

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 of Nunavut, constitutes an important source of food for Inuit communities in the Kitikmeot Region. Muskoxen are currently re-colonizing their historical range, such as King William Island. At this location, sightings of muskox were rare until 1992; however, hunters have reported that their numbers have been increasing in recent years (Gunn *et al.*, 1996; White, 2002).

While the number of muskox appears to be increasing in some locations, the opposite trend has been noted in others. In Cambridge Bay, Kitikmeot Foods Ltd. cancelled their commercial harvest in 2013 due to very few muskox within their harvesting zone (Kitikmeot Foods Ltd, 2012). In addition, 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 increases the risk of predation where an increase in the number of predators has been reported. All these factors may negatively affect muskox population dynamics and directly impact management planning 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) has recently inquired 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 can only be accomplished through updating the current muskox estimate in each management area.

This study aims to provide essential inventory information required to review existing management strategies and promote the conservation of the muskox herd, so that future generations of Inuit may continue to 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 William Island, previously referred to as MX-22, is now part of the new management unit called MX-10. The HTO of Gjoa Haven has expressed concerns that a potential over-harvest may occur on the island if a total allowable harvest (TAH) is set for the entire MX-10 area. Thus, they have decided to establish a separate harvest management zone for the island to help distribute the harvest and reduce the risk of local depletion (Dumond, 2010).

That same concern was expressed by the Kugluktuk HTO as the new unit, MX-11, represents a very large area that previously included three old management zones (MX-13, MX-14, and MX-19). Similarly, they also requested to establish a harvest management zone around Kugluktuk, so that it will be easier and financially feasible to regularly monitor the herd being harvested.

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

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

Study Area

Management Unit, MX-07

Management Unit MX-07 was divided into six strata and surveyed in two consecutive summer seasons, 2013 and 2014. Consistent standard survey procedures were applied in both years. Within the study area, Strata 1, 2 and 3, were flown in 2013, while Strata 4, 5, 6 were surveyed the following summer. Survey effort was allocated according to muskox sightings and significance of the area for harvesting. This helped to optimize the number of transects flown in each stratum, and allowed a minimum of 10% coverage in areas where there is no harvest, and up to 25% coverage in areas where harvest pressure is higher.

The northern parts of Victoria Island (Stratum 5 and 6) were surveyed at 10%, as those areas have very low rates of muskox harvest and human impact (Figure 1). Conversely, Stratum 4 (in the southern-west) was surveyed at 15% due to a small number of hunters from Kugluktuk who traditionally cross the sea ice to harvest muskox in this area.

The southeastern portion of Victoria Island, in the vicinity of Cambridge Bay, is impacted by an intensive commercial harvest, sport hunting, as well as subsistence hunting by residents. The percentage of area to be surveyed in Strata 1, 2, and 3 was determined in relation to the land used for harvesting, and also based on the number and distribution of muskox previously encountered during the winter ground surveys. Stratum 1 (southeast) and Stratum 2 (north-east) were surveyed at 20% coverage, while Stratum 3 (to the west of Cambridge Bay) was surveyed at 25%.

