# A Final Report to the Nunavut Wildlife Management Board on the Re-evaluation of Muskoxen (*Ovibos moschatus*) Populations in the Kivalliq Region

Report # 2-10-08

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Prepared by: The Rankin Inlet HTO[1], Nunavut Department of Environment[2] Kivalliq Region, & Nunavut Tunngavik Inc. Rankin Inlet, NU.[3]

1 – Norman Ford, Secretary Treasurer, Hunter's and Trapper's Organization, Rankin Inlet, NU
2 – Mitch Campbell, Wildlife Biologist, Nunavut Department of Environment, Arviat, NU.
3 – David Lee, Wildlife Biologist, Nunavut Tunngavik Inc.

## Introduction/Summary:

Prior to the enactment of protection in 1917 (Burch, 1977), muskox populations throughout the central arctic were hunted to near extirpation. Muskox populations throughout Nunavut are currently re-colonizing much of their historical range, but there remain gaps of information on the status of muskox populations in much of the eastern Mainland (Fournier and Gunn, 1998). The distribution and abundance of muskox in the central Kivalliq region of Nunavut, an area south of Chesterfield Inlet/Thelon River, west to the NWT/Thelon Game Sanctuary boundaries, east to the Hudson Bay coast line and south to the Manitoba Border (Figure 1), were last estimated using fixed-width line transect surveys in July of 1985, July 1986, July 1991, and July 1999.

Recently, hunters have been reporting increased observations of muskox closer to their communities east of previous management zones MX/16, MX/18, MX/20 and MX/21 (Mulders and Bradley, 1991; Rankin Inlet HTO Pers. Comm.; Baker Lake HTO Pers Comm.; Arviat HTO Pers Comm.; Chesterfield Inlet HTO Pers Comm.; Repulse Bay HTO Pers Comm.; Coral Harbour HTO, Pers Comm.; Whale Cove HTO, Pers Comm. 2008). Ideally communities in the Kivalliq region would like to have access to healthy muskox populations.

Since the last survey took place over 10 years ago, a re-evaluation of the muskox status for this region was conducted in July 2010. Based on the most recent survey results, muskox numbers within the central Kivalliq region have steadily increased throughout the survey years (Table 1; Figure 3).

To date there are no indications of health problems within the herd. A research program examining the distribution of the lungworm (*Omingmakstrongylus pallikuukensis)* amongst mainland muskox has been initiated in MX/18 but all tests have shown no indication of presence in the Kivalliq populations. The collection of lower jaws to examine age structure has been ongoing. Future research should examine the extent to which muskox have occupied range outside presently defined management areas.

Both population and distribution estimates will provide information that will enable biologists to determine the potential long-term effects of current harvest regimes on muskox populations in the Kivalliq over the long term and will also provide information on the continued expansion of muskox into their historical range.

Traditional quantitative methods were used to analyze the data and the results have been reported to various co-management partners. These results are included in this final report[1] to the NWMB.

[1] In an initiative to test new quantitative methods, double observer distance sampling and sight-resight were also incorporated into the design of the survey. The application of these methods is novel and will be included in the GN-Department of Environment file report. The GN file report will replace previous reports produced for co-managers including the present work. The GN may update any of the results presented in this final report which has been developed

Based on the results derived from strip transect quantitative methods, total allowable harvests for the 2 populations of muskox within the Kivalliq region (one north of the Thelon/Chesterfield Inlet waterways (Northern Kivalliq - MX/17) and the second south (Central Kivalliq – MX/18) are currently based on 5% of the estimated adult muskox population (lower 95% confidence limit). At present a total allowable harvest of 42 is recommended for MX/17 and 60 for MX/18. Seasonal restrictions for beneficiaries are also in the process of being removed.

specifically to meet NWMB funding and reporting requirements. It is understood by all co-management partners that a fully reviewed GN DoE file report represents a final product of this research initiative.

