT 2022c. Map courtesy E. McHugh, ECC.

Water use in the NWT is regulated through the water licensing process, where the administration, application review and issuance is conducted by various land and water boards (Cott *et al.* 2008). Generally, for oil and gas exploration, water use of <100 m^3/day does not require a water license, and water use of between ≥100 and ≤300 m^3/day requires a Type B water license (Cott *et al.* 2008).

There are also guidelines and best practices for seismic program operators and resource managers with goals of minimizing impacts to wildlife as a result of land-based seismic programs with expectations outlined for the regulatory process (GNWT n.d.-e). The guidelines indicate that operators of seismic activities that require the use of explosives near fish-bearing waters should ensure that the instantaneous pressure change in the water column does not exceed 50 kPa and the peak particle velocity does not exceed 13 mm/second. In addition, seismic shotholes should be located at least 30 m from water bodies not frozen to the bottom in the Inuvialuit Settlement Region, and at least 50 m in the Mackenzie Valley (GNWT n.d.-e).

Interspecific Interactions

Scientific investigation indicates that co-habitation with beavers appears to have a net positive impact on muskrats (Mott *et al.* 2013; Matykiewicz *et al.* 2021). Mott *et al.* (2013) posits that muskrats may benefit from the work done by beavers in building lodges and otherwise engineering ecosystems for their shared use. A study on the interactions of introduced beaver, muskrat, and mink on Navarino Island, Chile showed that muskrats prefer habitats altered by beavers over habitats unaffected by beaver occupancy (Crego *et al.* 2016). In the northernmost extent of the muskrat and beaver range, beavers are expanding into tundra regions (Jung *et al.* 2016; Tape *et al.* 2018), possibly promoting muskrat range expansion alongside beavers.

Changing Environmental Conditions

With cliomes shifting northwards (see *Habitat Trends*), it is likely that muskrats are experiencing or will experience a range expansion and/or increases in abundance northward alongside these changing ecological conditions. This is based on similarity in habitat use by beavers and muskrats along with the documented range expansion of beaver in Alaska (Tape *et al.* 2018; Turner pers. comm. 2025) and in the outer Mackenzie Delta and surrounding tundra, as well as changing beaver densities reported in the Mackenzie Delta (see *Population: Trends and Fluctuations*).

Increased water flow in most NWT rivers (see *Habitat Trends*), depending on the timing of the increase flow, could improve the quality of muskrat habitat in many parts of the NWT, and changes in the timing and quantity of water flow in NWT watersheds may have positive impacts on muskrat populations.

Observed changes in NWT waters, like increases in alkalinity and organic carbon, changes in chloride levels and turbidity, and warmer waters (GNWT 2022b), may impact muskrats, although it is not clear whether this impact would be positive or negative. Organic matter and nutrient levels in lake sediment are important for muskrat-occupied lakes in the Mackenzie Delta (Turner *et al.* 2020), and muskrat habitat quality could benefit if there is more availability of these macro and micro-nutrients.

Conservation Measures

The NWT *Wildlife Act* and the *Trapping Regulations* outline measures to conserve muskrats and manage muskrat harvest. For instance, no person may harass furbearers like muskrats, and no person can destroy or damage a muskrat push-up (Gau pers. comm. 2026).

Indigenous muskrat hunters exercising their asserted or treaty rights within their traditional territory are exempt from any season or bag limits but are bound to using humane trapping methods outlined in the regulations, and may not waste the pelt or hide (Gau pers. comm. 2026).

General Hunting Licence holders, or the holder of any other permit or licence that authorizes the harvest of muskrats are also bound to using humane trapping methods but are limited to season which is depend on the timing of the breeding season in each wildlife management zone that generally ranges from mid-October or early November to the end of May or mid-June (*Wildlife Act; Trapping Regulations;* Gau pers. comm. 2026).

Restriction on the harvesting season ensures that juvenile and pregnant muskrats are not harvested. This is aligned with Indigenous conservation measures to hunt only in certain seasons and not when muskrats are pregnant and rearing young (AHTC *et al.* 2016; IHTC *et al.* 2016; THTC *et al.* 2016; Benson 2024).