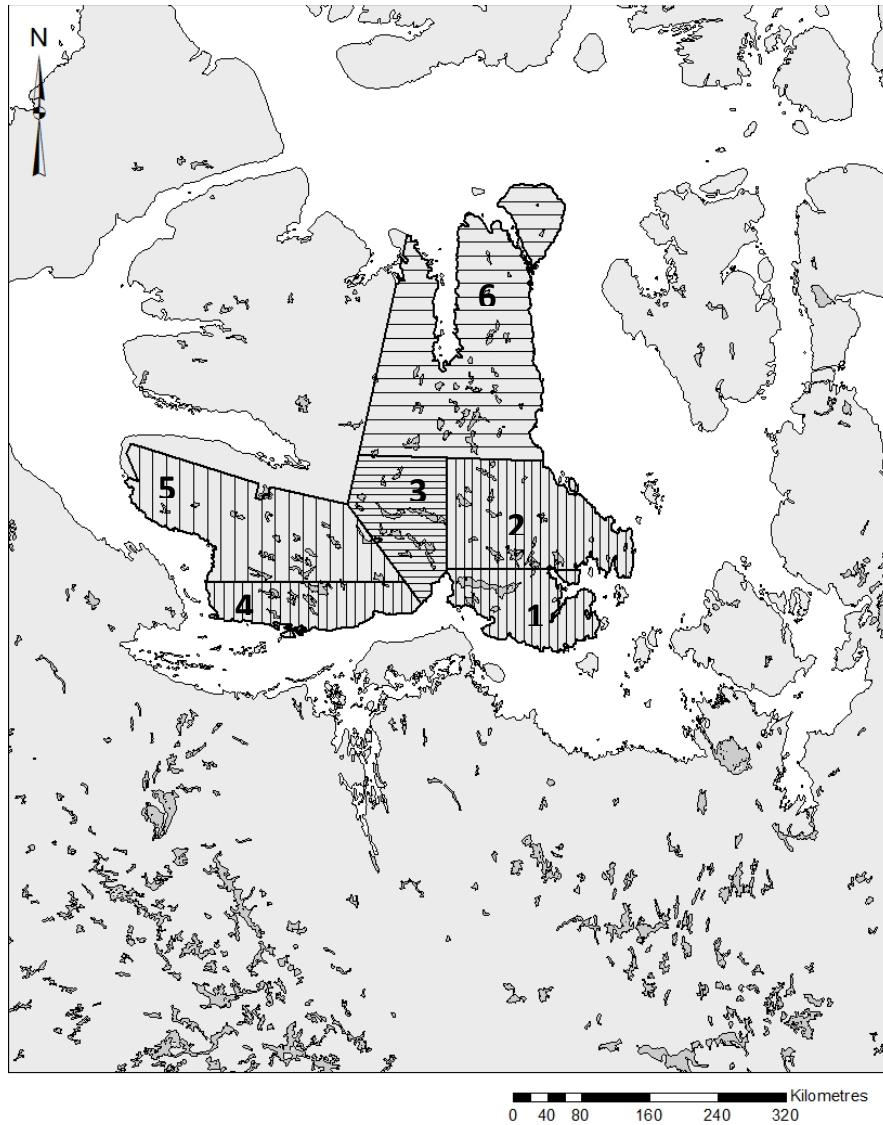


Figure1: Transect lines and the six strata boundaries (1,2,3,4,5,and 6) of the muskox management units MX-07 during a muskox survey of the Nunavut portion of Victoria Island, August 2013 and 2014.

Management Unit, MX-10

Due to the small extent of King William Island, the entire island, as well as Royal Geographical Society Island, Matty Island and Tennent Island, were flown (Figure 2). Based 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 strata, Stratum 1 (south) and Stratum 2 (north), where the northern stratum also included the islands off shore (Figure 3). The percentage of area cover for each stratum was determined based on the number and density of muskox previously encounter in the area, and the land use for harvesting. Stratum 1 was flown at 20% coverage, while Stratum 2 was flown at 25%.

