

Final Report

Project Number: 32-13-11

Project Title:

**Muskox Aerial Survey (*Ovibos moschatus*)
Of the Kitikmeot Region, Nunavut.**

Project Leader:

Lisa-Marie Leclerc

Regional Biologist, Kitikmeot Region

Department of Environment, Government of Nunavut

P.O. 377, Kugluktuk, NU, X0B 0E0

Introduction:

Muskox (*ovibos moschatus*), a native species, constitutes an important source of food for the Inuit communities. Muskoxen are currently re-colonizing their historical range, such as King Williams Island. At this location, sightings of muskox were rare until 1992, and soon after hunter observations have reported that they are increasing in number (Gunn *et al.*, 1996; White, 2002).

While the number of muskox seems to be increasing at some locations, the opposite trend is noticed in other. In Cambridge Bay, Kitikmeot Foods Ltd. stopped their commercial harvest in 2013 due to very few muskox within their harvesting zone (Kitikmeot Foods Ltd, 2012). In addition, the recent documentation of the muskox lungworm, *Umingmakstrongylus pallikuukensis*, in the central part of Victoria Island raised some concerns about the spread of this parasite from the mainland. This parasite can affect muskox survival by making them more vulnerable to other diseases, and increasing the risk of predation where the numbers of predator have been reported to increase. All these factors may affect the muskox population dynamics negatively and impact on management plan and decision making related to harvest levels.

The communities of Cambridge Bay, Gjoa Haven, and Kugluktuk have maintained a current harvesting rate for the past decade. The Kitikmeot Regional Wildlife Board (KRWB) inquires about the current status of the West Kitikmeot management plan, new Muskox Management Units and quota allocations (KRWB, pers. Comm.). These communities need to re-evaluate their respective quotas in order to maintain a sustainable harvest. This task is impossible without bringing the current muskox estimate up to date in each management area.

This study aims to provide essential inventory information to review existing management strategies and promote the conservation of the muskox herd, so future Inuit generations may continue to practice hunting techniques and harvest this resource. To do so, the relative muskox number, productivity of the herd and distribution will be assessed for three hunting communities of the West Kitikmeot: Kugluktuk, Gjoa Haven and Cambridge Bay.

Objectives:

This project aims to address the concerns and requests of Inuit hunters, as well as to fulfill two management priorities of the Nunavut Wildlife Management Board in the Kitikmeot Region. These priorities are 1) Muskoxen population assessment on King William Island and 2) Population research on current muskox zones. Therefore, the main objectives of this study are:

1. Determine the estimate number of muskox;
2. Determine the muskox distribution;

Materials and Method:

In July 2013, new Muskox Management Units were established across Nunavut. On Victoria Island, the three previous harvest zones (MX-07, MX-11, and MX-10) were fused into one, MX-07. King Williams Island, referred to as MX-22, is now part of the new management unit called MX-10. The HTO of Gjoa Haven has expressed concerns about a possible over-harvest on the island, if a TAH is set for the entire MX-10. Thus, they have decided to establish a harvest management zone to help distribute the harvest to avoid the risk of local depletion (Dumond, 2010).

The same concern was expressed by the Kugluktuk HTO as the new units, MX-11, represent a very large area that include three old management zones; MX-13, MX-14, and MX-19. Thus, they also requested to also establish a harvest management zones around Kugluktuk, so it will be easier and financially possible to monitor the herd being harvested more often.

With the new Muskox Managements Units, the proposed survey areas, MX-19, MX-11 and MX-22, were reviewed after consultations with NTL, NWMB, and the HTOs of Cambridge Bay and Kugluktuk. Funding availability and field logistic planning restricted the 2013 survey to a portion of the new Muskox Management Unit, MX-07 and MX-11. The survey area reflected the highest known muskox density of Victoria Island.

Consistent standards procedure was used throughout the survey of the three different zones. No reconnaissance survey was effectuated in priory to maximize the coverage area investigated. Instead, anticipated muskox distribution pattern was obtained from past surveys, hunter observations, and Inuit Traditional Knowledge/Inuit Qaujimatjuqangit.

Study area

Management Unit, MX-07

The Mmanagement Unit MX-07 was divided into six stratums that was survey in two consecutive summer season, 2013 and 2014. Consistent standard procedures used throughout the 2013 muskox surveys were also applied in summer 2014. The study area, stratum 1, 2 and 3, was

then flown in 2013 and Stratum 4, 5, 6 the following summer. In addition, survey effort was allocated according to muskox sightings and importance of the area for harvesters. This contributed to optimize the number of transects flown in each stratum and to cover a minimum of 10% at area where no harvest occurs to up to 25% where harvest pressure is higher.