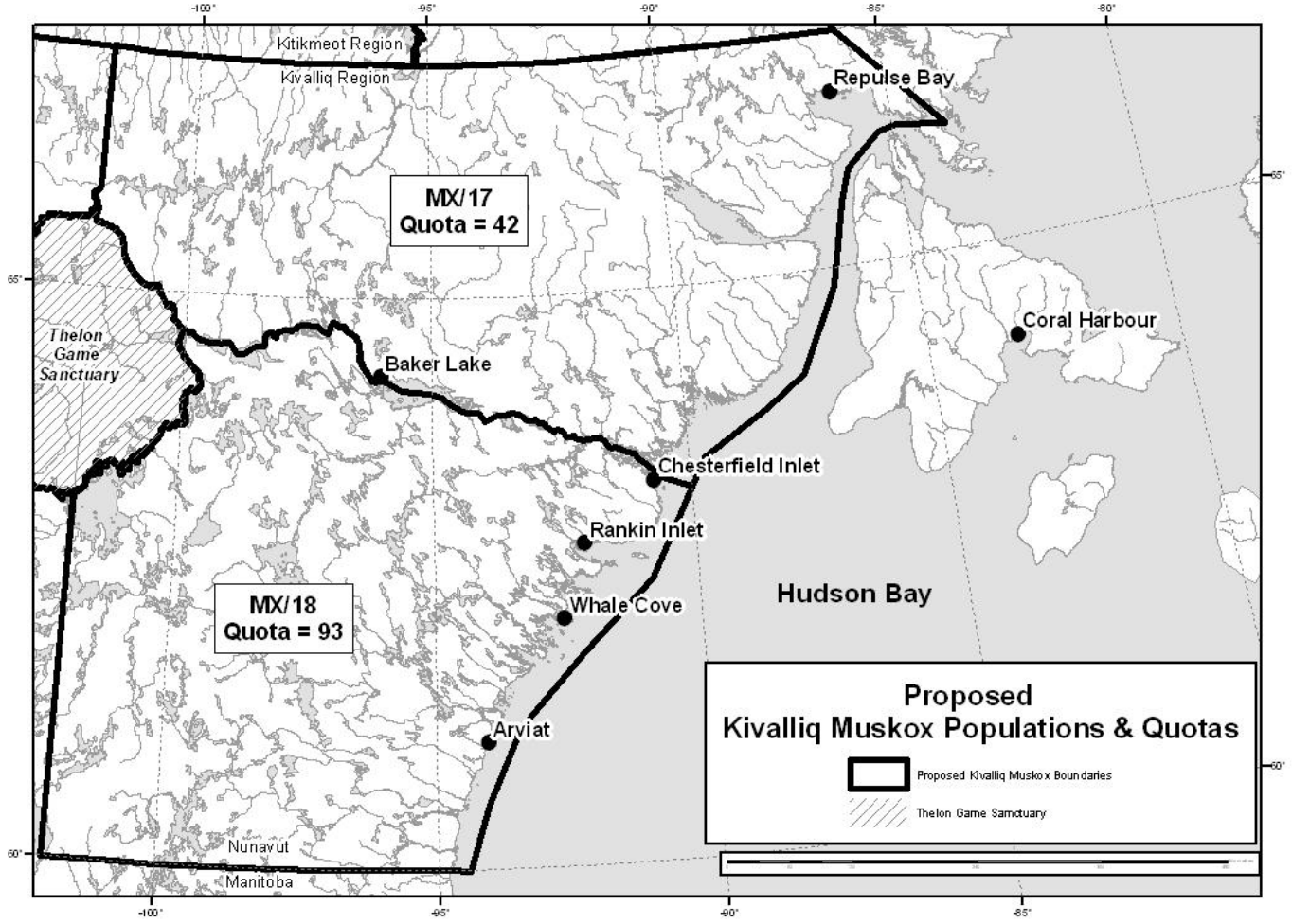


***Figure 1*** *The Central Kivalliq Muskox subpopulation (MX/18 and Northern Kivalliq Muskox subpopulation with associated quotas and management extents (Map and quotas based on July 1999 survey findings and a 5% productivity rate).*

## Objectives:

The objectives of the project were to utilize *Inuit Qaujimajatuqangit* and aerial survey methods to determine the population status of muskox in the Central Kivalliq Region (MX/18) of Nunavut. The results will be used to address requests by Kivalliq HTOs to harvest muskox. The results of the survey have provided recommendations for harvest levels and population boundaries. Specifically, the information from this survey has been used to:

**1)** Determine the numbers of muskoxen within MX/18 or the central Kivalliq muskox population as part of the requirement outlined in the Central Kivalliq Muskox Management plan developed by the Kivalliq Regional Wildlife Board in partnership with Nunavut Tunngavik Inc., and the Department of Environment, Government of Nunavut. Muskox populations in the Kivalliq must be estimated regularly in order to provide recommendations on sustainable harvest.

**2)** Determine the number of muskoxen on the periphery of previously delineated distributions. A comprehensive estimation of the muskoxen population outside known and historic distributions needs to be updated. Observations made by hunters suggest that there has been an increase in the number of muskox and that muskox had occupied a much large range than reported in July 1999. The expansion of muskox beyond previously delineated boundaries is confirmed in this report. The shorter growing season and thicker snow cover reported for the eastern arctic could make muskox expansion into historic range more sensitive to harvesting (Gunn, 1983; Forchammer and Boertmann, 1993). In order to develop harvest management recommendations, effort was put into determining the present status of the periphery of muskox populations to previous management zones.

## Study Area:

The July 2010 Central Kivalliq Muskox survey incorporates an area stretching from the Hudson Bay coast to the Kivalliq Regional Boundary in the West, and North from the Manitoba Boundary to the Thelon River system and Chesterfield Inlet to the North. The study area exists primarily within tundra habitats characterized by continuous permafrost, while a smaller portion extends along the fringe of the forest ecotone (Taiga).

The central Kivalliq study area included portions of the Maguse River Upland, Dubawnt Lake Plain/Upland, Back River Plain, and the Garry Lake Lowland ecoregions of the Southern Arctic ecozone, and the Wager Bay Plateau ecoregion of the Northern Arctic ecozone (Environment Canada 2001;

Table 1). These ecoregions are characterized by a cover of shrub vegetation consisting of dwarf birch (*Betula glandulosa*), willow (*Salix* spp.), and alder on warm, dry sites. Poorly drained sites are dominated by willow, sphagnum moss, and sedge. The region is associated with areas of continuous permafrost and Turbic Cryosolic soils, but unfrozen organic (Mesisol and Regosolic) soils also occur. Bedrock forms broad, sloping uplands and lowlands. Hummocky bedrock outcrops covered with till are dominant, and prominent esker ridges occur in some parts of the area. Twenty-five to 50% of the Maguse River Upland ecoregion is wetlands that are characteristically lowland low- and high-centered polygon fens (Environment Canada 2001). Sandy flats sparsely covered with vegetation characterize the Dubawnt Lake Plain/Upland ecoregion, and the southwestern portion is characterized by rolling terrain forming broad sloping uplands and lowlands where small and medium sized lakes are common. Soils in most of the southern study area are Turbic and Static Cryosols on level to undulating discontinuous veneers of sandy morainal and fluvioglacial deposits. The small portion of the central study area that falls within the northern Arctic ecozone is characterized by discontinuous cover of tundra vegetation including dwarf birch, willow, Labrador tea, *Dryas* spp., and *Vaccinium* spp. Lichen-covered rock outcroppings are common (Environment Canada 2001).