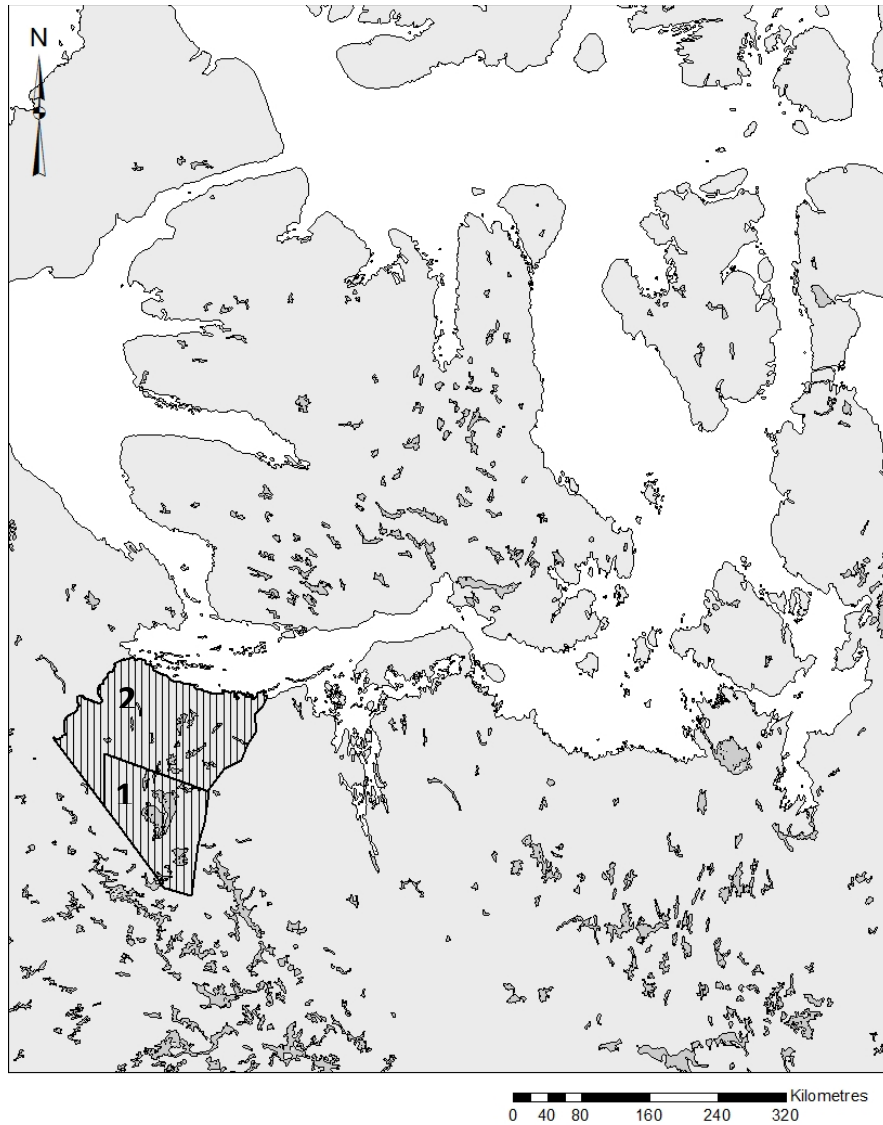


Figure3: Transect lines and the two strata boundaries (1 and 2) of the muskox management unit MX-11 during a muskox survey on the east side of the Coppermine River, Nunavut, September 2013.

Aircraft Configuration

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

$$w = W * h / H$$

where, W= the required strip width; 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 focused mainly on muskox; however, sightings of other species, such as caribou, grizzly bear, polar bear and wolf, were recorded as well.

Analyses

As this survey focused mainly on obtaining an estimated number, only unambiguous classification criteria were used to determine the number of calves and adults. The herd was then broken down into adults (female/male) and calves (Howard 2011). The flying height and speed did not allow for accurately distinguishing male from female muskox from the horn sexual dimorphism. Therefore, the proportion of calves per female cow was not determined, and no information on the recruitment was generated.

To determine the population number, 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 based on their precise geospatial position captured with a Global Positioning System (GPS). In addition, the variation in number of animals composing each herd, and abundance were 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 within the communities.
4. Re-evaluate 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 was undertaken in three phases: the collection of hunter observations, aerial survey, and report to the communities. Due to the large area to be covered, the survey was conducted over two consecutive years (2013 and 2014). The project was maintained on schedule for the most part, and 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 findings at the KRWB Annual General Meeting.

Results

Management Unit, MX-07

The first part of the survey, which consisted of Strata 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 problems and inclement weather. The three strata were surveyed in 58 hours, including on transect and ferry flight from/to Cambridge Bay.

The remaining part of Management Unit MX-07, Strata 4, 5 and 6, were surveyed from August 2 to August 12, 2014. Localized rain showers on August 2 prevented the departure to the fuel cache and camp location and the survey resumed on August 3. This area was surveyed in 71 hours, including on transect and ferry flight from/to Cambridge Bay. Due to the extensive area to be covered, ferry flight time was reduced by establishing two fuel caches and camps in strategic locations.