The northern part of Victoria Island (stratum 6) and the stratum 5 will be survey at 10%, as there is a very low muskox harvest rate and human impact (Figure 1). Few hunters from Kugluktuk traditionally cross the sea ice to go hunting on the south coast of Victoria Island. Therefore, southern-west stratum (4) was survey at 15% to increase the precision of the muskox number estimate at this location.

The southeastern portion of Victoria Island is the location of intensive commercial harvest, sport hunt as well as where subsistence harvest take place in the vicinity of Cambridge Bay. The percentage of area cover in stratum 1, 2, and 3 was determined in function of the land used but also based on the number and distribution of muskox previously encounter during the winter ground surveys. The south-east stratum (stratum 1) and the north-east (stratum 2) was survey at 20% coverage and the stratum to the west of Cambridge at 25% (stratum 3).

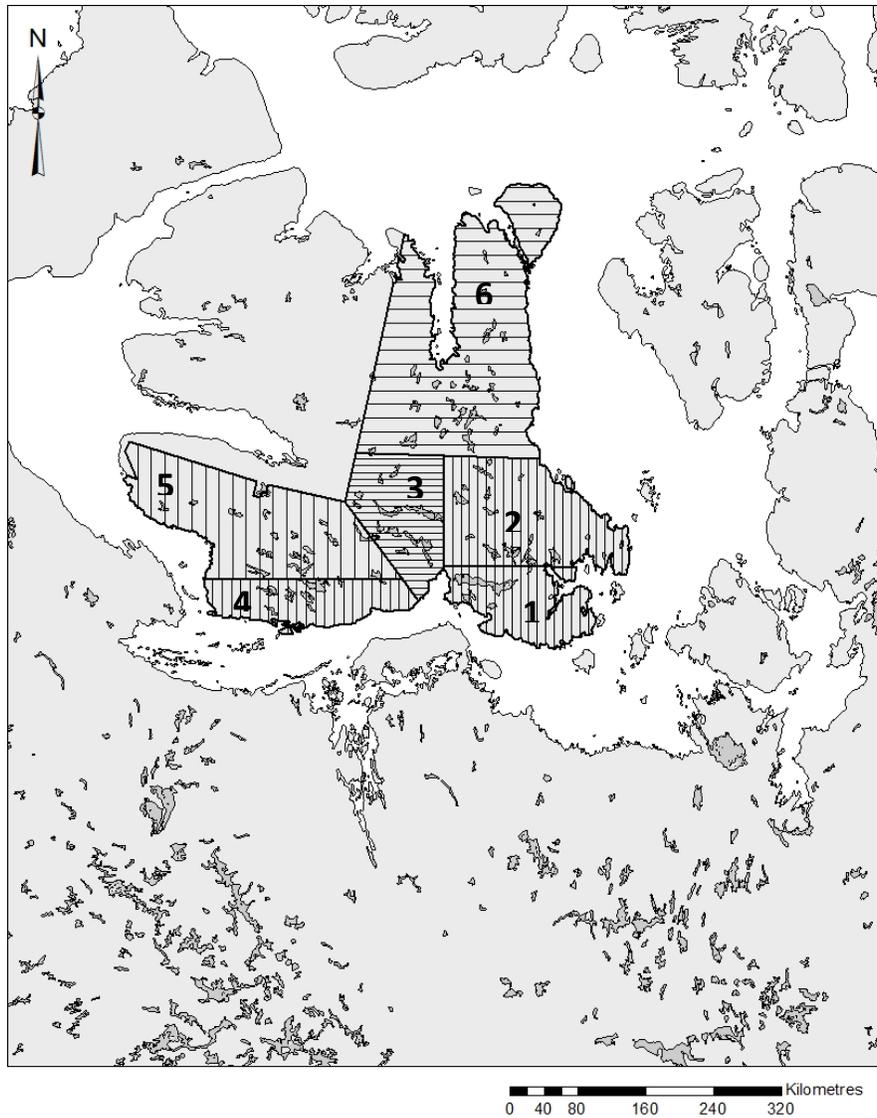


Figure1: Transect lines and the six strata boundaries (1,2,3,4,5,and 6) of the muskox management units MX-07 during a muskox survey of the Nunavut portion of Victoria Island, August 2013 and 2014.

Management Unit, MX-10

Due to the small extent of King William Island, the entire Island was flown in addition to the Royal Geographical Society Island, Matty Island and Tennent Island (Figure 2). Base on this information, the management unit MX-10, subdivision King William Island was surveyed at 20%.



Figure2: Transect lines covering 20% of the muskox management units MX-10, subdivision King William Island, during a muskox survey, September 2013.

