NWRT Final Report

NWRT Project Number: 0000000021

Project Title: Qamanirjuaq Herd Telemetry

Project Leader:

Mitch Campbell

Kivalliq Regional Wildlife Biologist

Department of Environment

Government of Nunavut

Box 120 Arviat, NU, X0C 0E0

(867)857-3171

Mcampbell1@gov.nu.ca

Summary:

In November 1997 the GNWT's Department of Environment deployed 5 satellite collars on female Qamanirjuaq caribou, 3 in the southwestern Kivalliq and the remaining 2 just west of Rankin Inlet. An additional 5 collars were deployed in April 1998 of which 2 were placed on Qamanirjuaq cows west of Arviat and the remaining 3 west of Rankin Inlet. Following a collar recovery program in November 2000 an additional 10 Telonics ST-3 satellite collars were deployed on Qamanirjuaq caribou cows in April 2001. In April 2004, 9 Telonics GPS III collars were deployed on Qamanirjuaq caribou cows. In April 2006, 6 ST-14 satellite collars and 14 GPS III collars were deployed in late March on adult Qamanirjuaq cows. In April 2008 an additional 10 GPS IV collars were deployed on adult female Qamanirjuaq caribou followed by an additional 10 in April 2010, 25 in April 2012, 25 in April 2014, 15 in April 2015, 25 in April 2017, and 25 in April 2019. Most recently 35 collars were deployed on Qamanirjuaq caribou cows in April 2019 and 25 in April 2022. Between deployments dropped collars were recovered while in the area conducting spring and/or fall recruitment studies. New dropped collars have to be recovered to receive store on board data as well as to determine if the collar was properly dropped or the result of the animal's death.

We successfully completed composition surveys on the Qamanirjuaq herd between March and May 2021 and 2022 using rotary wing aircraft to determine overwinter calf survival (Recruitment). We recorded cow to calf ratios of 16 calves per 100 cows in April 2021 and 27 calves per 100 cows in April 2022. Based on the assumption that 25 to 35 calves per 100 cows is consistent with population stability in terms of population growth, averaged

April 2021 and 2022 results suggest a continued slow declining trend though April 2022 results show values consistent with stability. Since the initiation of this project interests in mining across Kivalliq caribou range have continued to increase. In Addition, low spring recruitment values and a trend analysis of Qamanirjuaq caribou on their calving grounds have confirmed a slow decline in the subpopulation. These two issues continue to amplify concerns from both Biologists and Inuit experts alike, that the Qamanirjuaq caribou herd vulnerability is increasing.

Satellite based GPS telemetry offers a useful tool to monitor caribou and identify potential conflicts with resource development, as well as improving our understanding of caribou range use. The collars currently deployed transmit 6 locations daily to orbiting satellites. These locations are then communicated via. E-mail to ENV offices for processing every second day. Collar location data is used by local HTOs, regional organizations, and used biologically to: prevent conflicts with resource development, locate concentrations of caribou for survey work, identify seasonal ranges including core calving grounds and key access corridors, determine spring, rut, and fall migration corridors and movement patterns, and to monitor post-calving aggregations and movements. These data are then used to inform all stakeholders for the purposes of assisting in their participation in the management of the herd including land use planning and protections. In concert with spring composition work, telemetry can also be used to track productivity through an assessment of annual movements, habitat use, and recruitment rates, as an index of herd vulnerability and trend.

In general, Kivalliq caribou herd movements differed little between 2021 and 2022. Qamanirjuaq herd movements during calving and post calving continue to press into the north eastern extents of their calving, post calving and annual range. The GN continues to work with co-management partners and the Kivalliq Wildlife Board (KWB) regarding impacts along linear mining infrastructure. At present the GN is working on road effects studies north of Baker Lake during fall migration for the NEM herds, and on a mining road in the vicinity of Rankin Inlet within the Qamanirjuaq herds post calving Range.

In June 1994, the Qamanirjuaq herd size was estimated to be 496,000. A reassessment of herd abundance of the Qamanirjuaq herd in June 2008 suggested the herd had declined to 348,000. An abundance survey flown in June 2014 confirmed a statistically significant decline in Qamanirjuaq numbers to 264,718 animals. A more recent survey of the Qamanirjuaq herd in June 2017, estimated 288,244, however this increase in mean abundance was not found to be statistically significant. Additionally, hunter reports from Arviat, Chesterfield Inlet, Whale Cove and Rankin indicated a suspected mixing of herds in 2014 and 2015 based on next year distributions and movements as well as physical traits reported by local harvesters and HTOs. Collar movements of the Lorillard and Ahiak caribou herds in 2015 suggest the likelihood of some mixing of the herds on the Qamanirjuaq calving ground over the 2014 survey period, observations consistent with hunter reports. These recorded and reported movements may have inflated the estimate of the Qamanirjuaq herd June 2017 survey. Most recently the Qamanirjuaq herd was successfully re-assessed in June 2022, with initial estimates provided in a companion report.

As development and mineral exploration activity increases in the Kivalliq, there will be increasing disturbance of caribou across all seasonal ranges. Existing and proposed caribou protection measures to date are ineffective as they are poorly enforced, unproven guidelines rendering any mitigative efforts largely ineffective. Additionally, all regulatory organizations have lacked, and continue to lack, the capacity to properly monitor developments adherence to these measures. Any measures would have to be complemented with a monitoring program which; 1) determines the geographically significant components of mainland migratory caribou annual range, 2) determines how these components relate to the herd's seasonal use of its range, and 3) defines seasonal range use annually, monitors and defines migratory corridors, and ensures that conflicts between caribou and exploration and mining activity can be acknowledged and effectively mitigated using scientifically verified methods in an attempt to minimize disturbance, and maximize herd productivity. The net effect of such a program would be to preserve Inuit harvesting rights and opportunities over the long-term.

Introduction:

The Qamanirjuaq Caribou Herd is the largest herd in the western arctic, occupying a massive (300,000km^2) yet poorly understood annual range. Kivalliq Inuit are believed to utilize over 8,000 Qamanirjuaq caribou per year followed by Manitoba Dene believed to be utilizing just over 2,000 caribou per year. Both Saskatchewan and NWT aboriginal harvesters are believed to utilize an estimated 500 to 1,000 animals though this harvest varies from year to year depending on the herds seasonal distribution (InterGroup, 2008). In total an estimated 10,000 to 11,000 Qamanirjuaq caribou are thought to be harvested annually (based on our best estimates) with an estimated annual value of over fifteen (15) million dollars. Any decline in productivity or increase in mortality herd wide would have a devastating impact on thousands of subsistence harvesters and their families across the range.

The logistics involved in determining how these caribou use their range are for the most part logistically and cost restrictive. The modification of a satellite telemetry program launched in 1993 into a GPS/satellite program has aided in the building of a comprehensive location and activity database. This database has been providing biologists, Hunter Trapper Organizations, Regional Wildlife Organization and inter-jurisdictional and jurisdictional management boards with the only source of information connecting the Qamanirjuaq caribou to their range. In recent years observations of Qamanirjuaq caribou movements have indicated shifts in their use of some seasonal range including calving and post-calving range. Qamanirjuaq winter range over the last five years has shown considerable overlap with the Bathurst and Beverly populations of barren ground caribou, while changes in Northeast Mainland movements and distribution, most notably in the vicinity of mining infrastructure, is believed to have led to some overlap with the Qamanirjuaq spring and calving range. The Qamanirjuaq herd has recently been estimated (June 2022) with survey results provided in a companion report, however there remains concern that all monitoring information is pointing to a continued decline.

Historically, a dramatic decline in Qamanirjuaq numbers, first identified in the early 1950's, sparked a flood of scientific studies all attempting to understand the underlying mechanisms responsible for the decline (Heard, 1985; Parker, 1972). Research efforts were at their peak between the late 1970's and late 1980's. A population survey in 1982 showed that the trend was dramatically, and despite research-based predictions, reversed (Gates, 1989). This unexplained increase was not surprising to local hunters as the local knowledge of the time disagreed strongly with scientific findings. Population surveys estimating the size of the Qamanirjuaq population of barren-ground caribou has shown considerable change over the years. An increase from 44,000 animals in 1977 to 221,000 (SE = 72,000) animals in 1988 to 495,665 (SE = 105,426) animals in 1994 (Williams 1995) then declining to 348,661 (SE = 44,861) by June 2008 (Campbell et al., 2010), indicates just how widely this populations long term cycles are capable of fluctuating (Heard, 1981; Gates, 1983; Russell, 1990; Campbell et al., 2010)). An abundance survey flown in June 2014 confirmed a statistically significant decline in Qamanirjuaq numbers to 264,718 animals from the 2008 findings. A more recent survey of the Qamanirjuaq herd in June 2017, estimated 288,244, however this increase in mean abundance was not found to be statistically significant. Additionally, hunter reports from Arviat, Chesterfield Inlet, Whale Cove and Rankin reported a suspected mixing of herds based on physical traits, while collar movements of the Lorillard and Ahiak caribou herds over the same period suggested some mixing of the herds on the Qamanirjuaq calving ground over the survey period which may have inflated the estimate of the Qamanirjuaq herd. Most recently the Qamanirjuaq herd was successfully re-assessed in June 2022, with initial estimates expected in winter 2023.

In recent years estimates of herd size are based on a combination of visual observation and aerial photography of the calving ground. During these surveys the numbers of breeding cows are counted and herd abundance extrapolated using fall composition counts. Up until 1994 the herd has appeared to have been growing. Presently trend analysis and monitoring indices suggest a declining population as do hunter reports of fewer caribou and an increasing incidence of disease. Cumulatively these findings/observations have raised considerable concern for the future of the herd across the Kivalliq region. These concerns were heightened with a documented drop in relative densities of calving Qamanirjuaq caribou between reconnaissance surveys flown between June 2008 and June 2010 and again between June 2010 and June 2012. Relative densities have continued to drop into 2022.

Results from a photographic calving ground survey of the Bathurst herd in 2003 and 2006 (Gunn et al. 2005, GNWT 2006) indicated that the Bathurst herd has been declining at about 5% a year for the past decade. At present the Bathurst Herd has declined below the basic needs of subsistence harvesters leading to a harvest moratorium in an attempt to recover herd numbers. Post-calving photographic surveys of the Cape Bathurst and Bluenose East and West herds in July 2005 and 2006 (Nagy and Johnson 2006a, 2006b) showed significant and continued declines in these three herds from 2000. There appears to be synchronicity between the barren ground herds that could be in response to large-scale events such as weather patterns, density dependant reproductive disease and parasites, all suggesting that these mainland caribou declines could be linked and thus beginning to impact eastern herds. With mining and exploration on the increase within calving and post calving habitat of the Qamanirjuaq herd, it is important that managers determine the status of herd abundance and movements in order to provide timely mitigation of potential human impacts to prevent and/or ease any of these impacts that would have a negative influence on reproductive productivity.