Number Estimate

Even though the percentage of each stratum surveyed varied from 10% to 25%, the overall area of the management unit that was surveyed was 17,453.52 km², representing 13% of the total study area (134,933.72 km²). During the survey, 1,296 adults muskoxen were recorded on transect. The estimate number of muskox in Management Unit MX-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 strata, 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 coast of Victoria Island (Stratum 4), whereas most of the muskox appeared to be north on Victoria Island (Stratum 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 abundance of muskox for the two surveys, August 26 to September 3, 2013 (Strata 1, 2 and 3), and August 2 to August 12, 2014 (Strata 4,5, and 6), was combined in the figure below (Figure 4). Muskoxen were predominately distributed uniformly throughout the study area. Most of the herds were small, numbering around 6 to 12 animals each. No muskox were seen within 50 km around Cambridge Bay (consistent with local observations), 10 km north-west of Washburn Lake, East of Mount Bumpus, nor on the east coast and Northern part of the Storkerson Peninsula and Stefansson Island.

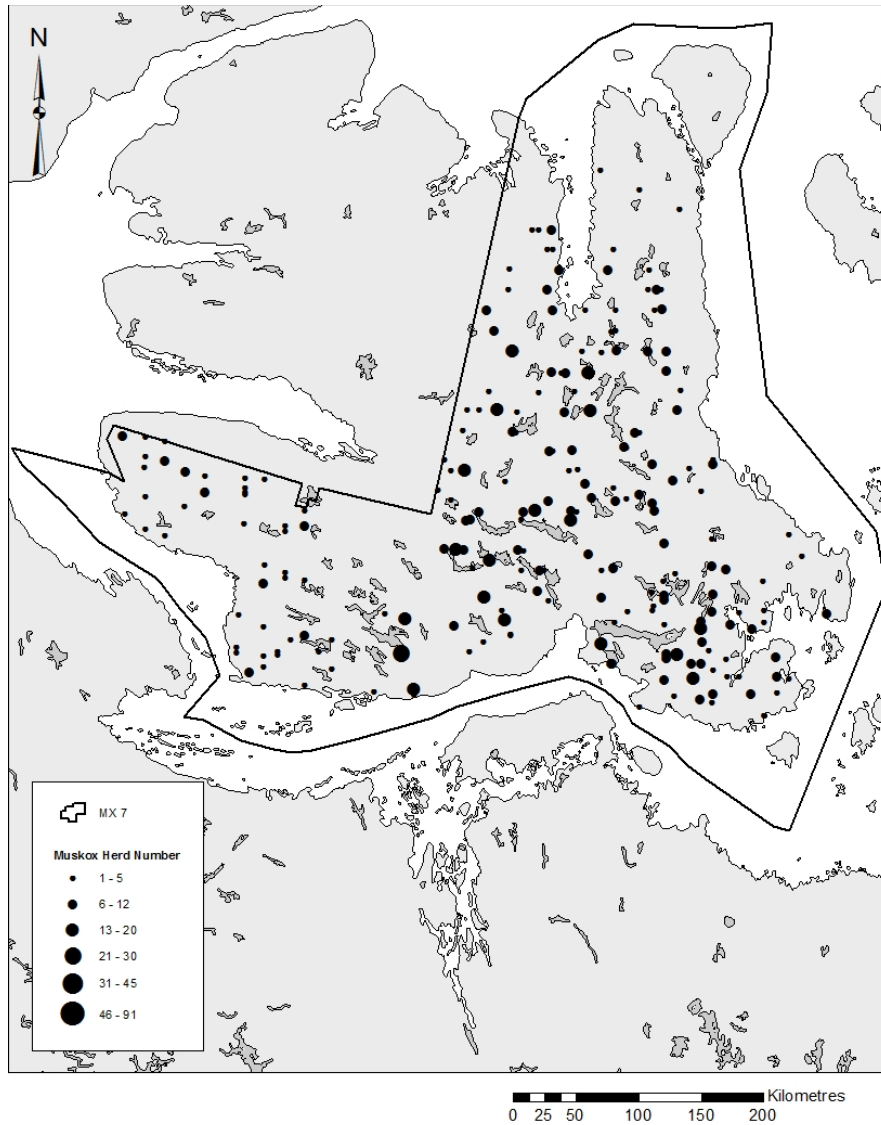


Figure 4: Muskox distribution and abundance recorded in Management Unit MX-07 during the survey taking place August 26 to September 3, 2013 (Strata 1, 2 and 3) and from August 2 to August 12, 2014 (Strata 4,5, and 6), where the number of animal per herd was grouped as 1-5, 6-12, 13-20, 21-30, 31-45,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