Management Unit, MX-11

The management unit MX-11, subdivision Kugluktuk was divided into two stratum, south (1) and north (2), where the north stratum also include the islands off shore (Figure 3). The percentage of area cover for each stratum was determined based on the number, density of muskox previously encounter in the area and the land use for harvesting. The southern stratum at 20% (stratum 1) and northern stratum was flown at 25% (stratum 2).

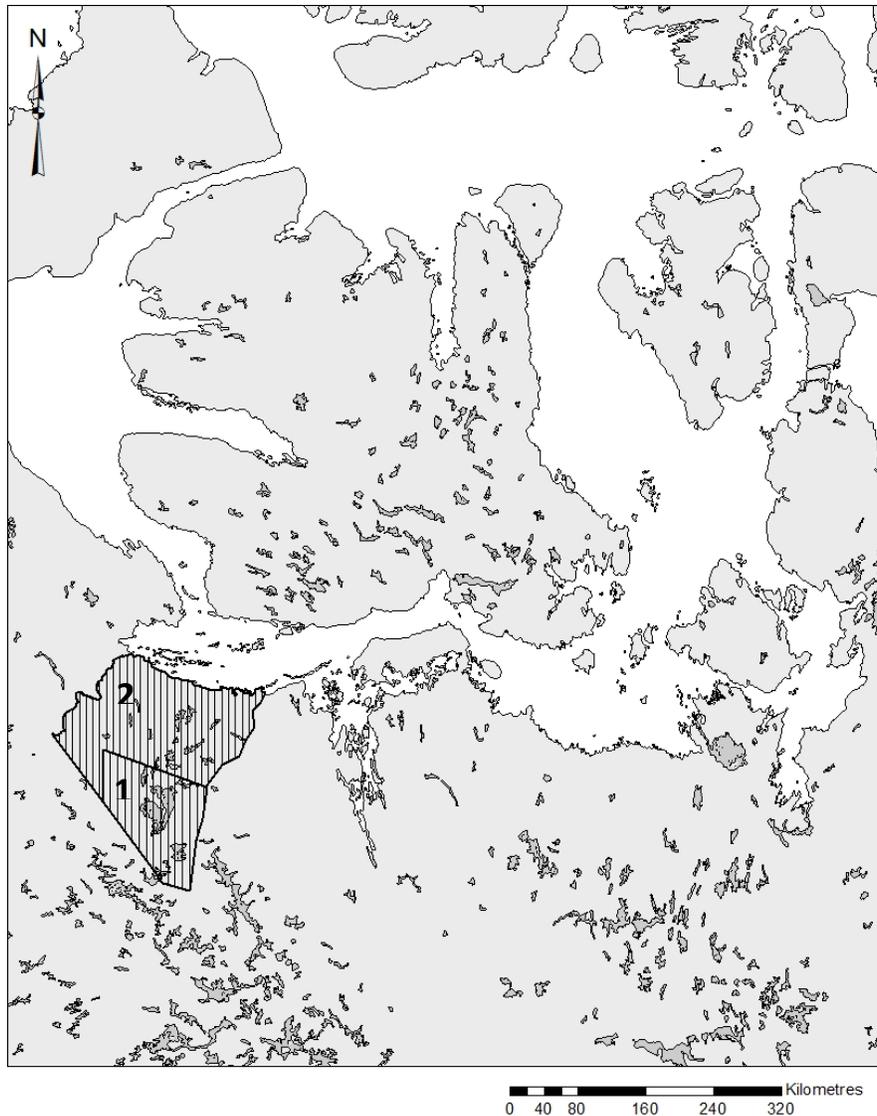


Figure3: Transect lines and the two strata boundaries (1 and 2) of the muskox management unit MX-11 during a muskox survey on the east side of the Coppermine River, Nunavut, September 2013.

Aircraft configuration

A systematic transects lines survey was flown with a fix-wing single engine turbine aircraft, a Turbo Beaver. The transect lines were surveyed at a speed of 160 km/hr. and at an altitude of about 150 meters depending of the relief. Pre-determined strips of 800 meters was set on the window based on calculation using the formula of Norton-Griffiths (1978) (Gunn and Patterson 2000; Howard 2011).

$$w = W * h / H$$

where, W= the required strip with; h= the height of the observer's eye from the tarmac; and H= the required flying height.

The strip transect was 800 meters on each side of the aircraft, for a total transect width of 1.6 kilometers. The strip width calculations were confirmed by flying perpendicular over a known distance marked at 800 meters. Two observers in the rear continuously searched for and counted muskox, either as on or off-transect; the number of short-yearlings (0 - 11 months old) were counted when possible. Photographs were taken of large herds (> 20 muskoxen). The data keeper recorded the number of muskox, GPS location and their distance from the transect line. This survey focuses mainly on muskox. Additional sightings of other species were recorded, such as caribou, grizzly bear, polar bear and wolf.