The Beverly and Qamanirjuaq Caribou Management Board (BQCMB 2005) co-ordinates and provides a single forum for the management of the Qamanirjuaq herd and is mandated to pursue partnerships for the herd's management. The BQCMB's overall purpose is to safeguard the caribou herds for traditional users, all Canadians, and people of other nations. Information on herd size is an integral part of the 2005-2012 management plan as enhanced management actions are called upon if herd trend is declining. Further management actions are also required if herd size is not able to meet subsistence needs levels. The BQCMB in its most recent annual report has listed the Qamanirjuaq and Beverly Herds as vulnerable and in need of heightened land use management aimed to protect critical caribou habitat. Information on herd size and trend is required for land use planning, decisions on commercial and resident harvest levels, forest fire management, and environmental assessments. The BQCMB is concerned that not monitoring the movements, disturbance effects, or demographic parameters of mainland migratory caribou herds, may lead to loss of critical habitat, herd fragmentation, or possible over harvest scenarios which, like the Bathurst herd, may, over time, leave the herd with too few caribou to support the basic needs of subsistence harvesters across the range. Our collective experience from the Bathurst Herd study warns that major declines in mainland migratory barren-ground caribou subpopulations must be caught early to reduce the hardship of a long-term restrictive harvest on subsistence harvesters. Knowing the trend and status of the population will allow managers to start, if required, less restrictive actions, such as non-quota limitations (NQLs) and critical range protection, earlier in the cycle to foster earlier and quicker recovery. All population indices indicate that the Qamanirjuaq herd is declining, lack of appropriate management actions may exacerbate, prolong, or prevent herd recovery and place future undue hardship on communities that harvest this herd both commercially and for subsistence.

Ungulate monitoring programs are crucial to the development of management plans and actions, land use planning, and effective mitigation methods and plans, seasonal closures, and the steering of land use activities in an informed and conservation minded direction. As land use activities heighten to meet the needs of a rapidly growing natural resource-based economy, the maintenance of viable wildlife populations with high sustainable yields will require an escalation in our attempts to monitor caribou movements and quantify seasonally important caribou habitat (Gray and Donihee, 1983; Scotter, 1980; Thompson et al, 1980). Knowing where the caribou are is the key to protecting critical habitats and avoiding conflicts between natural resource industries and caribou (Tennenhouse, 1986).

Project Objectives:

The objectives of the research are to maintain a collar deployment of GPS/satellite collars on adult Qamanirjuaq caribou cows. The information collected from these collars will be used to: 1) establish and update an important habitats information base for the Qamanirjuaq herd by integrating the location and activity database, using spatial analysis software, with vegetation, hydrological, topographical, exploration, and land use databases, 2) provide resource users, regional Wildlife Organizations, and Jurisdictional and inter-jurisdictional Management Boards, access to an information base with which to make management decisions and steer land use activities in an informed and conservation minded direction, 3) locate caribou concentrations for annual spring classifications, future population surveys, and calving ground and other seasonal delineations, and 4) Continue analysis into the effects of Anthropogenic disturbance/infrastructures on caribou distribution and long-term health and abundance. Following is a breakdown of the study's main objectives:

1) To provide a near real time accessible information base to wildlife managers, commercial stakeholders, Land use regulators, RWO's, and HTOs. To provide the necessary deliverables for informed land use planning, to assess and steer land use in an environmentally sustainable manner: Biological rationale: Conflicts can and will arise when commercial development occurs on caribou seasonal range. Without current, adequate knowledge of commercial impacts on caribou health, distribution, and productivity, long-term and/or permeant alterations of wildlife populations and habitat, resulting from development, hunting and trapping, and natural

change, separately or combined are at high risk of occurring (Donihee and Grey, 1982). Telemetry was and continues to be used to monitor Qamanirjuaq adult cow movements to ensure conflicts with natural resource users and industries can be identified, removed, avoided and/or mitigated in a timely manner using methods that are scientifically proven effective.

2) Locate and quantify the seasonally important range for the Qamanirjuaq herd using GPS/satellite telemetry: Biological rationale: Habitat quality, quantity and availability, largely define the biological limitations of wild populations (Gray and Donihee, 1983; Scotter, 1980; Thompson et al, 1980; Dasmann, 1981). An understanding of the locations and size of important habitat, and how these habitats are important to barren-ground caribou will as assist wildlife managers and land use planners in assessing the potential for seasonal levels of disturbance, potential cumulative effects on herd distribution and productivity, and impacts to Inuit harvesting rights under the Nunavut Agreement. A GPS/satellite telemetry program offers the most cost effective and logistically simple means of identifying and monitoring caribou range use on a seasonal basis.

3) To cost effectively locate Qamanirjuaq caribou cows for population studies: Biological rationale: The most time consuming and costly component in the assessment of caribou demography is the assurance that all possible aggregations of caribou cows are located and quantified. Because of the often-massive range of barren-ground caribou herds, telemetry programs have become a critical component used to insure appropriate coverage during demographic surveys. Using collar locations as the focal points for any proposed scientific study, would save considerable time and money relative to the cost of collar deployment and maintenance.

4) To access overwinter calf survival as an indicator of herd vulnerability, health, and abundance trends.

Materials and Methods:

Telemetry data, showing caribou locations over time will form the main dataset for future analyses. Base data (at various scales) and anthropogenic information will also be compiled to facilitate the mapping and to provide a time snapshot of what the current conditions are on the landscape. The seasons identified in the Nagy analyses (Nagy et al. 2011) and (Campbell et al, 2014) will be correlated and updated for each subpopulation and grouped into nine seasons for this project: spring migration, calving, post-calving, summer, late summer, fall migration – pre-breeding, rut/breeding, fall migration – post-breeding, and winter. The date ranges defining the season for each subpopulation are outlined in appendix 6. Based on a review of the movement patterns, some of the date ranges may be refined from the Nagy seasons based on animal movements.

The most current telemetry data will be partitioned into the nine seasons and analysed according to subpopulation, as seasonal space-use patterns for subpopulations in the study area are distinct (Nagy et al. 2011). Seasonal ranges will be identified for the calving, post-calving, summer, late summer, rut/breeding and winter seasons using utilization distribution surfaces derived from a kernel density analysis on the location data (points). Movement corridors, characterized by high movement rates, will be identified for spring, fall pre-breeding, and fall post-breeding migration seasons using the movement paths represented by walk lines between locations. The resulting seasonal use and corridor surfaces will be combined to define the core seasonal ranges. These analyses will be developed separately for each subpopulation and the results merged together to derive a study area wide dataset depicting regional distribution. In areas of overlap the highest density will be priority.

While there are many possible approaches to seasonal range identification, minimum convex polygon (MCP) (e.g., Dyer et al., 2001; Hins et al., 2009; Mosnier et al.,, 2003) and utilization distribution Methods (UD) (e.g., Koehler & Pierce, 2003; Rivrud et al., 2010; Skarin et al., 2008; Smulders et al., 2012) are most commonly applied (Laver and Kelly 2008; Powell 2000). The MCP approach delineates home ranges by creating a minimum bounding convex polygon that encompasses all sampled location points. Defining seasonal ranges using MCP is practical, as it is straightforward to implement and interpret, and requires no input parameter selection by the user. However, the approach’s simplicity is also limiting as it can overestimate range size by incorporating unused areas found between outlying points and its equal use of the land base within its boundaries (Powell 2000, Börger et al. 2006, Nilsen et al. 2007, Long and Nelson 2012).

Utilization distribution (UD) approaches differ from MCP in that they delineate seasonal ranges based on probability of use contours derived from density surfaces. Kernel density estimation (KDE) is arguably the most common UD method (Börger et al. 2006, Kie et al. 2010). KDE generates a density surface from sample location points by placing a probability density function over each location point to estimate a density value for that area. A user-defined continuous grid is superimposed on the data and a density estimate is produced for each cell. For cells where the probability density functions overlap, estimates are averaged (Silverman 1986, Worton 1989, Seaman and Powell 1996). KDE requires the user to select an output grid size, kernel shape[1] and search radius size; however, of these, the search radius has been shown to have the most influence on the resulting range boundaries (Worton 1989, Seaman and Powell 1996, Hemson et al. 2005, Kie et al. 2010). Many search radius selection methods have been proposed (e.g., least squares cross

[1] Default kernel shape in ArcMap is a quartic kernel function

validation, likelihood-cross validation, reference search radius selection, plug in search radius selection), but no consensus has been reached on which is most appropriate. KDE is an improvement over MCP as it better represents seasonal range boundaries and provides a measure of space-use that can be used to distinguish areas of intense versus occasional use within the defined range (Börger et al. 2006; Kie et al. 2010; Laver and Kelly 2008; Worton 1987). KDE was selected for seasonal range analysis since it would allow for the identification of key habitats, characterized by high use, within each of the caribou subpopulations' seasonal ranges. Additionally, KDE has been widely used to identify seasonal and home ranges for wide ranging mammals living in multi-use landscapes similar to that of the barren-ground caribou herds (Dalerum et al. 2007, Mitchell and Powell 2007, Berland et al. 2008, Sorensen et al. 2008, Sjoberg 2013).

Spring classification counts were conducted in late April using existing collar locations to locate aggregations of caribou. Since the spring of 1999 classifications have been difficult because of the herd's distribution into areas logistically difficult or impractical to reach using ground transportation. For these reasons a rotary wing aircraft was required to effectively complete this monitoring component. In addition, cow / calf ratios varied depending on where on the spring range these groups were located (eg. Groups of caribou further west may have higher cow/calf ratios then groups in the south or eastern portion of their spring range). It is essential that caribou aggregations within each of the geographically segregated groups be classified to avoid any error created by this effect. Once located, aggregations were approached and classified at distance using image stabilizing binoculars to maximize approach distances. Allocation of effort was based on relative collar densities to insure representative sampling.

Study Area:

The study area for the 2021 and 2022 spring monitoring program encompassed the Qamanirjuaq spring range (**Figure 1**). The range sits predominantly within the forest ecotone though migrating caribou had moved out onto tundra environment by late April. Composition flights for both the 2021 and 2022 field seasons was based out of Arviat.