Humane harvesting methods are in place because of international agreements that aim to reduce non-lethal injuries by trappers and protect the industry at-large. Specifically for muskrats no person shall use a foothold trap unless the trap is sure to cause drowning; trap with metal teeth or serration on the jaw; trap on land other than a cage, leg snare restraining trap, quick kill trap or soft catch trap; or use a trap that is not maintained in a fit condition. Regulations can be amended within certain co-management arrangements in the NWT (GNWT n.d.-a), which allows harvesters to report concerns and advocate for changes like updated seasons when necessary. This allows for adaptive management, a best practice in present-day wildlife management and conservation.

Other conservation measures for muskrats are recommended in the Inuvialuit Community Conservation Plans (CCPs) and include identifying and protecting important habitats from disruptive land uses and, in the case of Aklavik, reducing the number of beavers and otters (AHTC *et al.* 2016; IHTC *et al.* 2016; THTC *et al.* 2016).

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BIOGRAPHY OF PREPARER

Chanda Turner is one of the few non-Indigenous muskrat experts in the Northwest Territories, though her knowledge is not comparable to harvesters and Indigenous Peoples who have lifetimes of experience with these animals. She began working with muskrats and Gwich'in and Inuvialuit knowledge holders in the Mackenzie Delta in 2013 as a research assistant with the University of Victoria. Fascinated by the knowledge and stories that people shared with her about muskrats and captivated by the landscape of the Delta, she spent the next two summers doing her Master's research on muskrats. Her thesis was entitled "Springtime in the Delta: The sociocultural role of muskrats and drivers of their distribution in a changing Arctic delta" and was the product of many interviews, trips on the land, and chats over tea with Gwich'in and Inuvialuit folks, and field and aerial surveys of over 40 lakes between Aklavik and Inuvik.

She has been lucky to learn from so many different Indigenous knowledge holders and spend time on the land trapping, skinning, and eating muskrats. The pull of the land and muskrats kept bringing her back to the Mackenzie Delta and she made Inuvik home in 2017. Over the last 7 years, Chanda has supported Inuvialuit co-management through her roles as an IGC Resource Management Coordinator at the Joint Secretariat, contractor with Turner Environmental Services and Boreal North Consulting, and Senior Biologist at the Department of Fisheries and Oceans, where she works on co-management of the Tarium Niryutait Marine Protected Area alongside Inuvialuit managers. She is passionate about reducing the gap between how scientific information and Traditional Knowledge are valued in wildlife management,and is endlessly grateful to be trusted to do this to the best of her ability. Chanda calls Inuvik and the Mackenzie Delta home, and spends a ton of time out on the land with her partner, step-kids, friends and family.

STATUS AND RANKS

COMMON MUSKRAT (*ONDATRA ZIBETHICUS*)

Region	**Coarse Filter (Ranks)**[3] To prioritize	**Fine Filter (Status)** To provide advice	**Legal Listings (Status)** To protect under species at risk legislation
Global	G5 – Secure (NatureServe Canada 2016)	Least Concern (IUCN Red List 2016)	
Canada	N5 – Secure (NatureServe Canada 2016)	Not Assessed	No Status
Northwest Territories	Secure (NWT General Status Ranking Program 2025) S5 – Secure (NatureServe Canada 2016)	To be determined	No Status
Adjacent Jurisdictions			
British Columbia	S5 – Secure (NatureServe Canada 2016)	Yellow list – Secure (B.C. Conservation Data Centre 2024)	
Alberta	S5 – Secure (NatureServe Canada 2016)	Secure (Government of Alberta 2024)	
Saskatchewan	S5 – Secure (NatureServe Canada 2016)		

[3] All NatureServe codes are as defined in Definitions of NatureServe Conservation Status Ranks: http://help.natureserve.org/biotics/Content/Record_Management/Element_Files/Element_Tracking/ETRACK_Definitions_of_Heritage_Conservation_Status_Ranks.htm#NatureSe