Table 1. Ecoregions of the central and northern muskox survey study areas in the Kivalliq and northeast Kitikmeot region of Nunavut.

| Study Area | Ecozone | Ecoregion |
|---|---|---|
| Central | Southern Arctic | Maguse River Upland |
| | | Dubawnt Lake Plain/Upland |
| | | Back River Plain |
| | | Garry Lake Lowland |
| | Northern Arctic | Wager Bay Plateau |
| Northern | Southern Arctic | Chantrey Inlet Lowland |
| | | Queen Maud Gulf Lowland |
| | Northern Arctic | Wager Bay Plateau |
| | | Victoria Island Lowlands |
| | | Boothia Peninsula Plateau |

## Methods:

### Survey Area:

Two methods were used to meet the stated objectives. The first was a collection of *Inuit Qaujimajatuqangit* and local knowledge to determine currently known distributions of Muskox. Detailed maps were drafted and multiple copies sent to the communities of Rankin Inlet, Baker Lake, Whale Cove, Chesterfield Inlet and Arviat. The community HTO selected an individual to coordinate the collection of current knowledge of muskox distribution and record this information on the maps provided. The information collected included a waypoint of the observation, the date, the number and composition of the herd observed, and an estimation of their condition. The completed maps were then transferred to DoE staff and used to determine survey study area. Once the survey study area was designated, systematic transects, drawn with a random starting point, were placed throughout the survey study area at a spacing of 7.0 km which when flown at an altitude of 152 meters (500 ft) with a maximum strip width of 2000 meters. This provided 29.2 percent coverage of the entire survey area (Figure 2). Due largely to the exceptional sightability of muskox in July, visual transect survey methods are widely accepted as being the most cost effective means of estimating muskox populations while still providing an acceptable level of precision (Case and Graf, 1986; Graf and Case, 1989; Graf *et al*, 1989; Gunn, 1995; Mulders and Bradley, 1991).

### Aircraft Configuration

The survey was flown using a Cessna 206 Grand Caravan high wing single engine aircraft based out of Rankin Inlet and Baker Lake. Strip widths of 0 to 250 meters, 250 to 500 meters, 500 to 750 meters and 750 to 1000 meters were established on the wing struts on both sides of the aircraft using streamers to mark off the 0 meter, 500 meter and 1000 meter markers and tape to delineate the remaining 250 and 750 meter segments (Figure 3). Strip width (w) was calculated using the formula of Norton-Griffiths (1978):

$$w = W * h/H$$

***where:***

*W = the required strip width;*

*h = the height of the observer's eye from the tarmac; and*

*H = the required flying height*

Strip width calculations were confirmed by flying perpendicularly over runway distance markers periodically throughout the survey. The strip width area for density calculations was 1000 m, for a total of 2000 m along each transect. The

further division of the 1000 meter markers into 250 meter segments was to facilitate estimates using distance sampling techniques.

Due to the size of the study area, the relatively limited data on muskox densities within much of the study area, and time and other logistic limitations, it was decided to allocate all of the survey effort into one systematic random transect survey. Survey altitude was maintained as close as possible to 185 m above ground level (agl) using a radar altimeter. Ground speed was maintained at an approximate range of between 125 and 190 kilometers per hour. The survey was initiated July 10, 2010 and completed July 22, 2010.

The entire survey was set up as an independent double observer sight-resight (capture/mark-recapture) distance sampling platform utilizing a survey crew of 7; two data recorders/navigators, two left side observers, two right side observers and the pilot. Two of the selected observers, one for each side of the aircraft, had experience surveying wildlife visually from aircraft. The two remaining observers were selected by the Rankin Inlet HTO. The observers were further divided into front and rear teams, each isolated from the other using visual barriers between the seats as well isolated through the use of two independent intercom systems monitored by each of a front data recorder/navigator and a rear data recorder/navigator. The pilot's responsibilities were to monitor air speed and altitude while following transects pre-programmed on a Garmin GPS 176 Geographic positioning system (GPS). The data recorder/navigators were responsible for monitoring a second and third identically programmed GPS unit for the purposes of double-checking the position as well as to record the waypoints and numbers of observed adult and calf muskox groups on data sheets. The responsibilities of the observers were to monitor their 1000 meter segmented strips and call out numbers of muskox, separated by adults and calves observed within each designated 250 meter wide sub-strip. The rear right and front left observers, the pilot and the two data collector/navigators remained consistent throughout the survey while the front left observer was switched out once following two days of surveying and the rear left switched out three times throughout the duration of the survey. Only counts of adults were used in the population estimate.