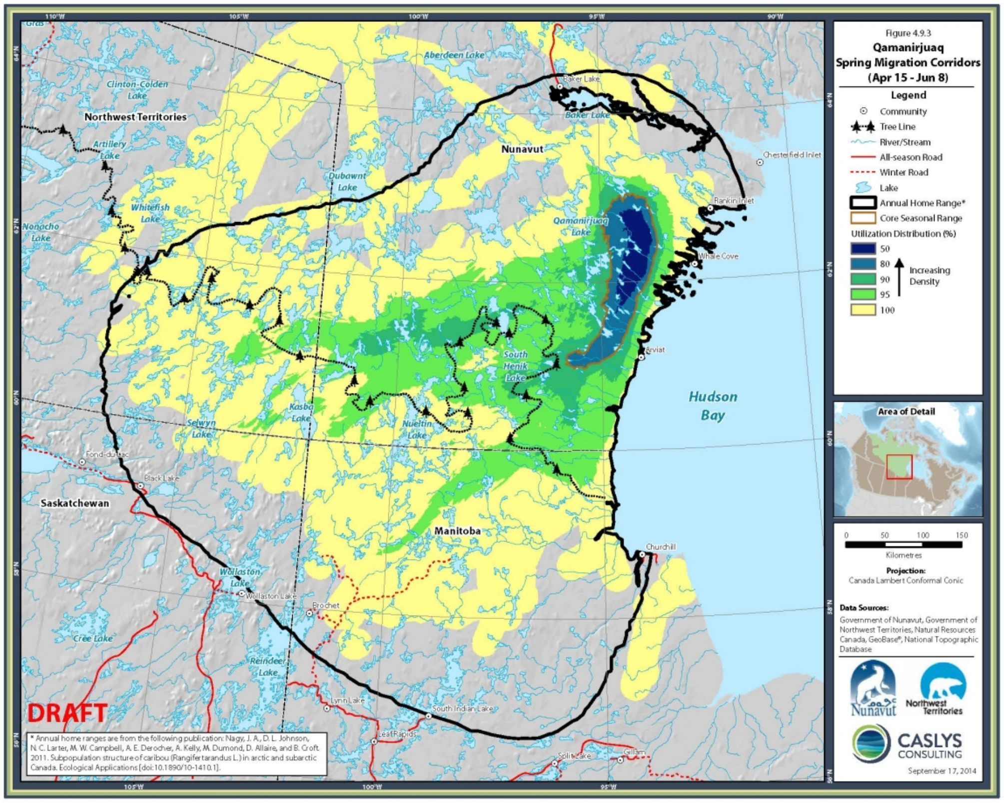


Figure 1. The Qamanirjuaq spring study area as defined by Qamanirjuaq spring seasonal range extents.

Results/Discussion:

Qamanirjuaq Caribou Cow Movements 2021-2023

Thirty-five (35) Telonics Iridium GPS-5 collars with automatic breakaway devices, were deployed on adult Qamanirjuaq cows in late-April 2022. Target capture locations, though modified to incorporate known groups of migratory caribou, were consistent with objectives (**Figure 2**). Of interest is the more northerly extents at the end of the spring migratory season, a behaviour that has been recorded since 2018, though 2022 recorded the most northerly extents since the telemetry programs beginnings in 1996.

Caribou telemetry movements recorded over 2021 and 2022 have displayed continued expansion of the Qamanirjuaq herds calving range into the northeastern extents of their annual range when compared with 2013 seasonal range assessments (**Figure 3**). The Qamanirjuaq range expansion is primarily occurring within calving, post-calving, and summer seasonal ranges. The reasons for these observed changes are uncertain at this time. All seasonal movements of collared adult Qamanirjuaq caribou cows is shown for each of the spring migration, calving, post-calving, summer, late summer, fall migration, rut/breeding, post breeding, and winter seasons (**Figure 4 through 12**).

An update to caribou seasonal range use for the Qamanirjuaq Herd is ongoing with an expected completion date of spring 2024. Analytical complications encountered to ensure all stakeholder concerns are accommodated have delayed the completion of this program. A new series of consultations involving representatives from DOE, NTI, KWB, and NWMB is planned for every Kivalliq community in early February 2024.

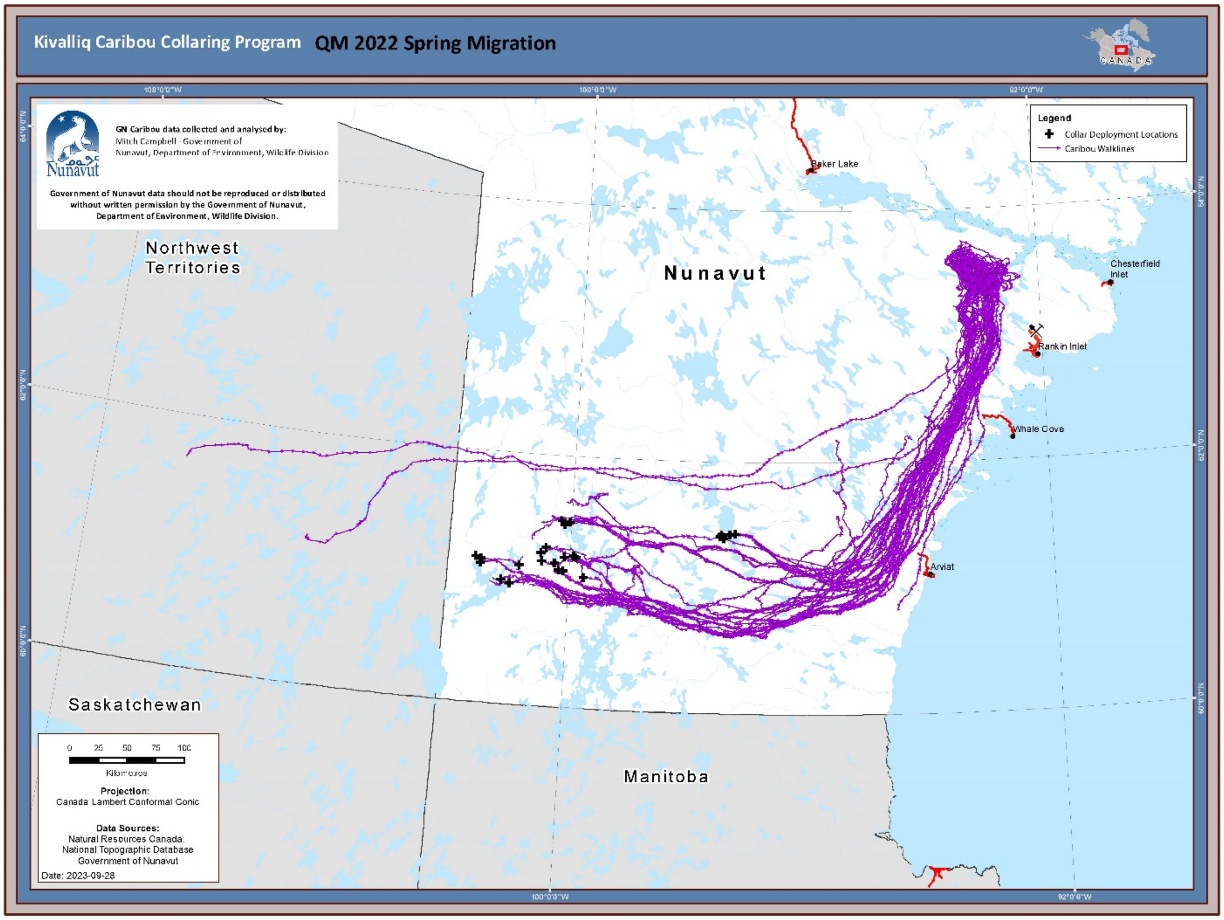
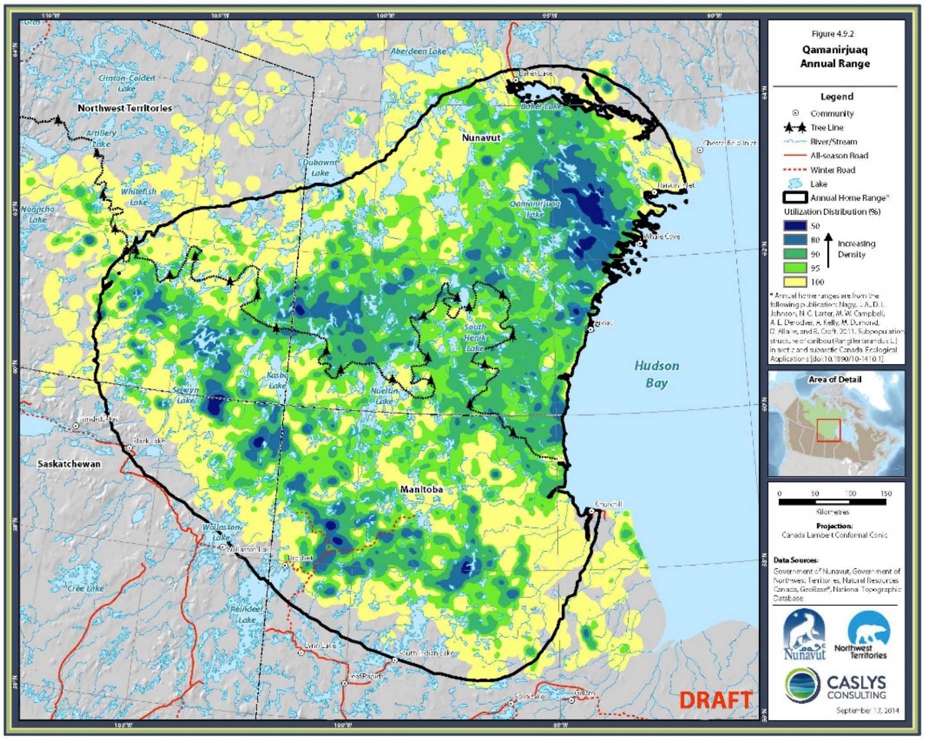


Figure 2. Qamanirjuaq spring collar deployment locations (+) and initial movements. Track lines without an "+" were from existing collars. Note the more northerly late spring extents of the migration then observed since the start of the Qamanirjuaq telemetry program in 1996.