Management Unit, MX-10

The survey was conducted from September 4 to September 5, 2013. The survey of Management Unit MX-10 had no interruptions due to weather. The area was surveyed in 15 hours, including time to fly the 1,560 km of transect lines and ferry from/to Gjoa Haven.

Number Estimate

During the survey, 280 adults muskoxen were recorded on transect on the 2,496 km² of transect area flown, 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 corresponds 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	Total area	Muskox on	Estimate	Standard	95% CL	CV
	Survey (km ²)	(km ²)	Transect		error (S.E.)	(±)	
MX-10	2,496	13,935	280	1,564	182.26	373.27	0.116
Subdivision							

Distribution

When the survey occurred, no ice was recorded around and/or linking King William Island to its satellite islands. Most of the muskoxen on King William Island were concentrated in the middle portion of the island, and distributed 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 area surrounding this herd failed to detect any other larger herds in between the transect lines. There was also 1 herd of 5 muskoxen on the west side of Matty Island. No muskox were present within 50 km around Gjoa Haven and on the Royal Geographical Society Island.

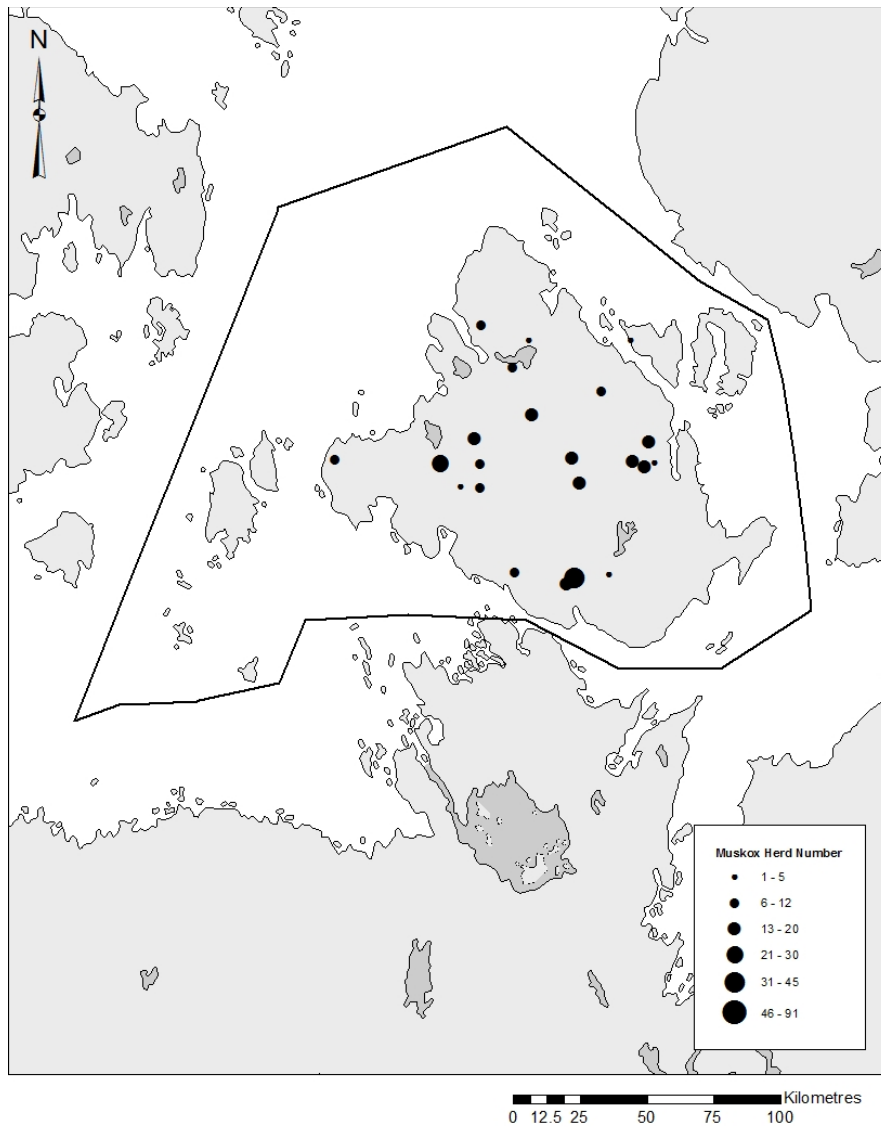


Figure 5: Muskox distribution and abundance recorded in the Management Unit MX-10 during the survey taking place on September 4 to 5, 2013, where the number of animal per herd was grouped as 1-5, 6-12, 13-20, 21-30, 31-45, and 46-91.

Management Unit, MX-11

The survey was conducted from September 9 to September 17, 2013. Weather days were encountered 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/to the Kugluktuk airport.

Number 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 Management Unit MX-11, subdivision of Kugluktuk (35,564 km²), totaled then $6,746 \pm 904.25$ (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 $5,744 \pm 870.06$ (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

At the time of the survey, adult muskoxen on transect, were concentrated in two locations (Figure 3). A large area of abundance extended north from north of Contwoyto Lake to the south shore of Coronation Gulf with numerous herds of about 31 to 45 animals observed along the coastline. 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, muskox, (one single animals and a herd of 5 animals) were observed on one of the islands north of Kugluktuk. In contrary, no muskox were present 25 km from the south and east boundaries of the management unit.