Manitoba	S5 – Secure (NatureServe Canada 2016)		
Yukon	S4S5 – Apparently Secure (NatureServe Canada 2016)	Apparently Secure/Secure (Government of Yukon 2024)	
Nunavut	S3S5 - Vulnerable (NatureServe Canada 2016)		

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APPENDICES

APPENDIX A: NWT records of Canadian toad, western toad, and northern leopard frog

Table A1. Common Muskrat Observation Records in the Northwest Territories

This table includes observations and count data for muskrat in the Northwest Territories from 1860-2025. The information is drawn from various sources which are noted in the first column. Data may be requested from the source contributors or from WMISTeam@gov.nt.ca.

Source	Date	Latitude	Longitude	Notes (collected by)
iNaturalist	2024	64.910203	-125.475922	Spencer Quayle
iNaturalist	2024	62.52045	-114.190225	kyrabou
iNaturalist	2009	62.444498	-114.363719	PC Smith
iNaturalist	2024	67.335468	-134.886802	Emily
iNaturalist	2024	62.458113	-114.377228	Allison McCabe
iNaturalist	2024	62.461194	-114.369532	Faye Manning
iNaturalist	2024	62.460772	-114.368287	Suzanne Carriere
iNaturalist	2024	62.450897	-114.388528	Allison McCabe
iNaturalist	2024	62.446572	-114.395103	Allison McCabe
iNaturalist	2024	62.461789	-114.369111	Eamon Riordan-Short
iNaturalist	2024	62.463763	-114.368033	Allison McCabe
MCZ (Museum of Comparative Zoology)	1860	61.85	-121.33333	B. R. Ross
iNaturalist	2023	62.463886	-114.366247	Trevor Gurd
iNaturalist	2023	62.463858	-114.365659	Redbird Wu
TCWC (Texas Cooperative Wildlife Collection)	1988	67.38758	-134.92461	Derr, J.N.; Lockwood, S.F.
iNaturalist	2023	62.457784	-114.378032	Yousif Attia
iNaturalist	2023	62.552107	-114.026271	Kyle Blaney
iNaturalist	2023	62.46035	-114.373213	everosm
iNaturalist	2023	60.02132	-112.351949	Tracy
iNaturalist	2023	62.44043	-114.349183	Michele Grabke
iNaturalist	2023	61.854534	-121.348735	Taylor Justason
iNaturalist	2022	69.373256	-133.048806	Jukka Jantunen
iNaturalist	2022	62.463272	-114.366317	Bird Explorers
iNaturalist	2022	62.456103	-114.378564	Bird Explorers
iNaturalist	2022	62.518135	-114.320362	Suzanne Carriere
iNaturalist	2021	62.54066	-114.316267	C Graydon
iNaturalist	2021	61.606612	-125.760998	tinapca
UVIC (University of Victoria)	1983	68.68976	-134.13507	Charles D. Arnold
iNaturalist	2021	62.517318	-114.320197	Suzanne Carriere
iNaturalist	2020	62.47395	-114.344567	johanna_s
iNaturalist	2020	61.860969	-121.345261	kathrynwalpole
iNaturalist	2017	62.463037	-114.366898	Graham Sorenson