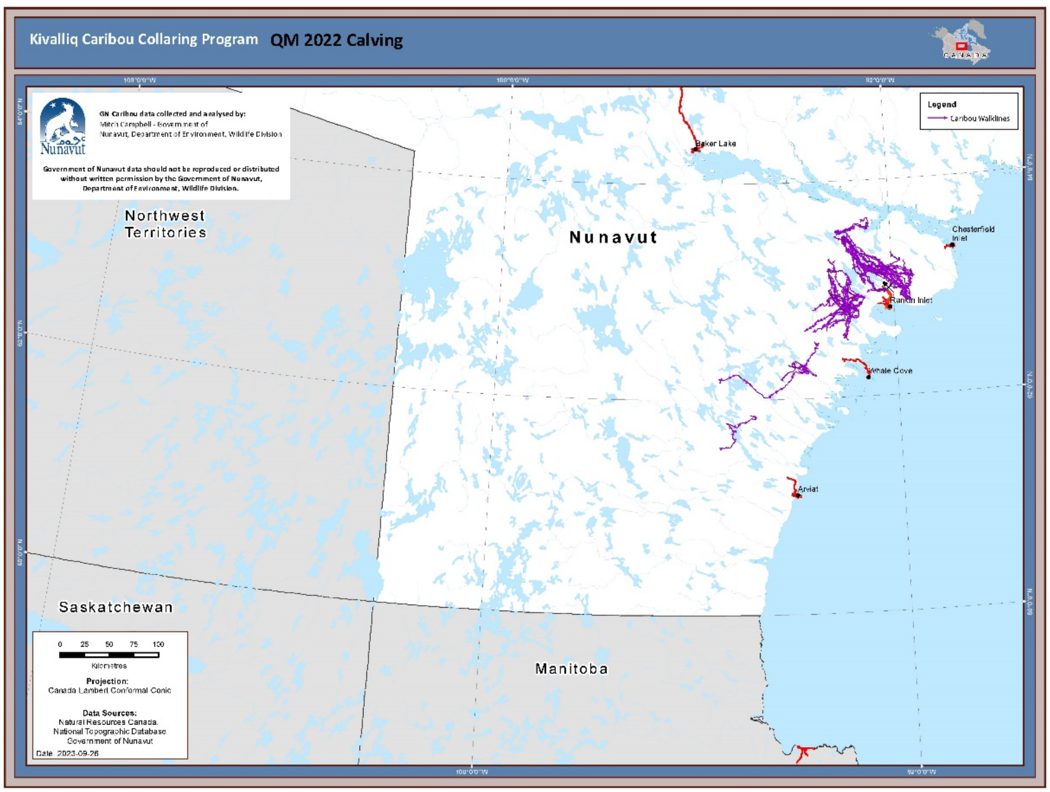
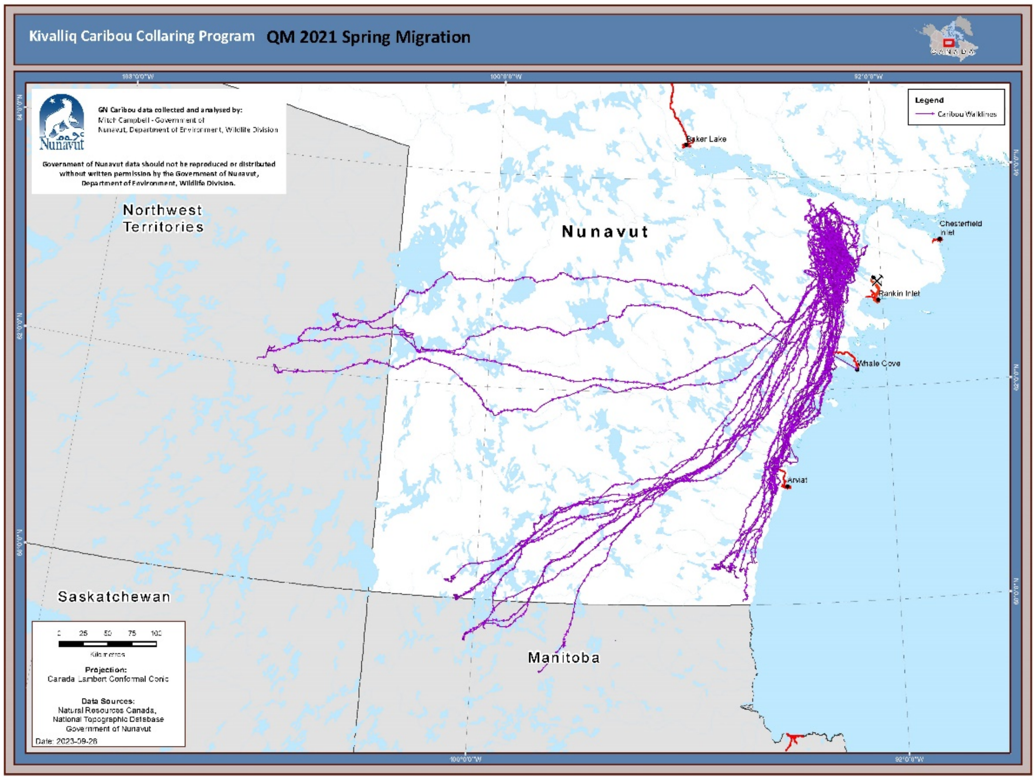


Figure 3. The annual range of the Qamanirjuaq herd (above) developed using kernel analysis of telemetry data current to 2013. When compared with 2022 movement data (below), it appears that the herd is calving further north and east than previously documented.



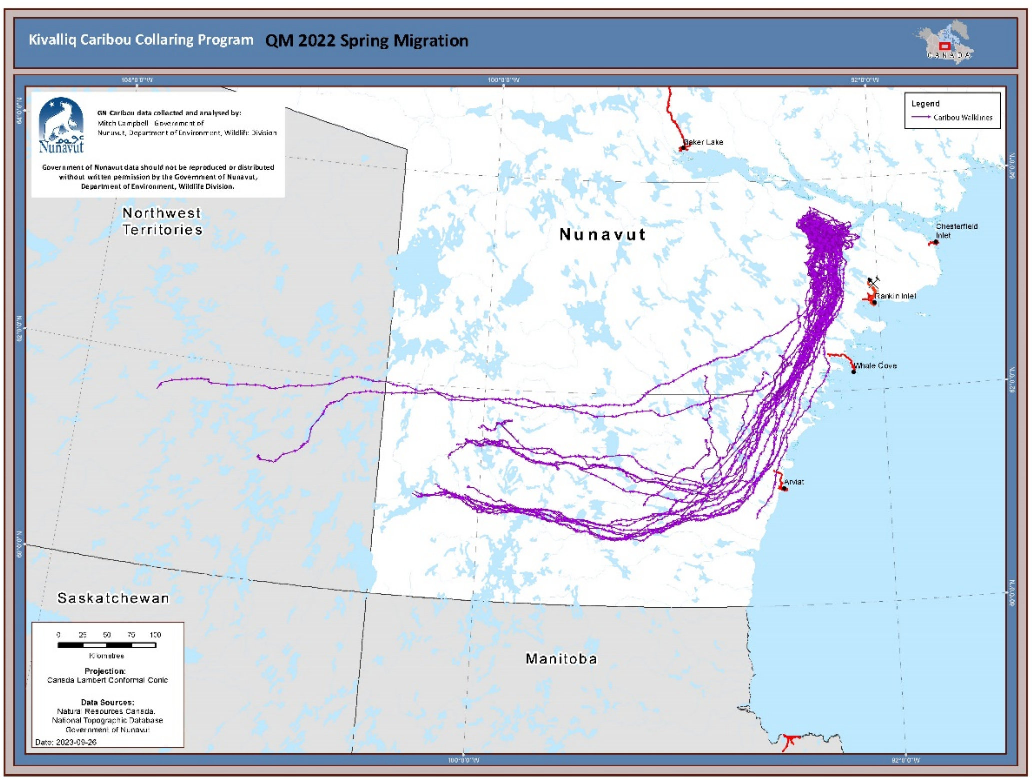
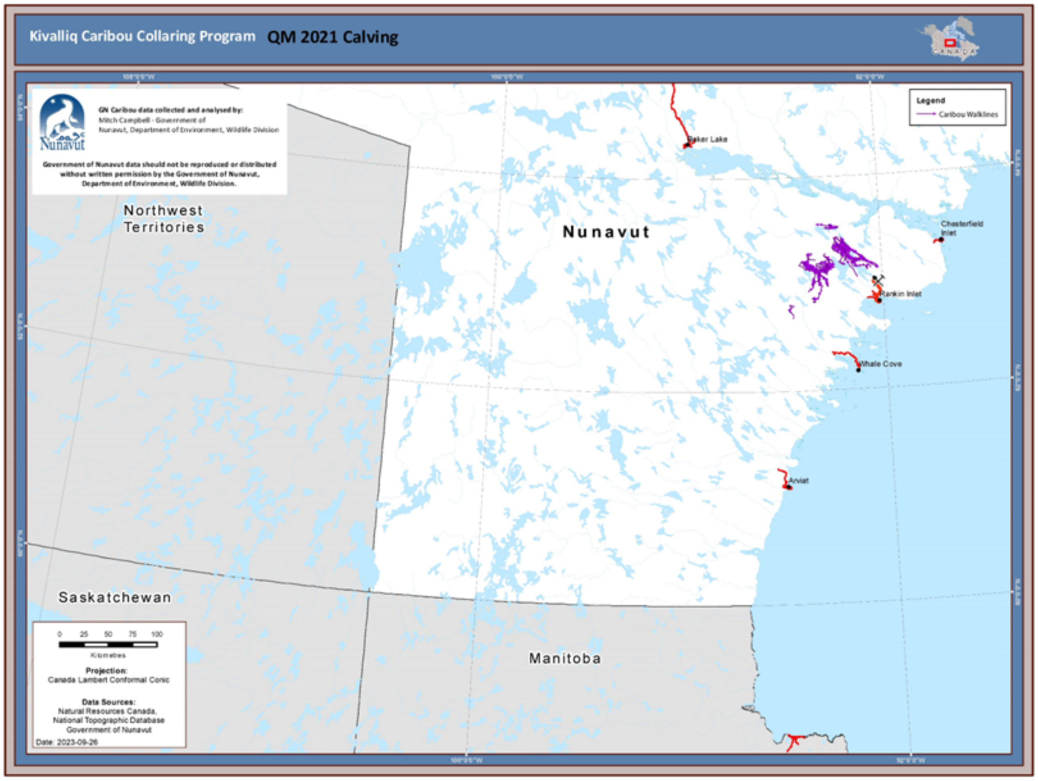


Figure 4. NEM caribou cow movements during spring 2021 (above) and spring 2022 (below). Includes all collar data from April 6th through June 12th.