Analyses

As this survey focuses mainly on obtaining an estimate number, only unambiguous classification criteria was used to determine the number of calve and adult. The herd was then broken down into adults (female/male) and calves (Howard 2011). The flight high and speed did not allow to accurately distinguishing male from female muskox from the horn sexual dimorphism. Therefore, the proportion of calf per female cow could not have been determined and no information on the recruitment was generated.

To determine the population number, the adult muskox sightings recorded on transect in each stratum and in each management unit were analyzed using Jolly's Method 2 for unequal sample sizes (Jolly 1969). Only the counts of adults were used for the final estimates in the management unit using a coefficient limit of 95%.

The area occupied by the population during this specific season within the management units was determined. Thus, the distribution was illustrated by plotting each muskox sighting on transect base on their precise geospatial position captured with a Global Positioning System (GPS). In addition, the variation of number of animal composing each herd, abundance was highlighted using an increasing size of symbol to represent herd of 1-5, 6-12, 13-20, 21-30, 31-45 and 46 to 91 animals.

Deliverables:

1. Produce a report expressing the new muskox status. This report will be distributed to the funding agency.
2. Provide information on muskox number and distribution range.
3. Increase the awareness on the muskox situation to the communities.
4. Re-evaluation of existing quotas in the Kitikmeot region with the HTOs.
5. Provide results that will be used to generate the West Kitikmeot Muskox Management Plan developed by DoE, NTI
6. Generation of local employment. Hunters will take part at the survey as observers during sampling transect.

Project schedule:

This project will be realised in three phases, such as collection of observation, survey, and report to the communities. Due to the large area cover by this survey, the surveys was e realised in two stages, 2013 and 2014. The surveys took place from August 25 to September 17, 2013 and from August 2 to August 12, 2014. The project has remained mostly on schedule as originally planned

1. March 2013 to May 2013: collection of information on the muskox distribution observed by the Inuit hunters and harvest records.
2. August 2013 and August 2014: transect sampling of MX22, King Williams Island., MX11, MX-07, and MX11, Southeast of Kugluktuk.
3. October 2014: Muskox workshop organized with the West Kitikmeot HTO and co-management partners. Presentation of the finding at the KRWB AGM meeting.

Results

Management Unit, MX-07

The first part of the survey, which consisted of stratum 1, 2 and 3, took place from August 26 to September 3, 2013. There were no flights on August 27 and September 1, due to mechanical problem and weather day. The three stratum was survey in 58 hours, including on transect and ferry flight from the transect lines to Cambridge Bay.

The remaining of the Management Unit MX-07, stratum 4, 5 and 6, was surveyed from August 2 to August 12, 2014. Localized shower prohibited the departure to the fuel cache and camps location. The survey resumed on August 3. This area was surveyed in 71 hours, including on transect and ferry flight from the Cambridge Bay airport to the transect lines. Note that due to the extensive area to cover, ferry flight time was reduced by setting two fuel caches and camps at strategic location.

Estimate

Even though the percentage of each stratum varied from 10% to 25%, the overall cover of the management unit survey with 17,453.52 20 km² represented 13% of the total study area (134,933.72 km²). During the survey, 1,296 adults muskoxen on transect were recorded. The estimate number of muskox in the management unit 07, totalized then 10,026 ± 596.90 (S.E.) ($p < 0.005$, $t = 1.984$, $N = 732$ and $n = 125$). For this estimate, the total number of transect at 100% coverage was 732 (N) and 125 (n) transect lines were surveyed (Table 1).

Within the six stratum, the number of adult muskox on transect varied from 112 to 299 giving an estimate from 777 ± 143.21 (S.E.) to 3,032 ± 437.21 (S.E.) respectively. The stratum with the lowest number of sighting was on the south cost of Victoria Island (4) whereas most of the muskox appears to be north of Victoria Island (6) (Table 1).