Source	Date	Latitude	Longitude	Notes (collected by)
iNaturalist	2019	69.440819	-133.024048	Evan Centanni
iNaturalist	2015	62.460813	-114.36802	Kyle Blaney
iNaturalist	2018	62.454793	-114.378466	Yousif Attia
iNaturalist	2018	62.45855	-114.37849	C Graydon
iNaturalist	2018	62.458471	-114.349566	C Graydon
iNaturalist	2018	62.461194	-114.369532	C Graydon
Canadian Museum of Nature (CMN)		68.7	-134.133	Stevens, Ward E.
CMN	1962	67.7667	-136.033	Youngman, Dr. Philip Merrill
CMN	1976	68.7833	-134.367	Lawton, Todd R.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1950	61.25	-113.667	Law, C.E.
CMN	1950	61.25	-113.667	Law, C.E.
CMN	1950	61.25	-113.667	Law, C.E.
CMN	1973	68.8333	-136.417	Martell, Arthur M.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1950	61.25	-113.667	Law, C.E.
CMN	1962	67.7667	-136.033	Youngman, Dr. Philip Merrill
CMN	1950	61.25	-113.667	Law, C.E.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1950	61.25	-113.667	Law, C.E.
CMN	1971	68.8333	-136.417	Martell, Arthur M.
CMN	1946	68.7	-134.183	Banfield, A.W. Frank
CMN	1948	68.7	-134.133	Stevens, Ward E.
CMN	1973	68.8333	-136.417	Martell, Arthur M.
CMN	1928	67.0333	-119.833	Porsild, Alf Erling
CMN	1950	61.25	-113.667	Law, C.E.
CMN	1950	61.25	-113.667	Law, C.E.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1952	69.4333	-133.033	Macpherson, Andrew H.
CMN	1962	67.7667	-136.033	Youngman, Dr. Philip Merrill
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1976	69.1	-134.3	Campbell, David B.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1947	68.7	-134.133	Stevens, Ward E.
CMN	1948	68.7	-134.133	Stevens, Ward E.
CMN	1968	65.7167	-126.667	Wrigley, Robert E.
CMN	1949	68.7	-134.133	unknown collector

Source	Date	Latitude	Longitude	Notes (collected by)
iNaturalist	2017	62.463298	-114.366785	C Graydon
iNaturalist	2017	62.462318	-114.367626	Suzanne Carriere
SUI (State University of Iowa)	1893	61.85	-121.333	Russell, Frank; Frank Russell Arctic Expedition
BBM (Beaty Biodiversity Museum)	1947	67.700001	-135.0087	W.E. Stevens
BBM	1947	67.700001	-135.0087	W.E. Stevens
BBM	1949	60.0053	-111.8829	C.E. Law
BBM	1947	68.22	-135.0087	Ian McTaggart Cowan
BBM	1947	68.22	-135.0087	Ian McTaggart Cowan
BBM	1947	67.700001	-135.0087	Ian McTaggart Cowan
BBM	1947	67.700001	-135.0087	Ian McTaggart Cowan
BBM	1947	67.700001	-135.0087	W.E. Stevens
BBM	1947	68.345517	-135.0087	Ian McTaggart Cowan
BBM	1947	67.700001	-135.0087	Ian McTaggart Cowan
BBM	1947	68.345517	-135.0087	Ian McTaggart Cowan
BBM	1947	67.700001	-135.0087	Ian McTaggart Cowan
BBM	1947	67.700001	-135.0087	Ian McTaggart Cowan
BBM	1947	68.345517	-135.0087	Ian McTaggart Cowan
BBM	1947	68.345517	-135.0087	Ian McTaggart Cowan
BBM	1947	68.345517	-135.0087	Ian McTaggart Cowan
BBM	1947	68.345517	-135.0087	Ian McTaggart Cowan
BBM	1947	68.345517	-135.0087	Ian McTaggart Cowan
BBM	1947	69.333333	-134.5	Ian McTaggart Cowan
MSB (Museum of Southwestern Biology)	2004	65.283333	-126.85	Collector(s): Richard Popko; Preparator(s): Joseph O'Connell
MSB	2004	65.283333	-126.85	Collector(s): Richard Popko; Preparator(s): Joseph O'Connell
MSB	2004	65.283333	-126.85	Collector(s): Richard Popko; Preparator(s): Joseph O'Connell
Dedats'eetsaa: Tłı̨chǫ Research and Training Institute	2023	65.300753	-113.946342	P. Jacobsen; Dedats'eeda: Tłı̨chǫ Research & Training Institute 2024
iNaturalist	2025	63.611447	-112.123811	Eamon Riordan-Short

APPENDIX B: Threats Assessment[1]

Threats have been classified for common muskrat in the NWT only (i.e., not including threats that may be present in neighbouring jurisdictions). The threats assessment is based on whether threats are of concern for the sustainability of the species in the NWT over approximately the next 10 years.