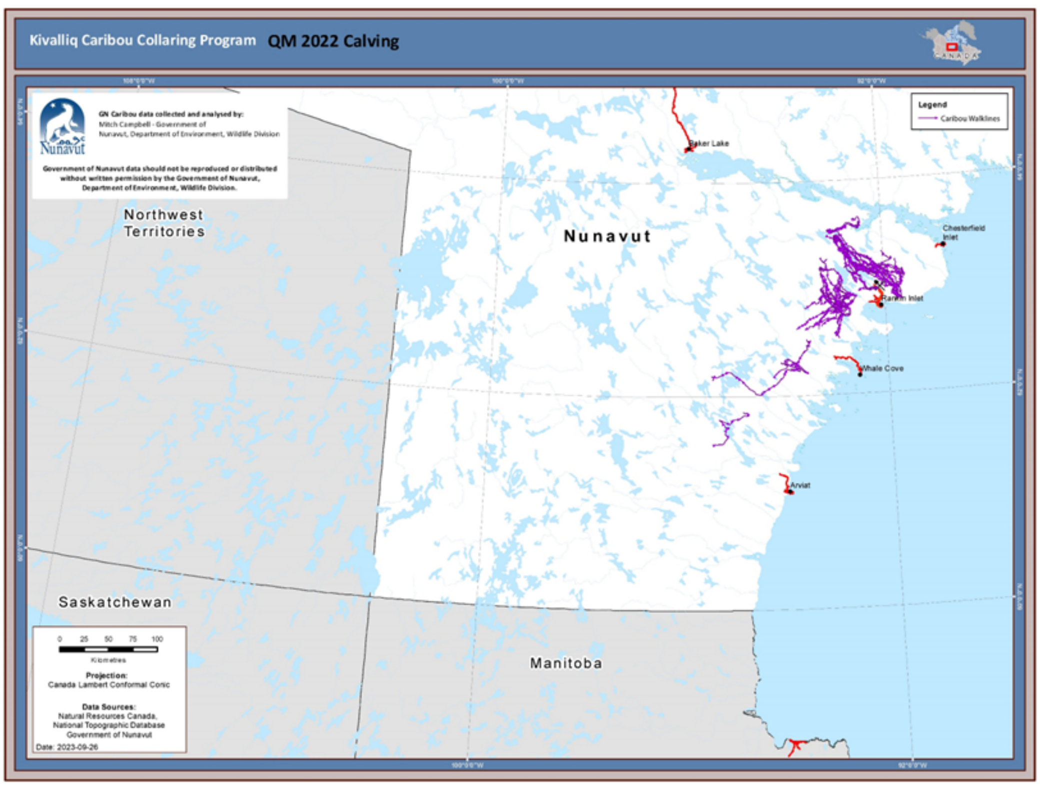
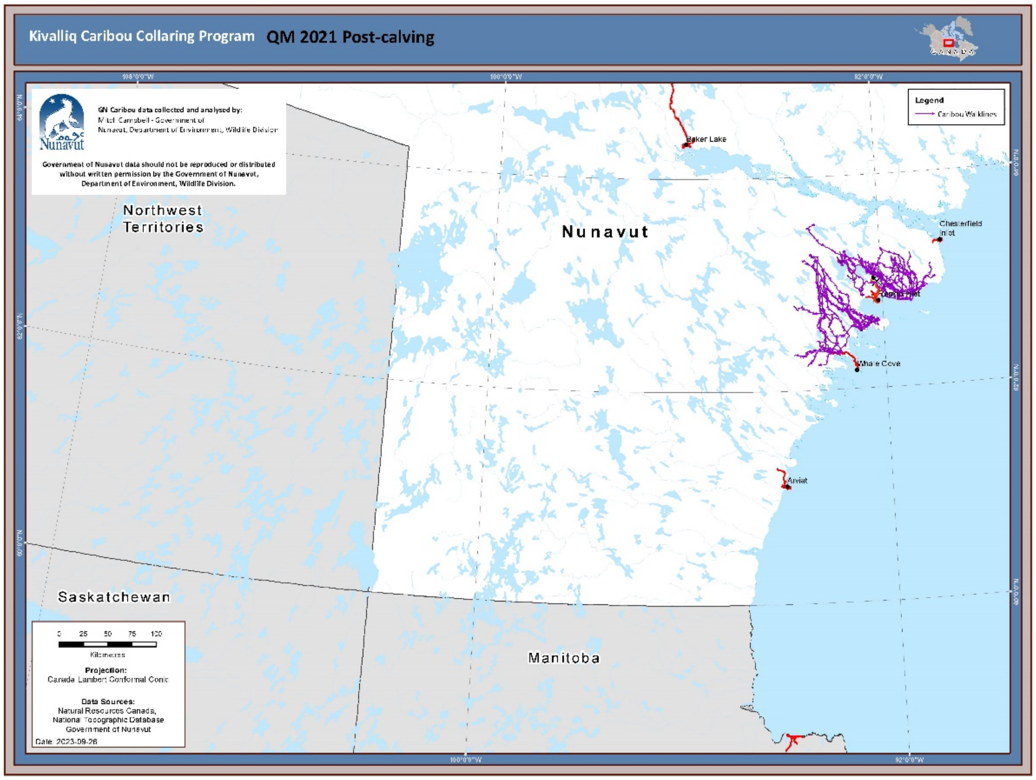


Figure 5. NEM caribou cow movements during calving 2021 (above) and calving 2022 (below). Includes all collar data from June 13th through June 25th.



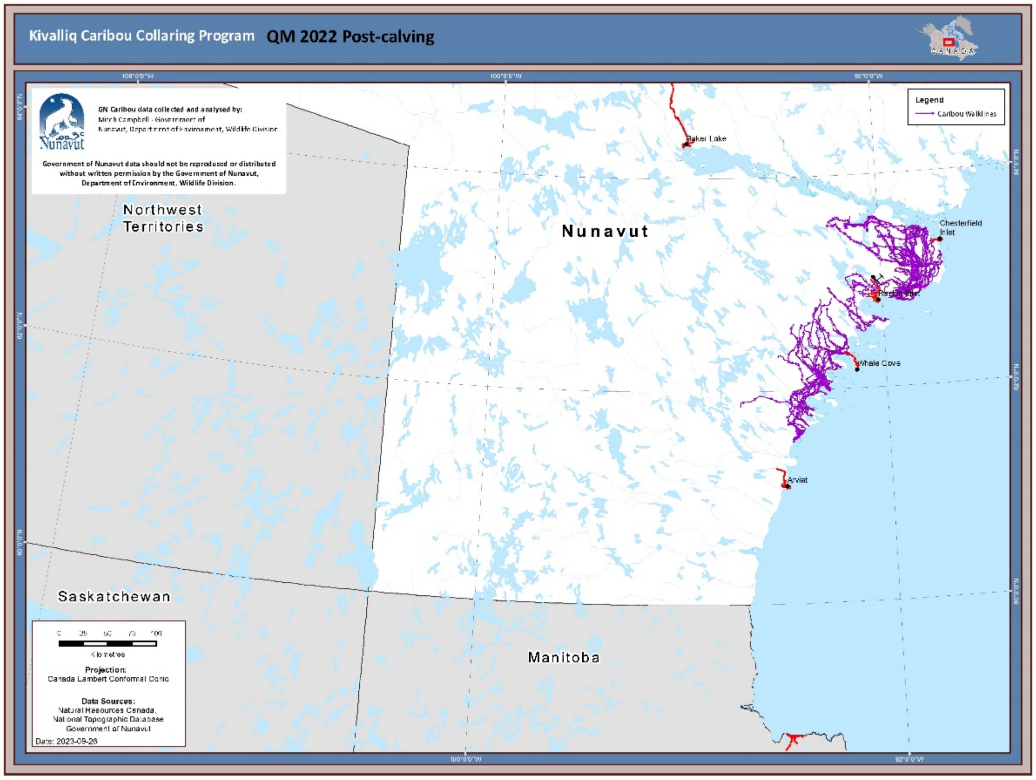
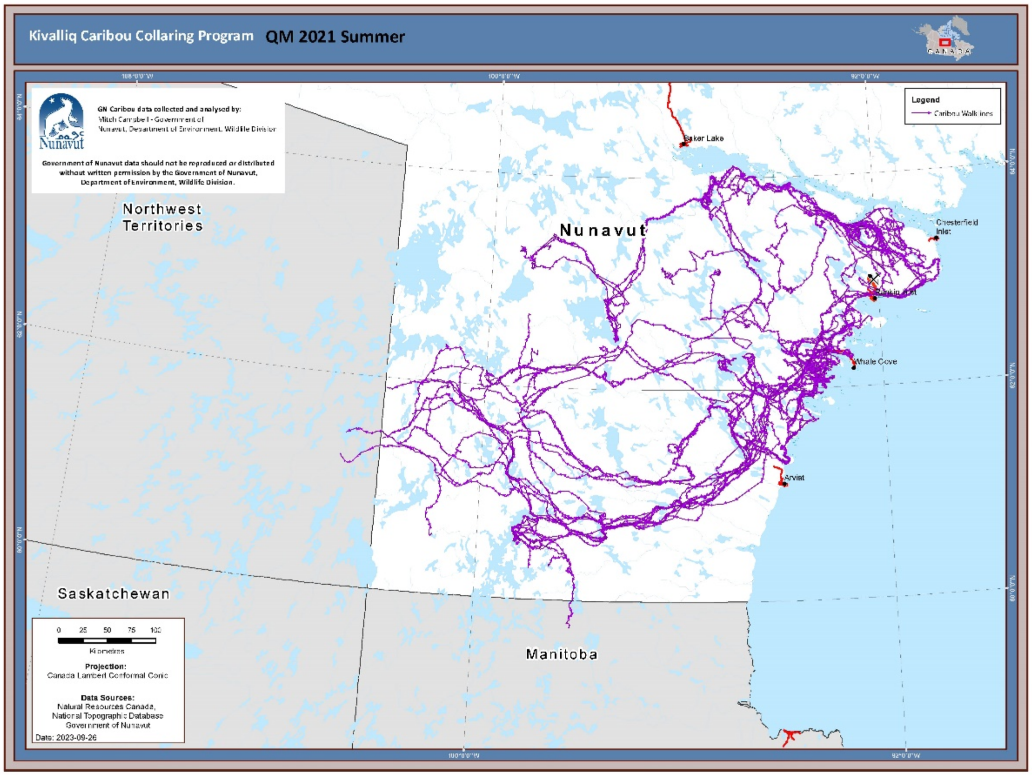


Figure 6. NEM caribou cow movements during post-calving 2021 (above) and post-calving 2022 (below). Includes all collar data from June 26th through July 12th.



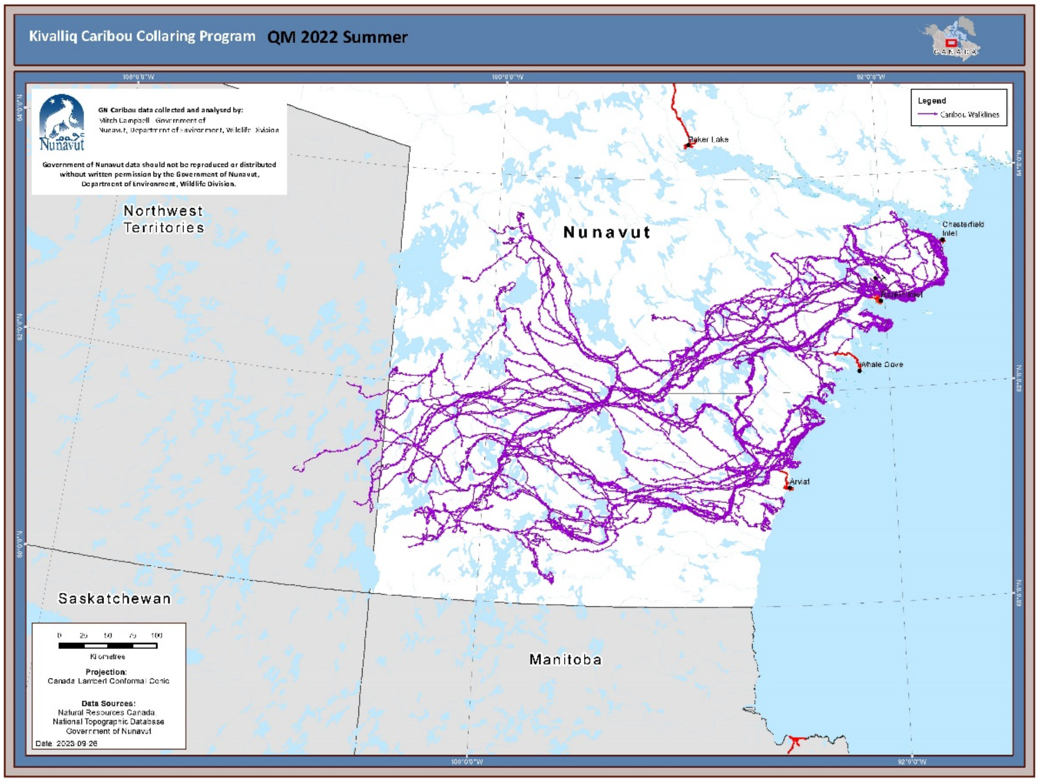
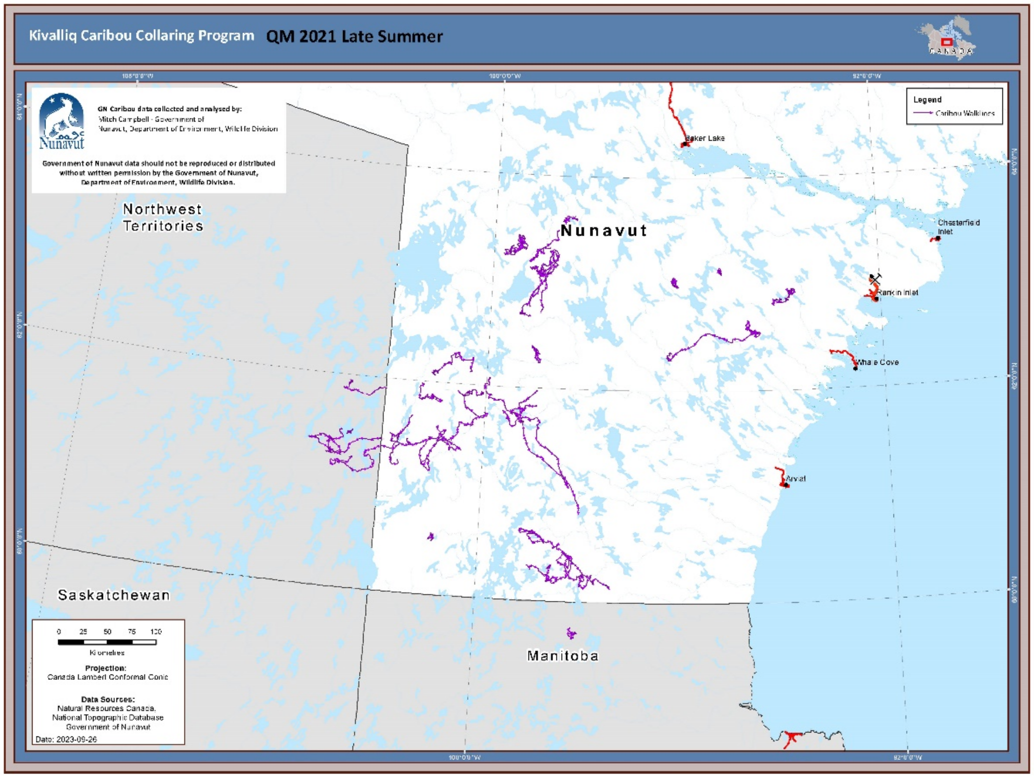