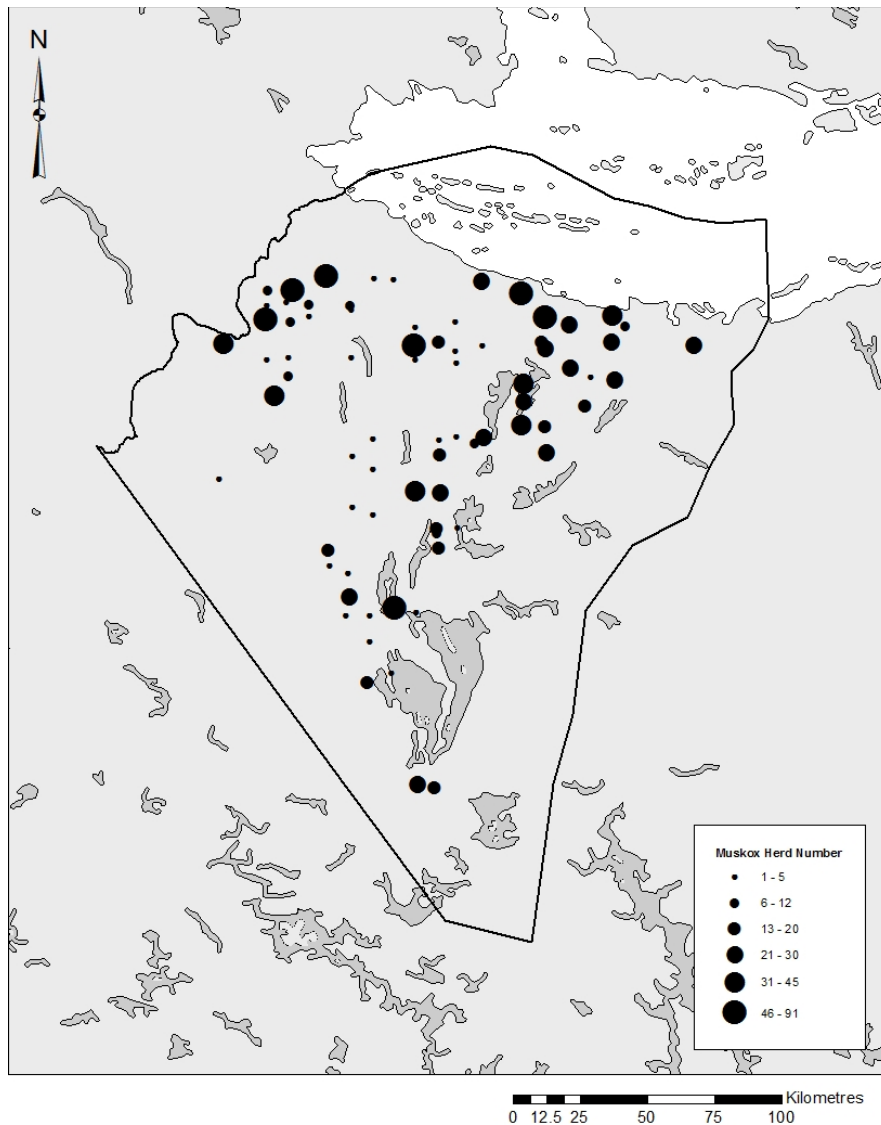


Figure 3: Muskox distribution and abundance recorded in Management Unit MX-11, subdivision Kugluktuk, during the survey taking place on September 9 to 17, 2014, where the number of animal per herd was grouped as 1-5, 6-12, 13-20, 21-30, 31-45, and 46-91.

Preliminary Discussion and Management recommendations:

As the Management Units MX-07, MX-10 and MX-11 were created a year ago, it is difficult to compare the muskox number with previous studies 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 on Victoria Island. The estimate numbers of muskox per management units actually match the local observations of hunters in all three communities.

Muskox population dynamics have an impact on management plan and decision-making related to harvest levels. The recommendations will be intended as short-term advice based on the 2013 and 2014 season surveys. From the scientific data, management recommendations, included in this scientific report, will be used along with the community consultation report as supporting documents to the muskox management plan. During the Muskox Workshop planned for October 14-15, 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, to help count muskoxen, and see their land from their own eye. The table below (Table 4) list the name of the local participant for each community. In total, ten local people participated. Having both a youth and experienced hunter observer 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 Klengenberg
	Jospeh Tikhak
	Jimmy Haniliak
	Joseph Tikhak

Community consultation plan and reporting:

This project relies strongly on the support of the communities 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 throughout the entire duration of this research project was maintained to allow opportunities for 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, updates on the program were reported to the HTO of Cambridge Bay before and after the surveys. The distribution of muskox and other sighting were shared with this HTO in August 2014.