This threats assessment was completed collaboratively by members of the NWT Species at Risk Committee, at a meeting on June 20, 2025 and updated with new information on April 15, 2026. Parameters used to assess threats are listed in Table B1.

Table B1. Parameters used in threats assessment

Parameter	Description	Categories
LIKELIHOOD		
Timing (i.e., immediacy)	Indicates if the threat is presently happening, expected in the short term (<10 years), expected in the long term (>10 years), or not expected to happen.	Happening now Short-term future Long-term future Not expected
Probability of event within 10 years	Indicates the likelihood of the threat to occur over the next 10 years.	High Medium Low
CAUSAL CERTAINTY		
Certainty	Indicates the confidence that the threat will have an impact on the population.	High Medium Low
MAGNITUDE		

[1] This approach to threats assessment represents a modification of the International Union for the Conservation of Nature's (IUCN) traditional threats calculator. It was originally modified for use in the Inuvialuit Settlement Region Polar Bear Joint Management Plan (Joint Secretariat 2017). This modified threats assessment approach was adopted as the standard threats assessment method by the Species at Risk Committee and Conference of Management Authorities in 2019.

Extent (scope)	Indicates the spatial extent of the threat (based on percentage of population or area affected)	Widespread (>50%) Localized (<50%)
Severity of population-level effect	Indicates how severe the impact of the threat would be at a population level if it occurred.	High Medium Low Unknown
Temporality	Indicates the frequency with which the threat occurs.	Seasonal Continuous
Overall level of concern	**Indicates the overall threat to the population (considering the above).**	**High** **Medium** **Low**

Overall Level of Concern

The overall level of concern for threats to [species] are noted below. Please note that combinations of individual threats could result in cumulative impacts to [species] in the NWT. Details be found in the *Detailed Threats Assessment*.

Overall level of concern:

- **Threat 1 – Climate change impacts to habitat (water quantity) Medium**
- **Threat 2 – Climate change impacts to habitat (warmer temperatures) Low**
- **Threat 3 – Pathogens and parasites Low**
- **Threat 4 – Predation Low**
- **Threat 5 – Environmental Contamination Low**
- **Threat 6 – Reduction in harvest and traditional population controls Low**

Detailed Threats Assessment

Threat #1. Climate change impacts to habitat (water availability)	
Specific threat	Muskrats are well-adapted to and rely on wetland ecosystems throughout the year and during all life stages. However, climate change and human water and land use activities (e.g., hydroelectric facilities and dams) are altering water availability and changing the hydrological cycle of wetlands. These changes have the potential to negatively impact muskrat directly and/or indirectly by changing the quality of their habitat. Water-level regulation systems have a negative influence on muskrat abundance, and drying wetland habitats are a primary driver for observed declines in muskrat numbers. Water levels that are excessively high or periods of drought are the greatest selection pressure affecting muskrat.
Stress	Aquatic environments must be of suitable depth to sustain the growth of emergent and submerged vegetation for forage. Good inflow/outflow is also important in supplying fresh water and nutrients for the growth of vegetation. Spring flooding also provides inputs of water and organic matter necessary to sustain conditions and food resources suitable for muskrat survival. Muskrats overwinter in aquatic habitats that do not freeze to the bottom. During the winter muskrats use pushups and houses/burrows for shelter, food storage, and protection from predation. If water bodies are too shallow, then the underwater entrances to their house or burrow may freeze solid. This in turn forces them to forage above ground exposing them to cold air temperatures and predation. Fluctuations in water levels also negatively impact muskrat populations. For example, overflow events in the fall, winter or spring (outside of the open water season) have the potential to freeze pushups/houses/burrows preventing access or blocking exits. Reduced frequency of flooding due to ice-jams in the spring impact muskrat habitat; peak water levels are reduced resulting in some water bodies perched above the flood zone not getting replenished by water and the nutrients it carries. The year-to-year variability in these water regimes decreases muskrat population densities through nutritional stress and predation risk. Global atmospheric oscillations influence weather patterns including wet/dry conditions and temperatures. These oscillations can amplify the effects of a changing climate and, in some years, can rapidly affect environmental conditions in the NWT. Extreme drought conditions have persisted since 2022 and may cause enough drying in wetland ecosystems to impact muskrat populations by reducing the availability of overwintering habitat. Significant and sustained declines in water levels and unpredictability in flooding regimes have been observed to negatively impact muskrat abundance in the Peace-