Table 1: Muskox estimate in the Muskox management Unit MX-07

Stratum	Area Survey (km ²)	Total area (km ²)	Muskox on Transect	Estimate	Standard error (S.E.)	95% CL (±)	CV
1	1,899.94	11,854.85	251	1,566	140.88	295.99	0.090
2	3,711.14	22,642.23	229	1,397	180.26	374.94	0.129
3	2,798.61	14,147.27	232	1,173	186.81	389.70	0.159
4	1,663.63	11,538.85	112	777	143.21	297.02	0.184
5	2,800.80	28,320.87	173	1,750	239.57	501.42	0.137
6	4,579.40	46,429.65	299	3,032	437.21	915.07	0.144
MX-07	17,453.52	134,933.72	1,296	10,026	596.90	1,184.26	0.060

Distribution

The distribution and the abundance of muskox for the two surveys, August 26 to September 3, 2013 (stratum 1, 2 and 3) and from August 2 to August 12, 2014 (stratum 4,5, and 6) was combined in the figure below (Figure 4). Muskoxen were mostly uniformly distributed throughout the study area. Most of the herds were small, with a number of muskox around 6 to 12 animals. No muskox were seen 50 km around Cambridge Bay as local observations reported, 10 km north-west of Washburn Lake, East of Mount Bumpus, and also on the east coast and the Northern part of the Storkerson Peninsula and Stefansson Island as well.

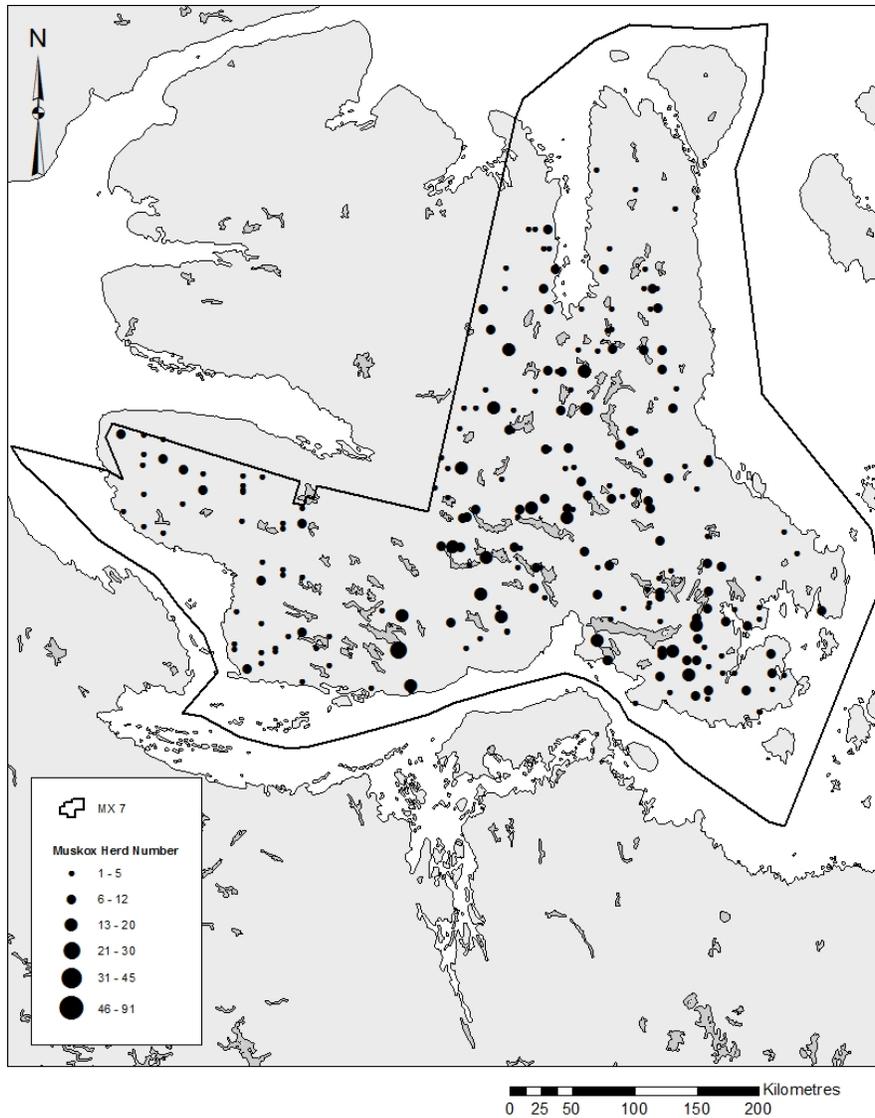


Figure 4: Muskox distribution and abundance recorded in the management unit MX-07 during the survey taking place August 26 to September 3, 2013 (stratum 1, 2 and 3) and from August 2 to August 12, 2014 (stratum 4,5, and 6), where the number of animal per herd was grouped as 1-5, 6-12, 13-20, 21-30, 31-45, and 46-91.

Management Unit, MX-10

The survey was conducted from September 4 to September 5, 2013. The survey was not interrupted due to weather day during the survey of the management unit 10. The area was surveyed in 15 hours, including time to fly the 1,560 km of transect lines and ferry from the Gjoa Haven airport to the transect lines.