In October 2013, preliminary results were presented at the KRWB Annual General Meeting in Cambridge Bay. The HTO managers were pleased to have a report on what was done and that the survey has been successful (i.e. 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, 2014 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 reviewed 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. Posters will be created and posted on community bulletin boards to inform the public about the health of the muskox around their community.

References:

Dumond, M. 2010. Muskox Management Consultation 2010-2011. Supporting Information on Muskox populations in the East Kitikmeot. 11 p.

Gunn, A., Lambert, K. and Morrison R., 1996. Distribution and Abundance of Muskoxen on Adelaide Peninsula, NWT. Gov. of N.W.T., File Report No. 117, 19 pp.

Gunn, A., and Patterson, B.R., 2000. Distribution and Abundance of Muskoxen on Southeastern Victoria Island, Nunavut. Gov. of the N.W.T., Unpubl. Rep.

Howard, F., 2011. Aerial Wildlife Survey Manual. Aerial Procedure Manual v. 0.9 (Uganda). Wildlife Conservation Society. 81 pp.

Jolly, G.M., 1969. Sampling methods for aerial census of wildlife populations. East Afr. Agric. For. J. 34: 46-49.

Kitikmeot Foods Ltd, 2012. Cancellation of the 2013 Commercial Muskox Harvest. Letter to the Board of Directors, Ekaluktutiak Hunters and Trappers Organization. December 10, 2012.

Norton-Griffiths, M. 1978. Counting Animals. Serengeti Ecological Monitoring Programme Handbook No.1. Afropress Ltd., Nairobi Kenya. 139 pp.

White. D., 2002. Muskoxen Density and Distribution on King William Island, Nunavut. Gov. of Nunavut, Unpubl. Rep., 22pp.