	Athabasca Delta in Alberta and in the Slave River and Delta. The Slave River, Great Slave Lake, and upper Mackenzie River were also at record low water levels in 2010.
Extent	Localized (<50%)
Severity	Medium
Temporality	Continuous
Timing	Happening now
Probability	High
Causal certainty	High
Overall level of concern	**Medium**

Threat #2. Climate change impacts to habitat (warmer temperatures)	
Specific threat	Muskrats are well-adapted to and rely on wetland ecosystems throughout the year and during all life stages. However, impacts driven by climate change in these aquatic environments are likely causing declines in the number of muskrat and the quality of their habitat.
Stress	Knowledge-holders feel that declines in muskrat numbers seen in the 1990s and 2000s are due to changes in the land caused by climate change. Many of the observed changes are related to warmer temperatures including a longer open water season, melting permafrost, excessive erosion, landslides and slumps, shrubification, and excessive willow growth. The open water season is increasing in at least the Mackenzie Delta region of the NWT and likely more broadly throughout the territory as temperatures rapidly warm. A longer open-water season increase the predation risk for muskrat. Muskrats are widely distributed and changes in the freshwater ecosystems they occupy are not occurring at the same rate or directionality across the territory. Some areas may become better habitat for muskrats while others may be negatively impacted by observed and expected changes.
Extent	Widespread
Severity	Low

Temporality	Continuous
Timing	Happening now
Probability	High
Causal certainty	Low
Overall level of concern	**Low**

Threat #3. Pathogens and parasites	
Specific threat	Muskrats are exposed to many pathogens (bacteria, fungi, viruses and parasites) across their range worldwide. Most pathogens reported in the literature do not cause mortality in muskrats. In the NWT, muskrats in the Mackenzie Delta had liver parasitism rates of 7 to 30%, similar to other studies in the Mackenzie Delta in the 1950s and 1970s. However, in 2016 knowledge holders (Aklavik) have reported seeing more muskrats with poor body and pelt condition/colour, and more spots on their livers than in the past. In studies of parasites, *Taenia taeniaeformis* was most commonly observed, which causes lesions on muskrat livers.
Stress	Bacteria have the most impact; of 24 bacteria species reported in the studies examined by Ganoe *et al.* (2020), six caused mortality, notably F. tularensis, C. piliformis, and cyanobacteria. Although, tularemia has been diagnosed in animals and humans in the Northwest Territories, there has not been a confirmed case of tularemia in humans in the NWT in the last 10 years. Mortalities from Tyzzer's disease, caused by *C. piliformis*, have been reported in Saskatchewan and British Columbia – but neither the disease nor spores have been detected in the NWT. Cyanobacteria (i.e., blue-green algae) can form toxic algal blooms with the potential to cause muskrat mortalities. Despite cyanobacteria blooms having been reported at low abundance in Great Slave Lake and other southern NWT water bodies, impacts to muskrat have not been observed. Several taxa of parasites affect muskrats, including protozoans, trematodes, cestodes, nematodes, acanthocephalans, pentastomes, and ectoparasites; trematodes and nematodes are the most prevalent but cause very few investigated muskrat mortalities and minor impacts to muskrat body condition. Parasitic protozoan species are prevalent in muskrat elsewhere, but do not appear to have significant health impacts. *Giardia spp*. and *Cryptosporidium spp*. have been reported in muskrats in Alberta and Yukon. The prevalence of protozoan parasites in muskrats in the NWT is unknown. Muskrats also host

	several endoparasites including trematodes (i.e., flukes), cestodes (i.e., tapeworms), and nematodes (i.e., roundworms). Low level of infections from *Taenia taeniaeformis* parasites were detected in muskrats in the Mackenzie Delta, but there were no pathogenic impacts. Some of the pathogens and parasites discussed occur naturally with low prevalence, and any recorded outbreaks have been localized. The high reproductive rates and high dispersal capabilities of muskrat make their populations resilient to negative impacts from pathogens and/or parasites. More study is required to fully understand the impacts of many pathogens and parasites and their geographic distribution in the NWT.
Extent	Widespread
Severity	Medium-Low
Temporality	Continuous
Timing	Happening now
Probability	High (parasites/bacteria) Low-Unknown (disease outbreak)
Causal certainty	Low
Overall level of concern	**Low**