Estimate

During the survey, 280 adults muskoxen on transect were recorded on the 2,496 km² of transect area representing 20% of the management unit. For this estimate, the total number of transect at

100% coverage is 78 (N) and 29 (n) of this number was surveyed. This correspond to an estimated number for the total area (13,935) of $1,564 \pm 182.2$ (S.E.) muskox ($p < 0.005$, $t = 2.048$, $N = 78$ and $n = 29$) (Table 2).

Table 2: Muskox estimate in the Muskox management Unit MX-10

Stratum	Area Survey (km ²)	Total area (km ²)	Muskox on Transect	Estimate	Standard error (S.E.)	95% CL (±)	CV
MX-10 Subdivision	2,496	13,935	280	1,564	182.26	373.27	0.116

Distribution

When the survey occurred, no ice was recorded around and linking King William Island to its satellite islands. Most of the muskoxen on King William were concentrated in the middle portion of the island, from one side to the other (Figure 5). The largest herd of muskox, 36 animals, was observed on the southern portion of the Island. Additional flying in the surrounding of this herd failed to detect any other larger herd in between the transect lines. There was also 1 herd of 5 muskoxen on the west side of Matty Island. No muskox was present 50 km around Gjoa Haven and on the Royal Geographical Society Island.

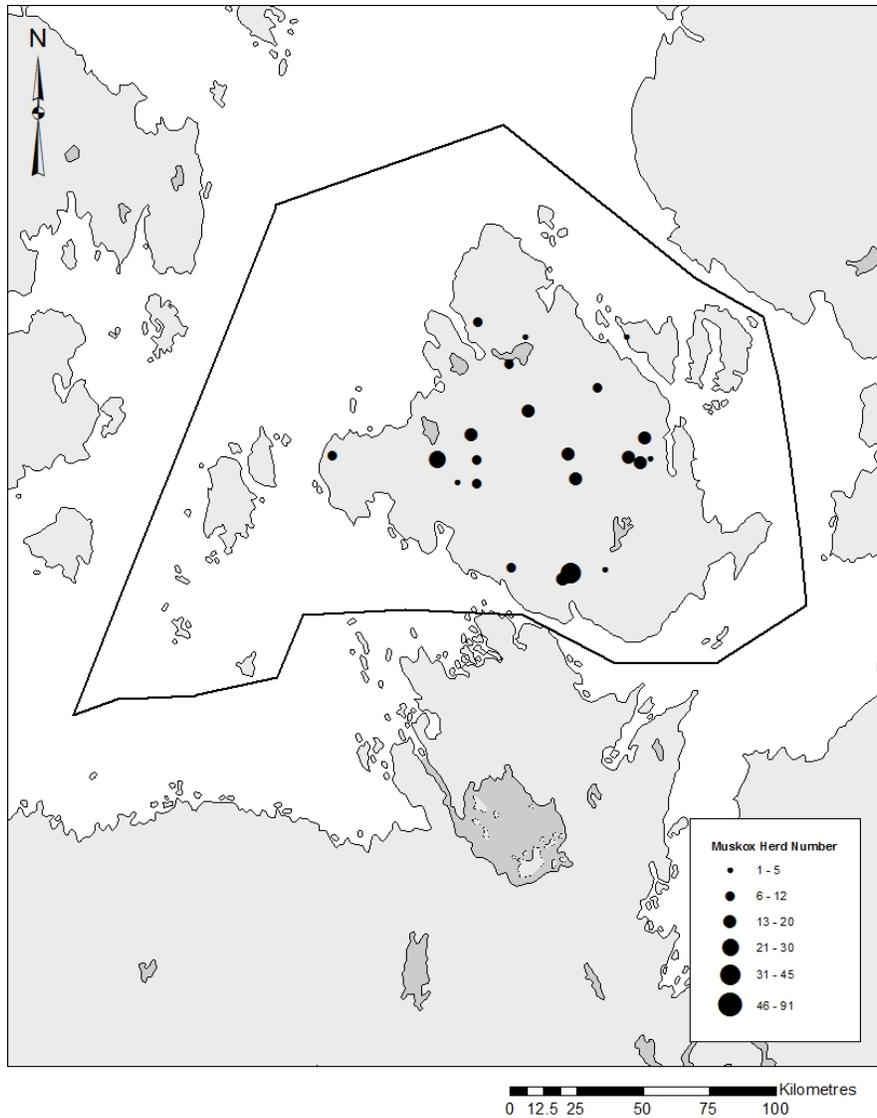


Figure 5: Muskox distribution and abundance recorded in the management unit MX-10 during the survey taking place on September 4 to 5, 2013, where the number of animal per herd was grouped as 1-5, 6-12, 13-20, 21-30, 31-45, and 46-91.