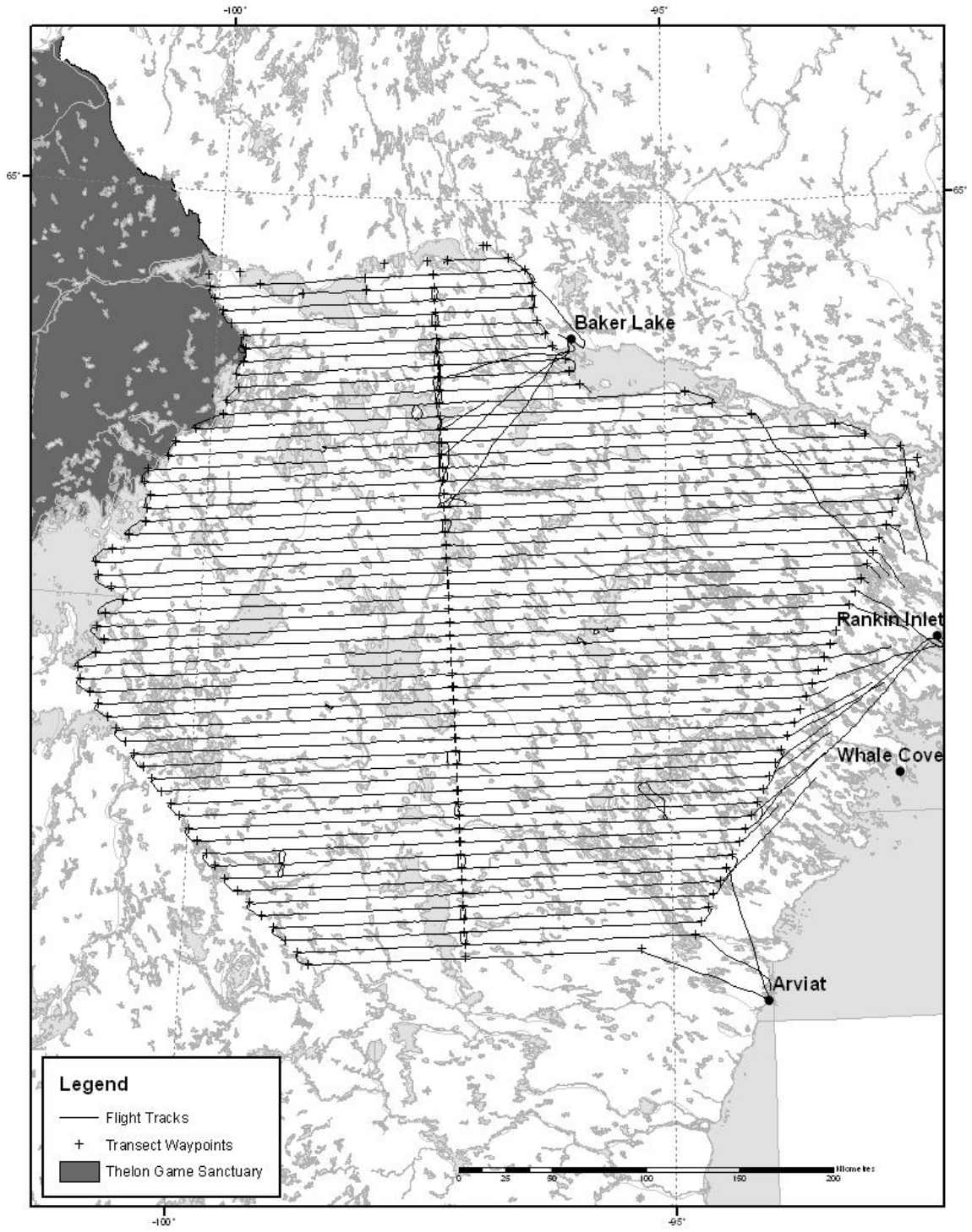


***Figure 2*** *Study area and transects of the July 2010 central Kivalliq Muskox survey. Study area was divided into western and eastern stratum based on estimated densities from IQ studies and past survey results.*

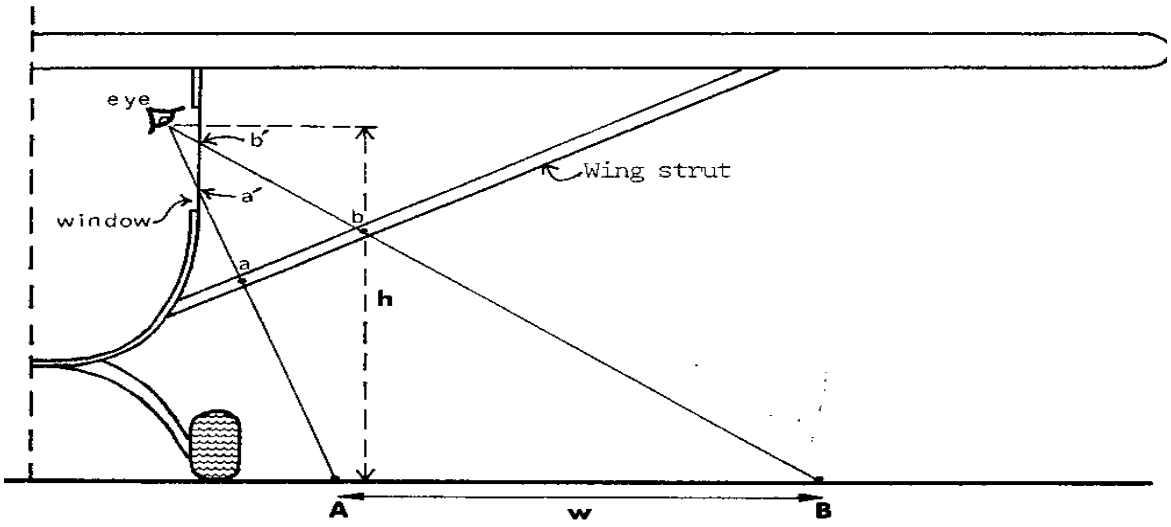


Figure 3. Schematic diagram of aircraft configuration for strip width sampling (Norton-Griffiths, 1978). W is marked out on the tarmac, and the two lines of sight a' – a – A and b' – b – B established. The dowels are attached to the struts at a and b. a' and b' are the window marks.

## Statistical Analyses

Survey data collected within each of two pre-stratified stratum were analyzed using Jolly's Method 2 for unequal sample sizes (Jolly 1969 *In* Norton-Griffiths 1978). Only counts of adults were used for the final population estimates. Lake areas were not subtracted from the total area calculations used in density calculations.

Other statistical methods to assess mark-capture/re-capture and distance sampling are being used and will appear in their entirety following the completion of a fully reviewed GN DoE file report. The completion of the file report is expected in the fall of 2012 and will replace any and all previous reports produced for co-managers including the present work. As other analyses are ongoing, the authors of this report and the GN DoE reserve the right to update the results presented in this report. Any and all GN DoE research projects are required to produce a comprehensive thoroughly peer reviewed File Report following the completion of the research program. The GN file reports represent the most comprehensive and complete reporting format and as a result will be the main documents used to make management recommendations.