Threat #4. Predation	
Specific threat	Predators, especially mink, influence muskrat population cycles. Decreased harvest of predators could result in increased predator abundance and higher predation pressure on muskrat populations. Some species of predators are expanding their range northward and/or population densities of some predators are increasing including grizzly bear at their northern extent and otter in the Mackenzie Delta.
Stress	Otters are "extremely efficient predators" of muskrat and in the Mackenzie Delta otter predation on muskrat is thought to influence muskrat populations. The level of predation by mink and other predators (e.g., marten, otter, jackfish) and possible impacts to muskrat abundance in the NWT have not been quantified, however it seems likely that there is some relationship.
Extent	Widespread

Severity	Unknown
Temporality.	Seasonal
Timing	Happening now
Probability	High
Causal certainty	Low
Overall level of concern	**Low**

Threat #5. Environmental Contaminants	
Specific threat	Environmental contaminants and water pollution can affect muskrat directly or indirectly by impacting their habitat and/or forage. Muskrats are known to be carriers of contaminants and their role in aquatic ecosystems causes them to be susceptible to exposure and bioaccumulation of contaminants that are often transported and stored by aquatic ecosystems. Muskrat individuals and populations can be affected by heavy metals (i.e. mercury, cadmium, lead, and arsenic), agricultural-related contaminants (pesticides, herbicides, and insecticides), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). Participants in a workshop in Fort Smith expressed numerous concerns about contamination of the Slave River; some of the potential sources named included oil sands operations, agricultural pesticides, contaminants from Uranium City, pulp mills and mines, among numerous other sources of pollution.
Stress	There is no evidence of population-level impacts on muskrats due to contaminants. However, some studies suggest that certain contaminants impact the health of individual muskrats, including dieldrin (a synthetic organochlorine pesticide used in agriculture) and PAHs. Few studies on contaminants in muskrats have been undertaken in the NWT, however one in the Slave River area in 1999 found that PCBs, dichlorodiphenyltrichloroethane (DDT), organochlorines and cadmium levels in muskrats were very low or not detectable. Similarly, in another study concentrations of mercury, cadmium, arsenic, lead and chromium were very low in the muscle tissue of muskrat, snowshoe hare, mink and beaver, and mercury concentrations had decreased in the livers of muskrat and hare over the last 25 years. Another study in the Mackenzie Delta analyzed metal

	contamination in muskrat tissue; concentrations were similar to samples collected across Canada. Muskrats are able to persist, and populations can be stable despite high levels of environmental contamination, although there may be impacts on individual animal condition.
Extent	Localized (but probably present on a large scale)
Severity	Low
Temporality	Continuous
Timing	Happening now
Probability	High
Causal certainty	Low
Overall level of concern	**Low**

Threat #6. Reduction in harvest and traditional population controls	
Specific threat	Despite muskrat being culturally important throughout their range, there has been a shift and muskrat are not being harvested as often. Hunting and trapping activities remove unhealthy and/or less vigorous muskrat from the population, allowing healthier animals to make the population more vigorous overall. These traditional activities, especially when done properly allowing muskrat time to have young, can prevent population booms that result in disease and starvation.
Stress	Harvesters say there seem to be more muskrat with poor pelt/coat condition and colour and 'abnormal lives' with the decline in trapping. With fewer people on the land, there is a disconnect between those who have knowledge about muskrat harvesting and muskrat habitat and those who make decisions about them.
Extent	Localized
Severity	Low
Temporality	Seasonal
Timing	Not expected

Probability	Low
Causal certainty	Low
Overall level of concern	**Low**