Figure 7. NEM caribou cow movements during summer 2021 (above) and summer 2022 (below). Includes all collar data from July 13th through August 12th.



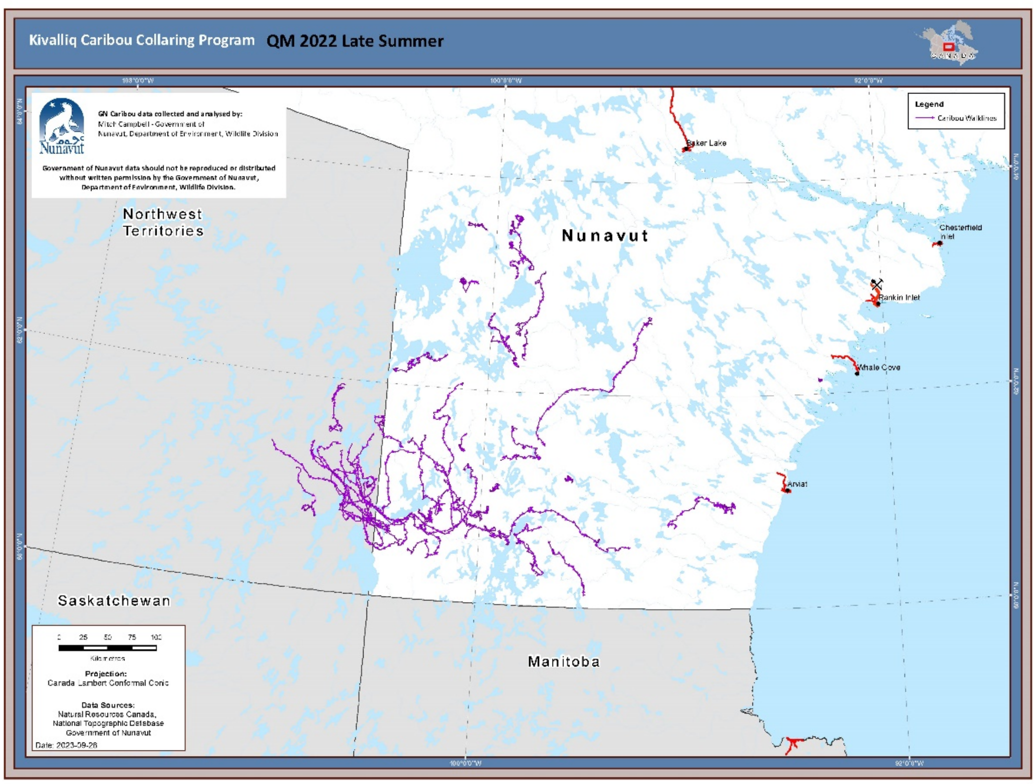
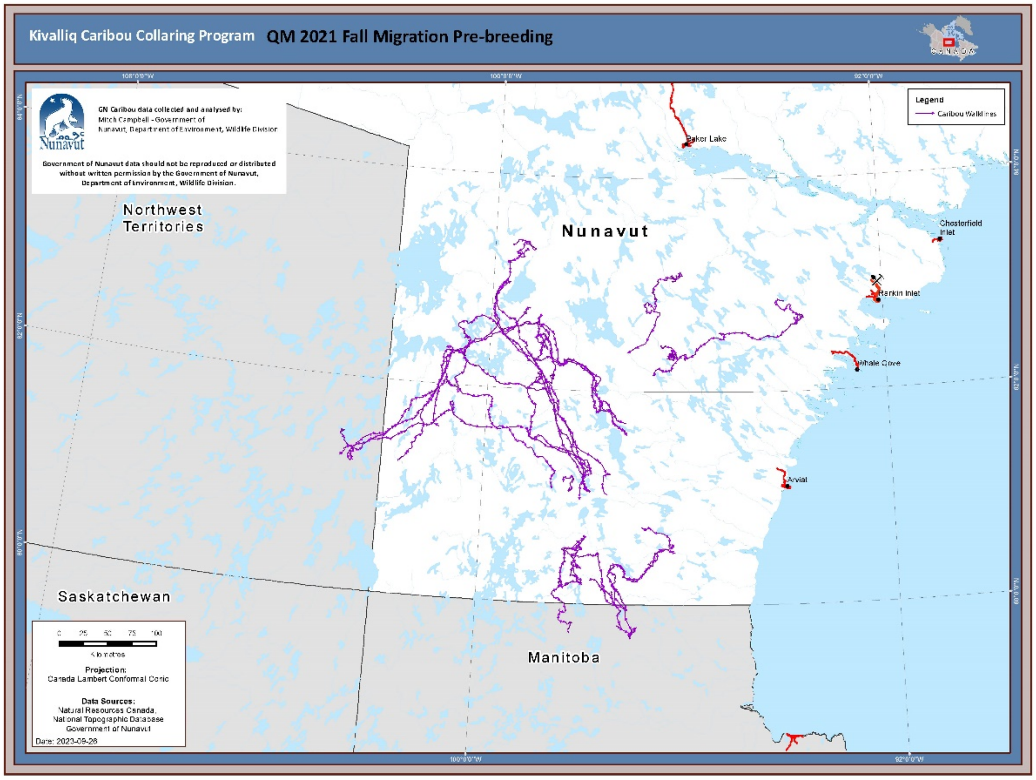


Figure 8. NEM caribou cow movements during late-summer 2021 (above) and late-summer 2022 (below). Includes all collar data from August 13th through September 21th.



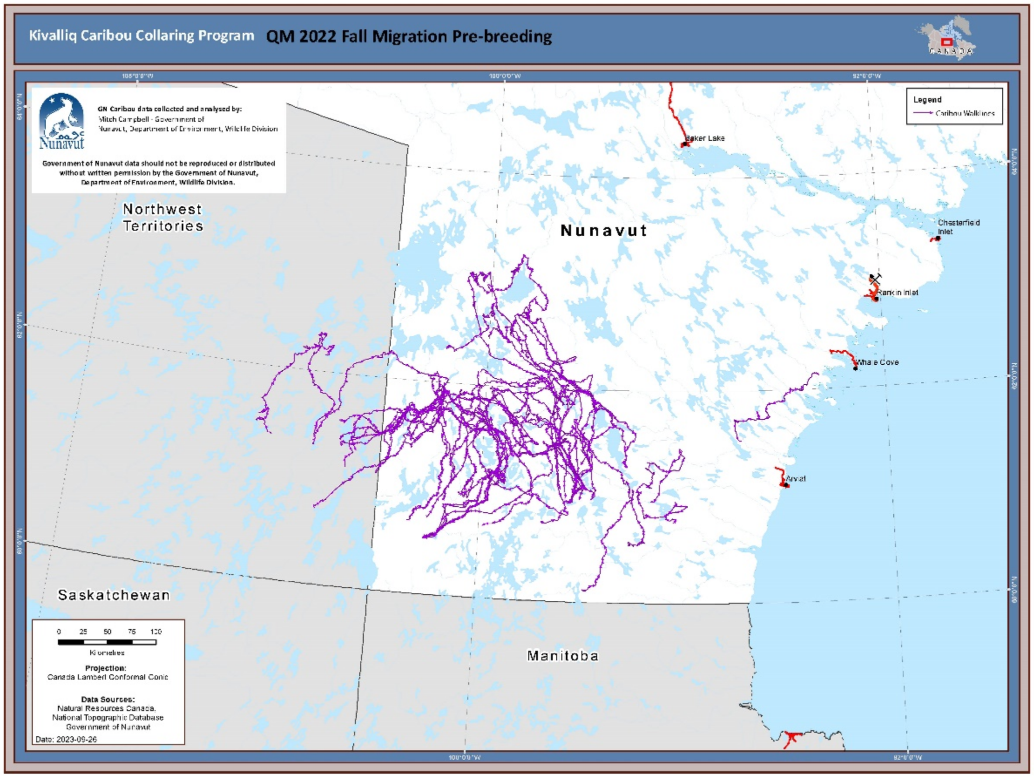


Figure 9. NEM caribou cow movements during fall migration pre-breeding 2021 (above) and fall migration pre-breeding 2022 (below). Includes all collar data from September 22nd through October 22nd.