## Project Schedule:

| Activity | Start Date | Completion | Status |
|---|---|---|---|
| IQ Study | Dec. 2009 | March 2011 | Complete |
| Survey Planning | Dec. 2009 | July 2010 | Complete |
| Aerial Survey | July 10th, 2010 | July 22nd, 2010 | Complete |
| Initial Reporting to HTOs | Jan. 10th, 2011 | Feb. 3rd, 2011 | Complete |
| Survey Analysis | July 22nd, 2010 | August 2011 | Ongoing |
| Reviewed DoE File Report | July 22nd, 2010 | Oct. 2012 | In Preparation |
| Community Consultation | August 2011 | Oct. 2012 | Ongoing |

## Preliminary Results and Discussion:

### Comparing Surveys

Initial July 2010 survey findings show an increase in the number of muskox within the central Kivalliq Muskox sub-population from July 1999 findings (Figure 4). The 2010 estimate clearly displayed an increase from July 1999 which in turn showed an increase of 1,325 to 2,041 muskox (lower and upper 95% confidence limits) within the area south of Chesterfield Inlet/Thelon River and west to the NWT/Thelon Game Sanctuary boundaries from the number estimated in 1991 (Figure 4; Table 2).

As the July 1991 survey found muskox in a much smaller area than the July 1999 survey, yet at similar densities, these differences could indicate both population and range expansion. The 2010 survey results, however, showed an increase in numbers but for the first time since 1985 showed a dramatic decline in muskox density within the survey area. This could be an artifact of the much larger survey area or it could suggest a punctuated/accelerated range expansion since the July 1999 survey. Further research and analysis is necessary before making any conclusions as to the mechanisms behind these survey findings.

Limitations to comparisons made with pre-1999 muskox surveys in the central Kivalliq were noted above. The primary limitation relates to variations in survey study areas, whereas the 1999 and 2010 central Kivalliq surveys included a

broader area designed to encompass all muskox within the central Kivalliq region.

Central Kivalliq muskox were found over a much broader area than previously recorded (Figure 5). During the July 1999 survey muskox were more concentrated within smaller geographic areas than observed in July 2010. One of the most surprising observations was the presence of numerous carnivores, and most specifically grizzly bears. A total of 15 grizzly bears were observed within the survey area. All were observed in very good to exceptional body condition (Figure 6). This represents a considerably higher number than observed during the July 1999 survey though the survey area in July 1999 was considerably smaller.

Observations of muskox in what was previously considered marginal habitat raised several questions as at the same time densities in what was previously considered better quality habitat dropped substantially. All these observations raise questions as to whether muskox populations are poised to increase further or are reacting to some environmental or anthropogenic changes within the environment. Further analysis is ongoing in attempts to explain the changes observed in July 2010.

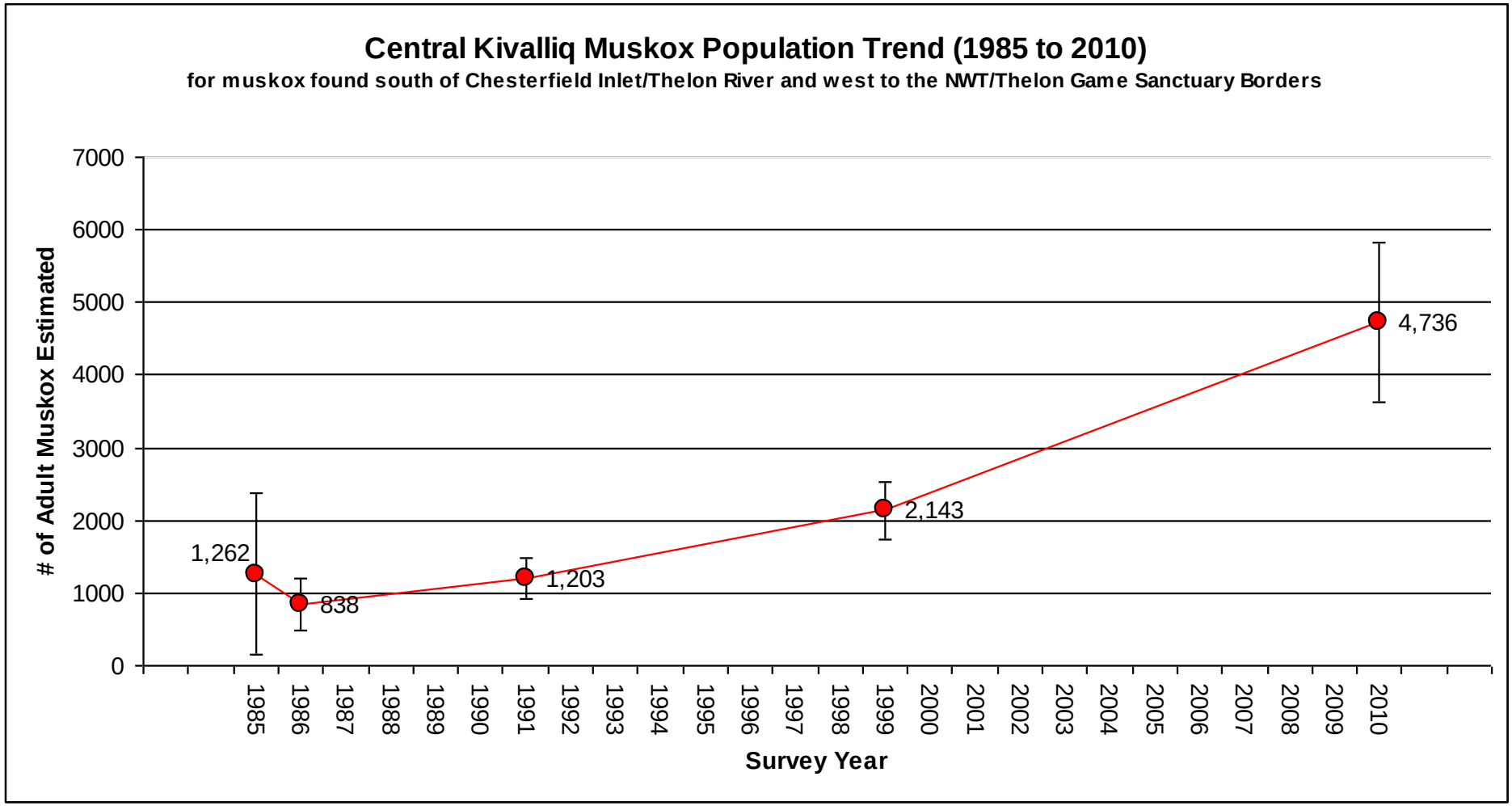


Figure 4 The trend of the central Kivalliq Muskox Population from 1985 through July 2010.