Management Unit, MX-11

The survey was conducted from September 9 to September 17, 2013. Weather days were encounter on September 9, 12, 15 and 16. During these days, the ceiling was too low to reach part of the survey area located over high terrain. The area was surveyed in 46 hours, including time to fly the 4,386km of transect lines and ferry from the Kugluktuk airport to the transect lines.

Estimate

During the survey, 1,331 adults muskoxen on transect were recorded on the 7,017.57 km² of transect area surveyed. The estimate number of muskox in the management unit 11, subdivision of Kugluktuk (35,564 km²), totaled then 6,746 ± 904.25 (S.E.) (p<0.005, t = 2.048, N = 185 and n = 46). For this estimate, the total number of transect at 100% coverage was 185 (N) and 46 (n) transect lines were surveyed (20% of the entire study area) (Table 3). Individually, the estimate number for the south stratum (1) is 955 ± 246.29 (S.E.) (p<0.005, t = 2.145, N = 61 and n = 15) and 5,744 ± 870.06 (S.E.) (p<0.005, t = 2.042, N = 124 and n = 31) for the north stratum (2).

Table 3: Muskox estimate in the Muskox management Unit MX-11, subdivision Kugluktuk

Stratum	Area Survey (km ²)	Total area (km ²)	Muskox on Transect	Estimate	Standard error (S.E.)	95% CL (±)	CV
1	2,366.54	12,271.52	184	955	246.29	528.29	0.258
2	4,651.03	23,292.52	1,147	5,744	870.06	1,776.67	0.151
MX-11 Subdivision	7,017.57	35,564	1,331	6,746	904.25	1,851.0	0.134

Distribution

In mid-September at the time of the survey, adult muskoxen, on transect, were concentrated in two locations (Figure 3). A large area of abundance from north of Contwoyto Lake to the shoreline with numerous herds of about 31 to 45 animals were observed along the coast lines. The second aggregation was located 25 km south of Kugluktuk. Also at this location, herds of 46 to 91 were found. Consistently with what the local hunters had reported, two herd of muskox, (one of 1 animals and the other one of 5 animals) were observed on one of the Island north of Kugluktuk. In contrary, no muskox was present 25 km from the south and east boundaries of the management unit.