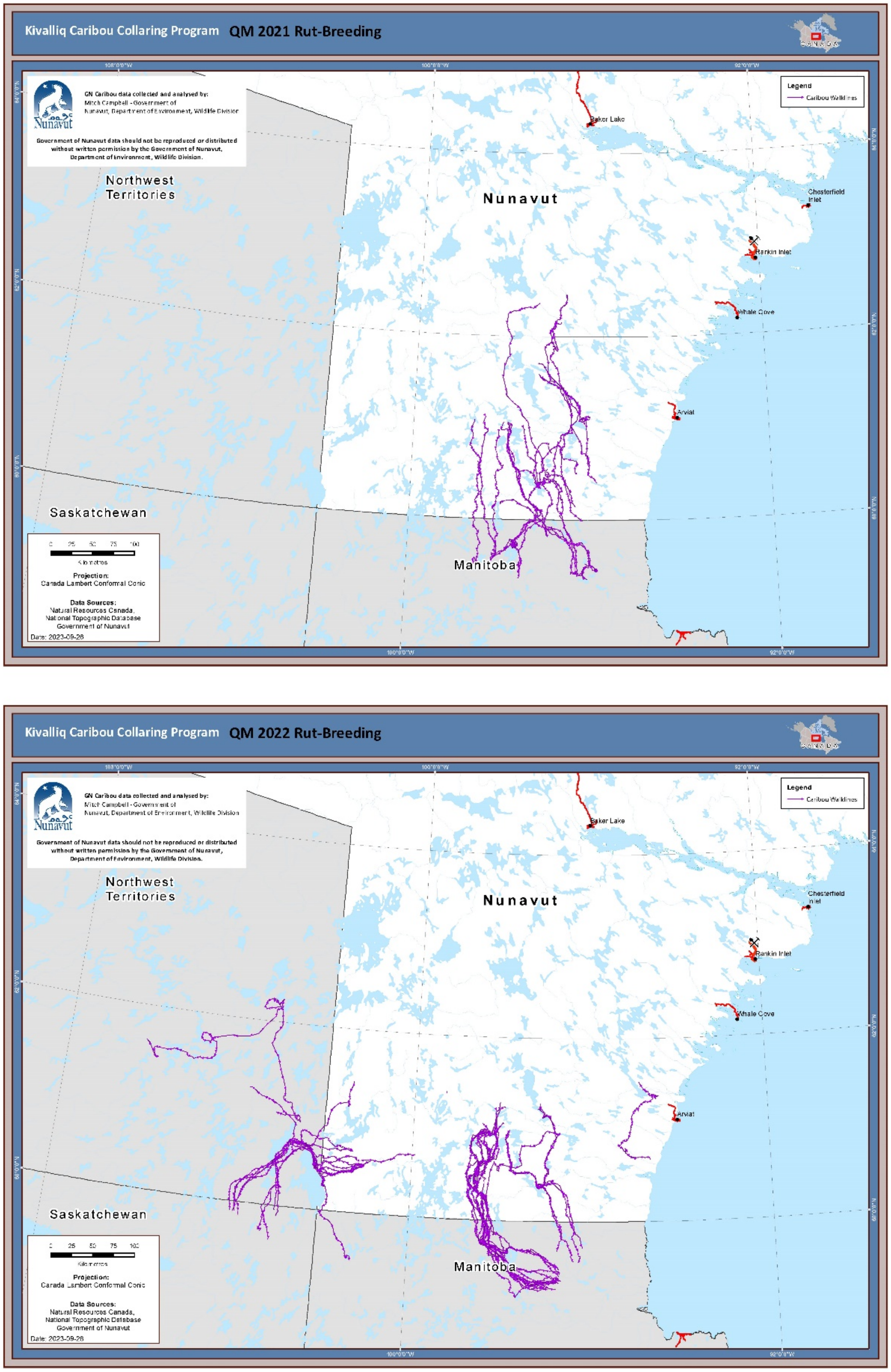


Figure 10. NEM caribou cow movements during rut/breeding 2021 (above) and rut/breeding 2022 (below). Includes all collar data from October 23rd through November 8th.

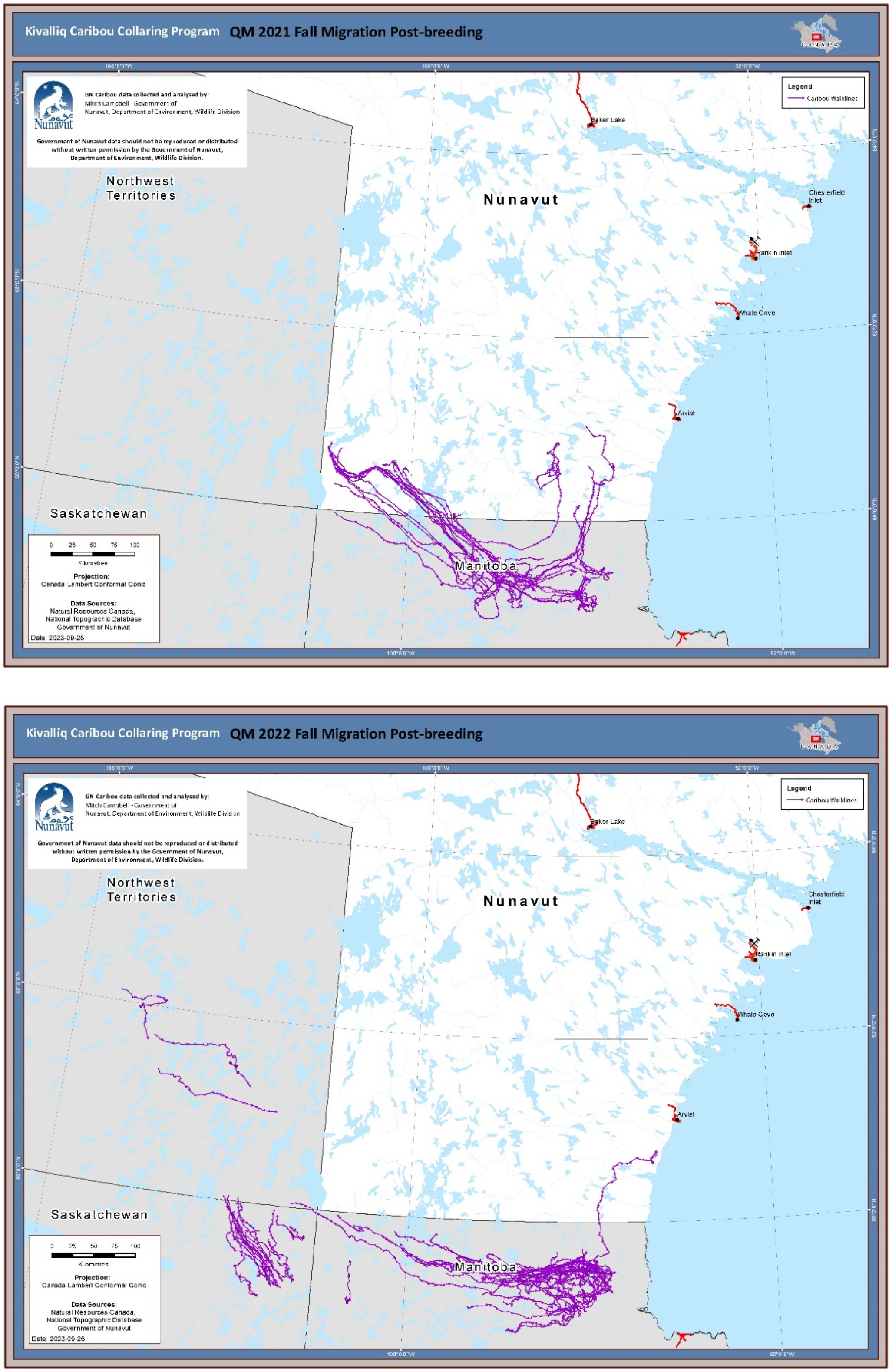
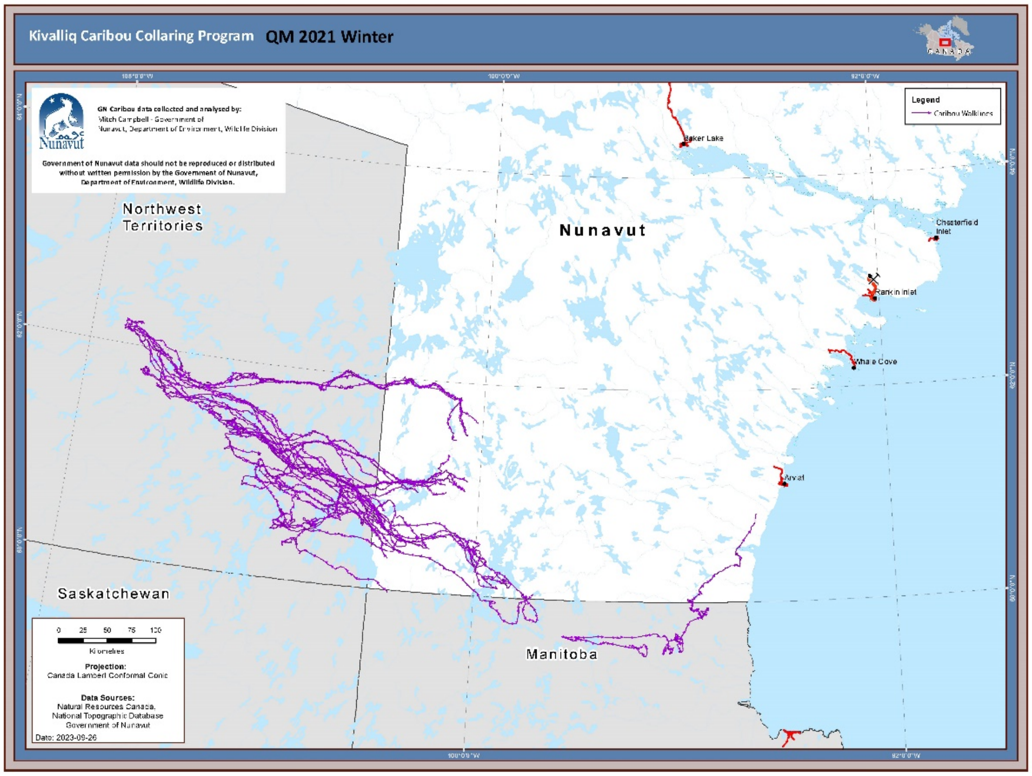


Figure 11. NEM caribou cow movements during post-breeding 2021 (above) and post-breeding 2022 (below). Includes all collar data from November 9th through December 15th.