Table 2. A summary Central Kivalliq muskox survey results south of Chesterfield Inlet/Thelon River and west to the NWT/Thelon Game Sanctuary boundaries.(1985–2010).

| *Year* | *Total stratum area ($km^2$)* | *Population estimate* | *Standard error* | *CV* | *Lower 95% CI* | *Upper 95% CI* | *% calves* | *Authors* |
|---|---|---|---|---|---|---|---|---|
| **1985** (Nov) | 19,706 | **1,262** | 563 | 0.45 | 159 | 2,365 | 17.9 | Case & Graf 1986 |
| **1986** (July) | 8,261 | **838** | 176 | 0.21 | 476 | 1,200 | 11.5 | Case et al. 1986 |
| **1991** (July) | 12,555 | **1,203**[2] | 145 | 0.13 | 919 | 1,487 | 15.9 | Mulders & Bradley 1991 |
| **1999** (July) | 19,475 | **2,143** | 199 | 0.09 | 1,747 | 2,539 | 15.0 | Campbell & Setterington, 2001 |
| **2010** (July) | 114,618 | **4,736** | 554 | 0.12 | 3,637 | 5,835 | 15.1 | This Study |

[1] This calculation of the 1991 population estimate includes lake areas, while Mulders and Bradley (1991) subtracted that area in their file report.

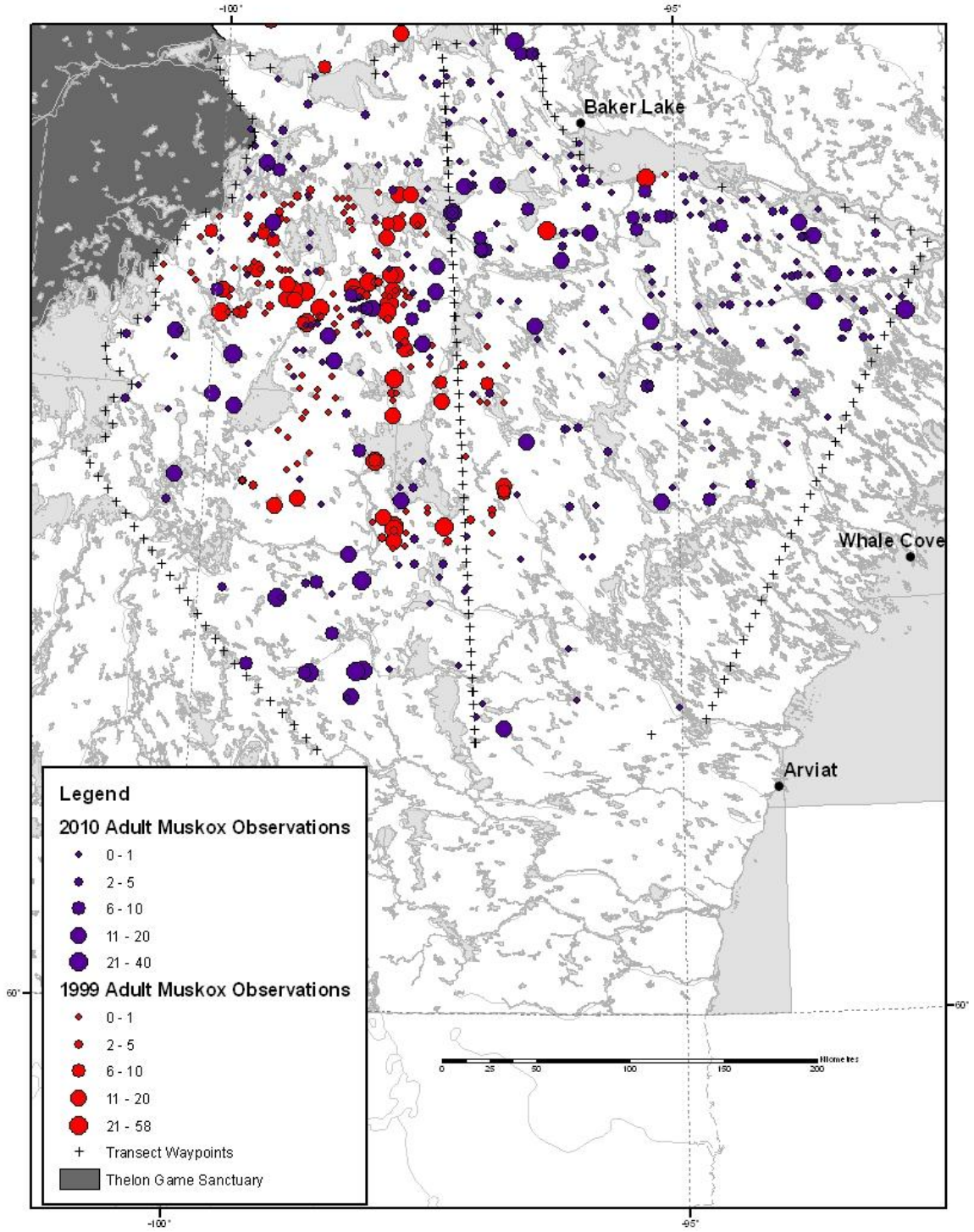


Figure 5 Central Kivalliq muskox survey results from July 1999 and July 2010.