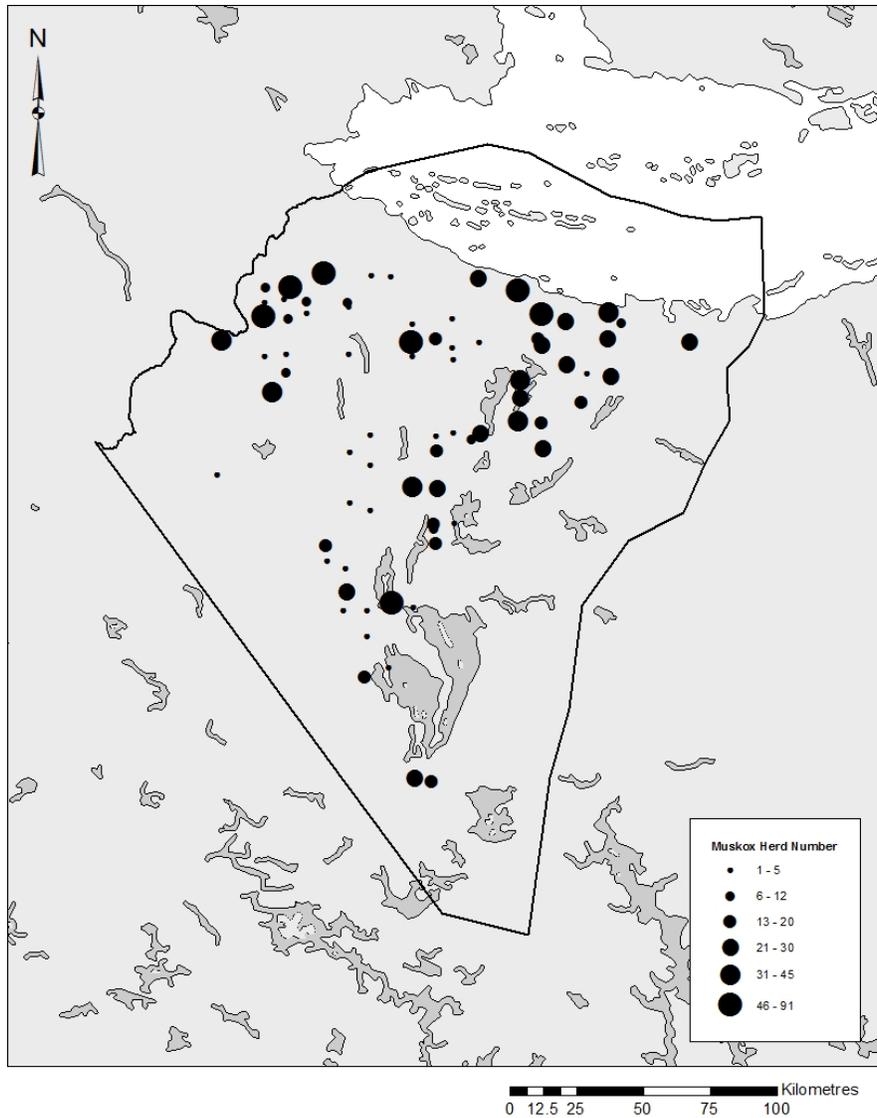


Figure 3: Muskox distribution and abundance recorded in the management unit MX-11, subdivision Kuluktuk, during the survey taking place on September 9 to 17, 2014, where the number of animal per herd was grouped as 1-5, 6-12, 13-20, 21-30, 31-45, and 46-91.

Preliminary Discussion and Management recommendations:

As the Management Unit, MX-07, MX-10 and MX-11 were created a year ago, it is difficult to compare the muskox number with previous study. There will be limitations in comparison due to the variation in survey study area. At this point, additional time is required to discuss more in depth the implication of the estimate number generated from this muskox survey program. Nonetheless, whereas the muskox number seems to have increased considerably at the vicinity of Kugluktuk and Gjoa Haven, the trend seems to be in the opposite direction in Victoria Island.

The estimate numbers of muskox per management units actually match the local observations of hunters for each community respectively.

Muskox population dynamics has an impact on management plan and decision making-related to harvest levels. The recommendations will be intended as short-term advice applying base on the 2013 and 2014 season surveys. From the scientific data, management recommendations included in this scientific report will be used with the community consultation report as support documents to the muskox management plan. During the Muskox Workshop planned the 14-15 of October 2014, results of the study will be review and discussed with the co-management partners and management recommendation will be discussed in length. Thus, at this point no management recommendations could be highlighted in this report.

Opportunities for local participation:

Local and Inuit knowledge on the muskox distribution was used to set up the percentage of area cover in each stratum. Community members were able to be involved to during the aerial surveys. They learned scientific methodology, and see from their own eyes their land and help counting muskoxen. The table below (Table 4) list the name of the local participant for each community, Kugluktuk, Gjoa Haven and Cambridge Bay. In total, ten local people participated. Having a youth and experienced hunter observed on the plane was a perfect fit. The youth had the opportunity to ask questions and learn about the geography, hunting locations, and important areas around their community. In summer 2014, we made sure to have a youth and an elder as observer, and once again it was a very enriching experience for the young observers.

Table 4: List of trained observers

Community	Observers
Kugluktuk	Eric Hitkolok Dennis Kokak Gordon Kokak
Gjoa Haven	Kyle Aglukkaq George Konana Sam Takkuruq
Cambridge Bay	Clarence Klengenber Josphe Tikhak Jimmy Haniliak Joseph Tikhak

Community consultation plan and reporting:

This project relies strongly with the support of the community of Kugluktuk, Gjoa Haven, and Cambridge Bay. As two of the five communities of the Kitikmeot region are requesting a

muskox survey, this proposal was made in collaboration with the HTOs to set the objectives of this project and to take their comments and suggestions.

Close contact with the community through the entire duration of this research project was maintained to allow input and insight. Kugluktuk HTO held a community consultation to identify concerns and to establish a harvest management zone around Kugluktuk. The community members were receptive of such a zone. In addition, update on the program was reported to the HTO of Cambridge Bay before and after the surveys, the distribution of muskox and other sighting was shared with this HTO last August 2014.

In October 2013, preliminary results were presented at the KRWB AGM meeting in Cambridge Bay. The HTO managers were pleased to have a report on what was done and that the survey has been successful (not cancelled due to weather.). In addition, they pointed out the need to hold a muskox workshop for the west Kitikmeot.

Thus, in October 14-15 a muskox workshop will be held to share the results of the muskox surveys, but also from the muskox community health program. The floor will be open to discuss from scientific and local community knowledge the results of this study and explained the observations. Current management will be review at this meeting and recommendation will be put forward in each field report for each management unit. A brief summary will also be presented at the KRWB AGM in 2014. Poster will be done and posted to the Coop board to inform the public about the health of the muskox around their community.

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