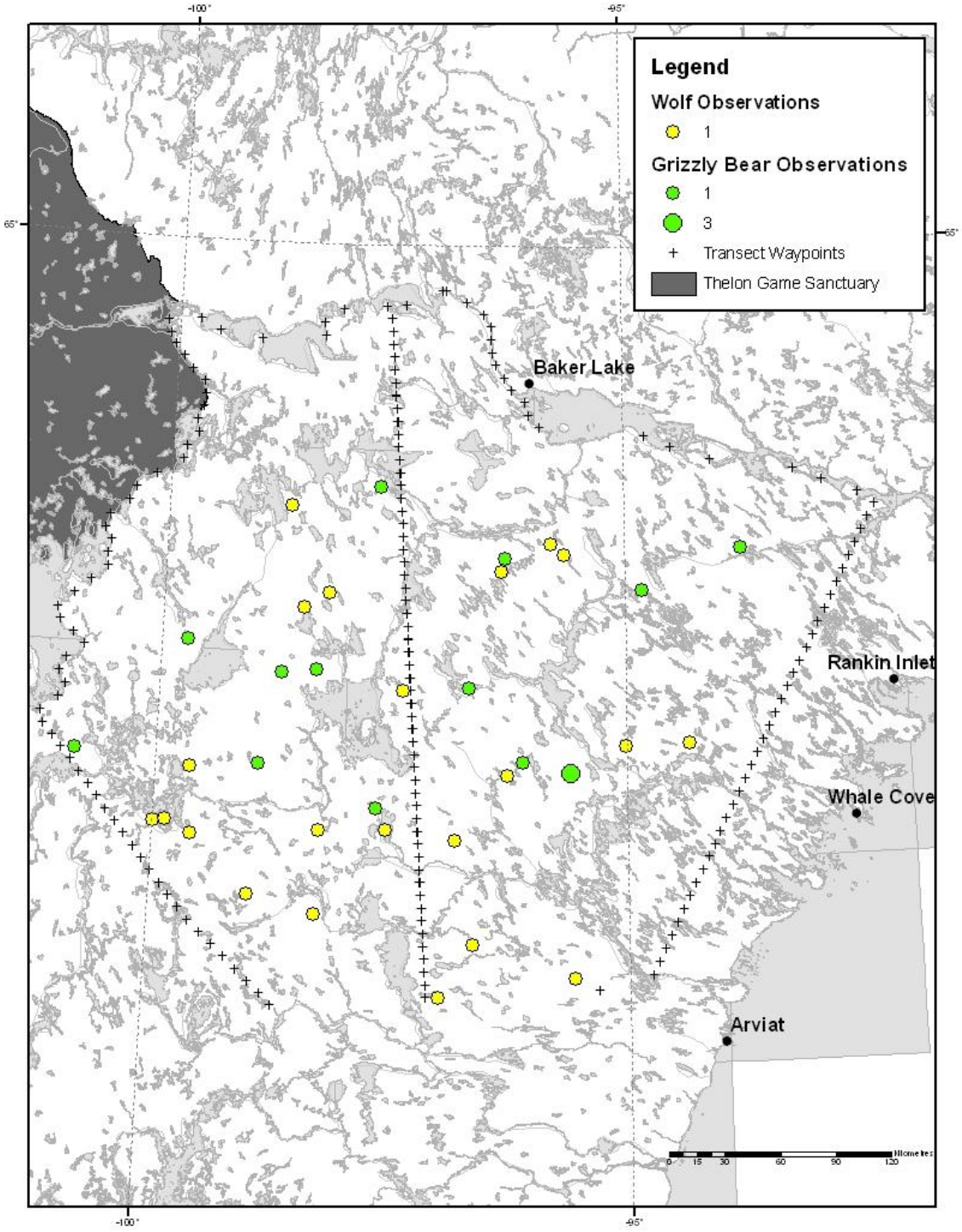


Figure 6 Carnivore observations during the July 2010 central Kivalliq muskox survey.

## Management Findings/Actions/Recommendations

1. The central Kivalliq muskox population (MX/18) has continued to expand outside of previously documented distributions, particularly to the south (towards the Manitoba Border) and eastward (to the coast of the Hudson Bay);

2. A management plan was developed in 2010 by the Kivalliq Wildlife Board, NTI and GN DoE. The July 2010 initial survey results presented herein will update a framework for population monitoring and harvest strategy for the central Kivalliq muskox population but will not supersede the results provided in a reviewed GN DoE file report expected in October 2012;

3. Additional monitoring of muskox must include the ongoing collection of IQ as well as periodic population assessments as deemed necessary through collected IQ. We suggest that the aerial survey used in the 2010 survey be repeated in future survey years and expanded as necessary;

4. To improve TAH recommendations and overall management, additional muskox research should focus on determining demographic parameters such as sex and age characteristics and levels of natural mortality within the population.

5. To improve TAH recommendations and overall management, additional muskox research should also focus on barren-ground grizzly bear abundance, distribution and feeding behavior and their effects on muskox behaviour and ecology.

6. The central Kivalliq muskox subpopulation (MX/18) boundaries should remain as indicated (Figure 7).

7. We recommend an interim increase in MX/18 from 93 tags to 182 tags, (assessment based the mean estimated number of adult muskox given a 5% rate of productivity);

8. We recommend that the non-quota limitations of seasons and sex selectivity be dropped for subsistence muskox harvesting based on the continued increase in population and range expansion observed since the 1999 July estimate.

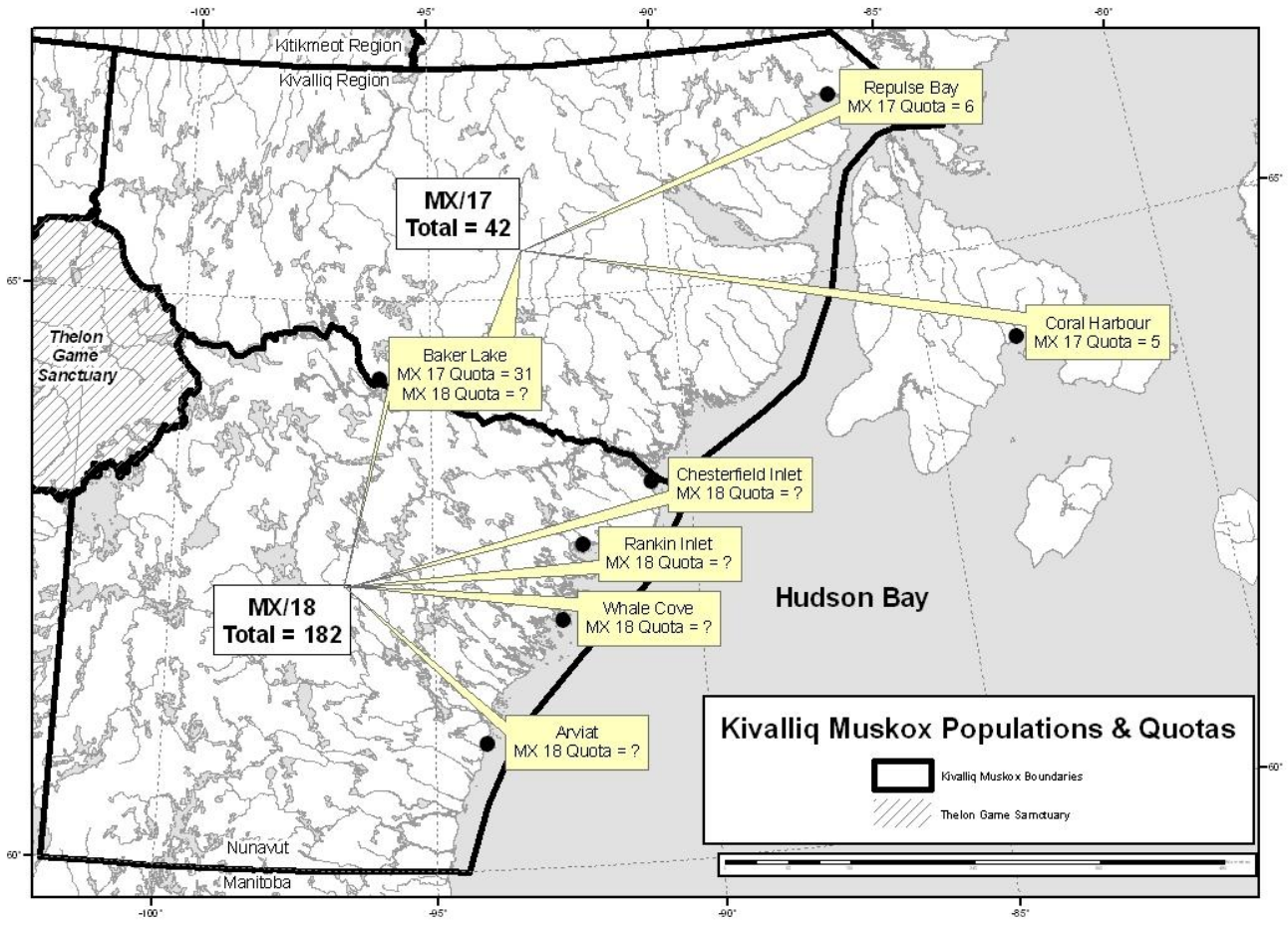


***Figure 7*** *Recommended population boundaries and quota increases to the Central Kivalliq Muskox (MX/18) subpopulation based on the July 2010 preliminary survey results.*

**Community consultation:**

All seven Kivalliq communities (Arviat, Whale Cove, Rankin Inlet, Chesterfield Inlet, Baker Lake, Repulse Bay and Coral Harbour) and the Kivalliq Wildlife Board have been informed of the projects preliminary results and are in agreement with the management recommendations presented in this report. All Kivalliq community HTOs agreed that the preliminary results are consistent with local IQ. The Kivalliq Wildlife Board also indicated that Kivalliq communities would like to take an active role in the analysis and final presentation of survey results. All parties agree that the quota increase should be re-assessed following the production of the Departmental file report. To this end these validated results were used to apply an exemption permit for the 2011/2012 harvesting season. Presently HTO members, local wildlife officers and local hunters are taking part in the continued collection of local knowledge concerning the location of muskox groups across the central and northern Kivalliq, and incorporating IQ in the possible mechanisms surrounding there continued range expansion into marginal habitats and observed lower relative densities.

## Literature Cited:


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## Budget:

**Budget Variance:**

Actual project costs exceeded proposed survey costs as additional IQ collected just before survey initiation required the study area to be expanded and survey transects lengthened. IQ was a fundamental component in the planning of this survey and had to be included regardless of timing to ensure adequate coverage of muskox distributions as well as increase community confidence in survey results.

**BUDGET 2010-2011**
**Project Name: Kivalliq Muskox Re-Evaluation**
**Project Code:**
***Year: 2010-2011***

| | **ORIGINAL TOTAL** |
|---|---|
| **Travel and Accommodation** | $10,724.22 |
| | |
| **Casual Wages** | $10,000.00 |
| | |
| **Materials and Supplies** | $2,000.00 |
| **Contract Services (Fixed Wing)** | $199,809.03 |
| ***Proposed Total Budget*** | **$211,500.00** |
| **ACTUAL TOTAL** | **$222,533.25** |

**Contributions:**

| **Re-evaluation of muskoxen (*Ovibos moschatus*) populations, and quotas in the Kivalliq .** | | | |
|---|---|---|---|
| **AGENCY** | **CONTRIBUTION** | | |
| | | **2010/2011 (Funds)** | **Confirmed/Requested** |
| DoE | | $142,533.00 | Confirmed |
| NWMB | | $55,000.00 | Confirmed |
| Agg. Canada | | $25,000.00 | Confirmed |
| | | | |
| **TOTALS** | | **$222,533.25** | |