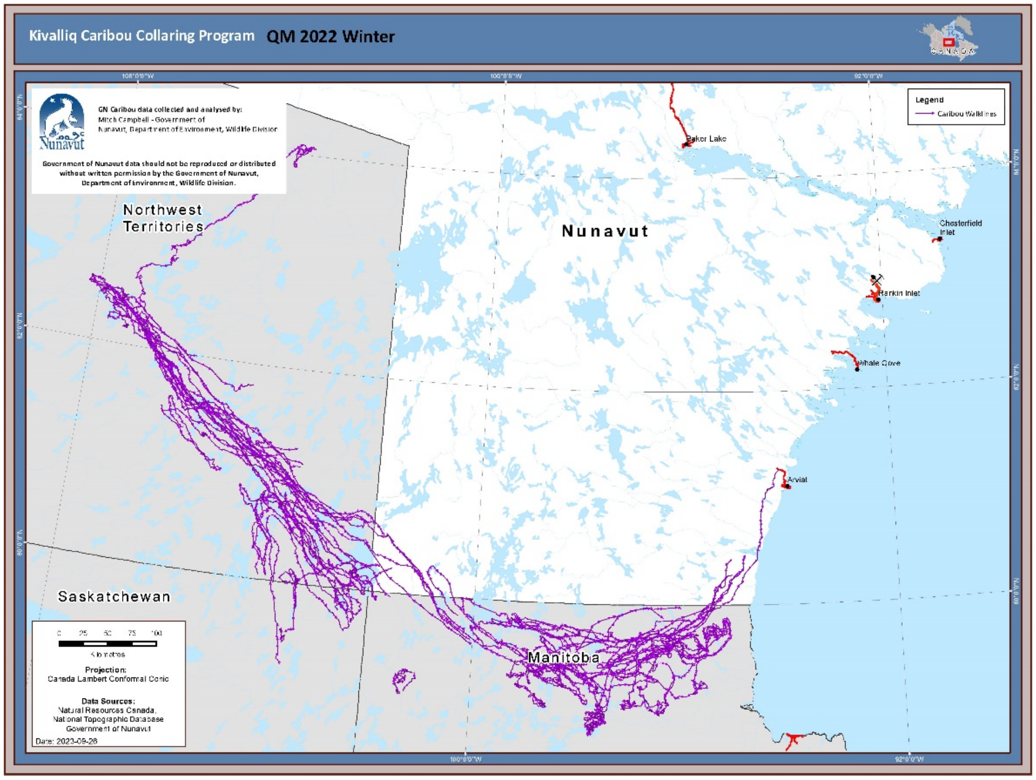
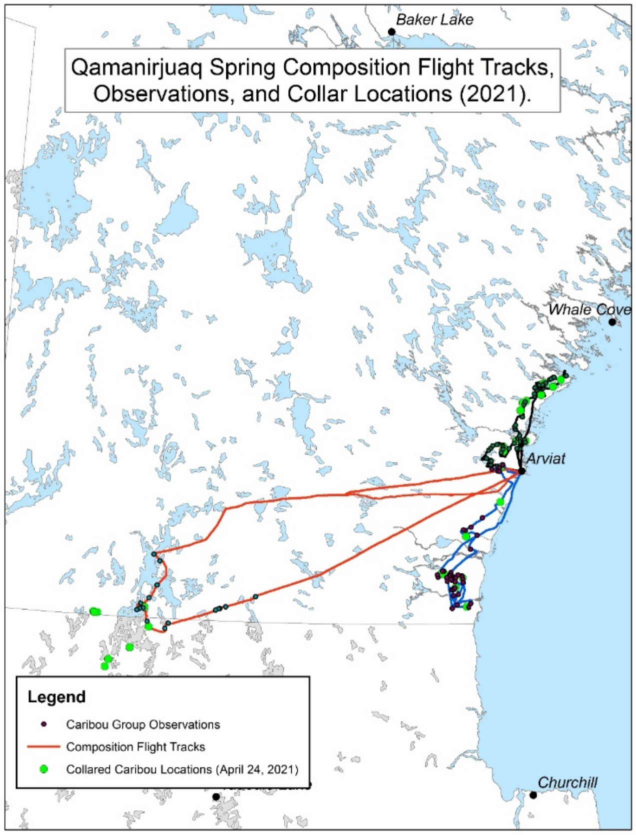


Figure 12. NEM caribou cow movements during winter 2021 (above) and Winter 2022 (below). Includes all collar data from December 16th through April 5th.

Other Telemetry Based Research Programs

Spring composition studies in 2021 were initiated April 24th and completed May 1st, and involved 3 days of flying and 5 weather days during which the composition crew was grounded (**Figure 13**). Spring composition studies in 2022 took 3 days beginning April 24 and were completed April 26th. Flight tracks flew through the main aggregations of collars and composition effort spread based on relative collar densities. Though the 2021 composition effort maintained good collar coverage within coastal aggregations of caribou, the western most extents of collared caribou received only partial coverage, though composition results differed little from those recorded within coastal groups of caribou suggesting consistency amongst geographically distinct groups. Spring composition in April 2022 was able to cover all main collar aggregations finding relatively consistent cow to calf ratios between female dominant groups. We classified 12,228 caribou cows, yearlings, calves, young bulls and mature bulls, in 115 groups of caribou in April 2021, and 11,765 caribou in 100 groups of caribou in April 2022. Calf to cow ratios in 2021 were 16%, a value consistent with a declining population, while 2022 results showed calf to cow ratios of 27%, just slightly over the lower limit of the estimated ratios indicative of stability (**Figure 14**). Over all, the past two years of spring composition, when combined, suggest a small continued decline for the Qamanirjuaq herd (over winter calf survival rates over the 2-year period averaging below 25%).

To further understand the mechanisms behind impacts related to mining infrastructure the GN ENV, working with Kivalliq HTOs and the KWB (Kivalliq Wildlife Board), has initiated a continued study into the effects of industrial linier infrastructures on barren-ground caribou distribution and movements. The ongoing analysis continues to assess post-calving, summer, and fall impacts to Qamanirjuaq caribou cow movements and distribution along the all-season Meliadine mining road north of Rankin Inlet (**Figure 15**). The group hopes to have initial results available for discussion by spring 2024. Currently real-time collar distribution and movement data is provided to mining and regional management authorities with the express purpose of informing these authorities of approaching caribou in the hopes that effective mitigation measures can be triggered in a timely fashion. Unfortunately, these efforts to provide early warning do not seem to be consistently applied and thus, unable to resolve the negative impacts from linier infrastructure of the road on caribou migratory behaviour and range use.


Qamanirjuaq Spring Composition Flight Tracks,
Observations, and Collar Locations (2021).
Baker Lake
Whale Cove
Arviat
Churchill
Legend
Caribou Group Observations
Composition Flight Tracks
Collared Caribou Locations (April 24, 2021)

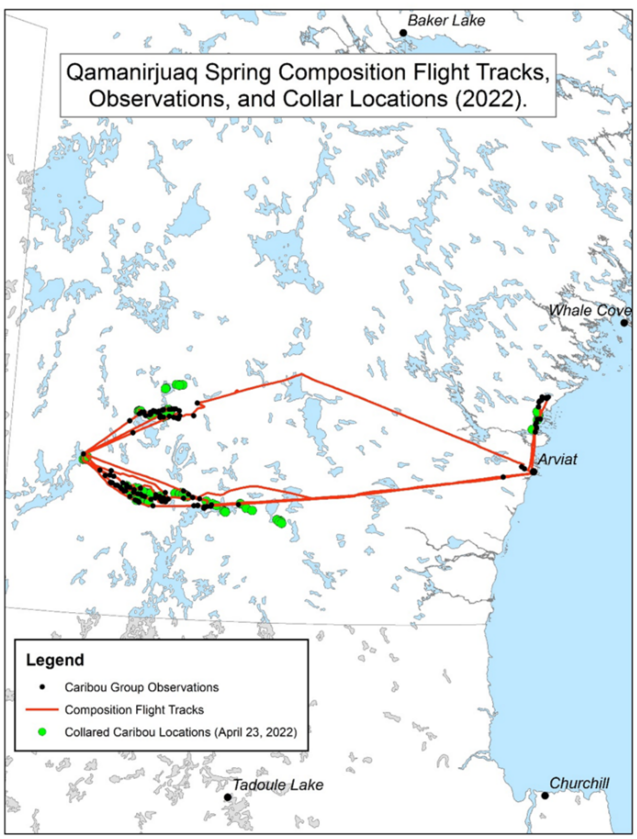

Qamanirjuaq Spring Composition Flight Tracks,
Observations, and Collar Locations (2022).
Baker Lake
Whale Cove
Arviat
Tadoule Lake
Churchill
Legend
Caribou Group Observations
Composition Flight Tracks
Collared Caribou Locations (April 23, 2022)

Figure 13. Flight tracks, observed caribou groups, and collard cow locations recorded for the Qamanirjuaq April 2021 (Top) and 2022 (Bottom) spring composition surveys.

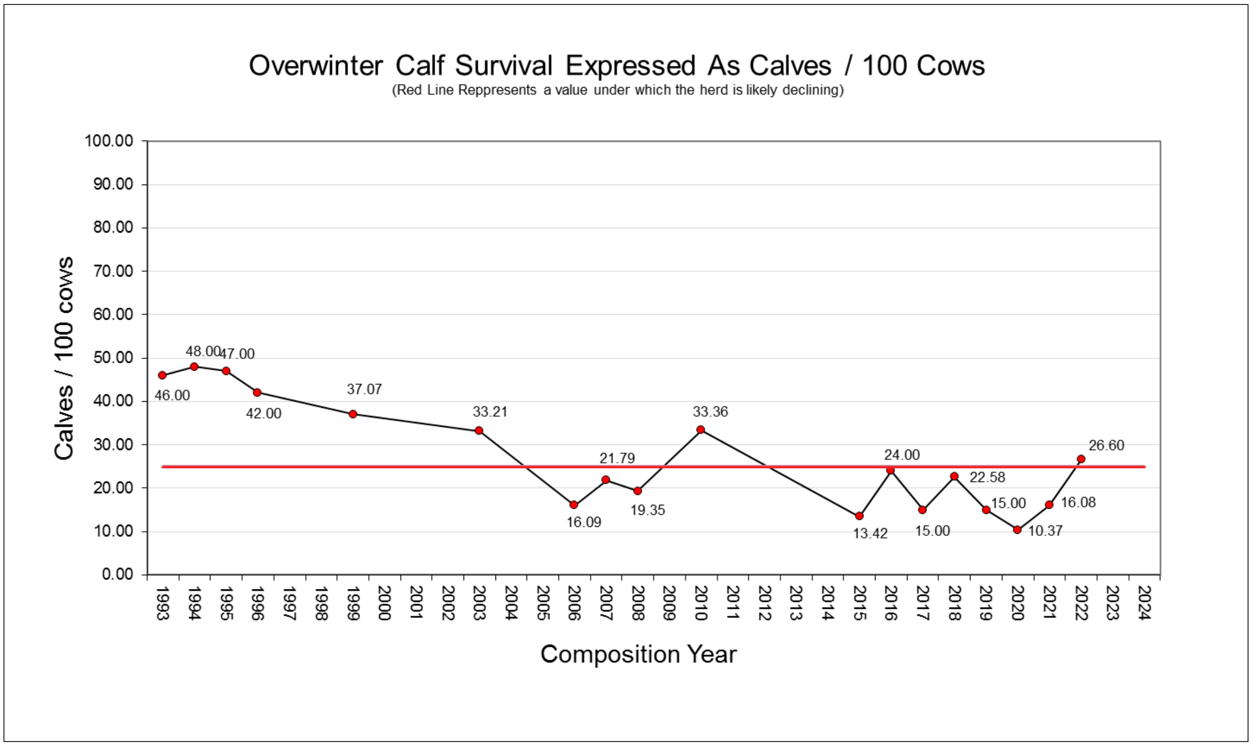


Figure 14. Spring composition results from March/April 1993 through April 2022. Trends have been on average, below stability indices since April 2010.

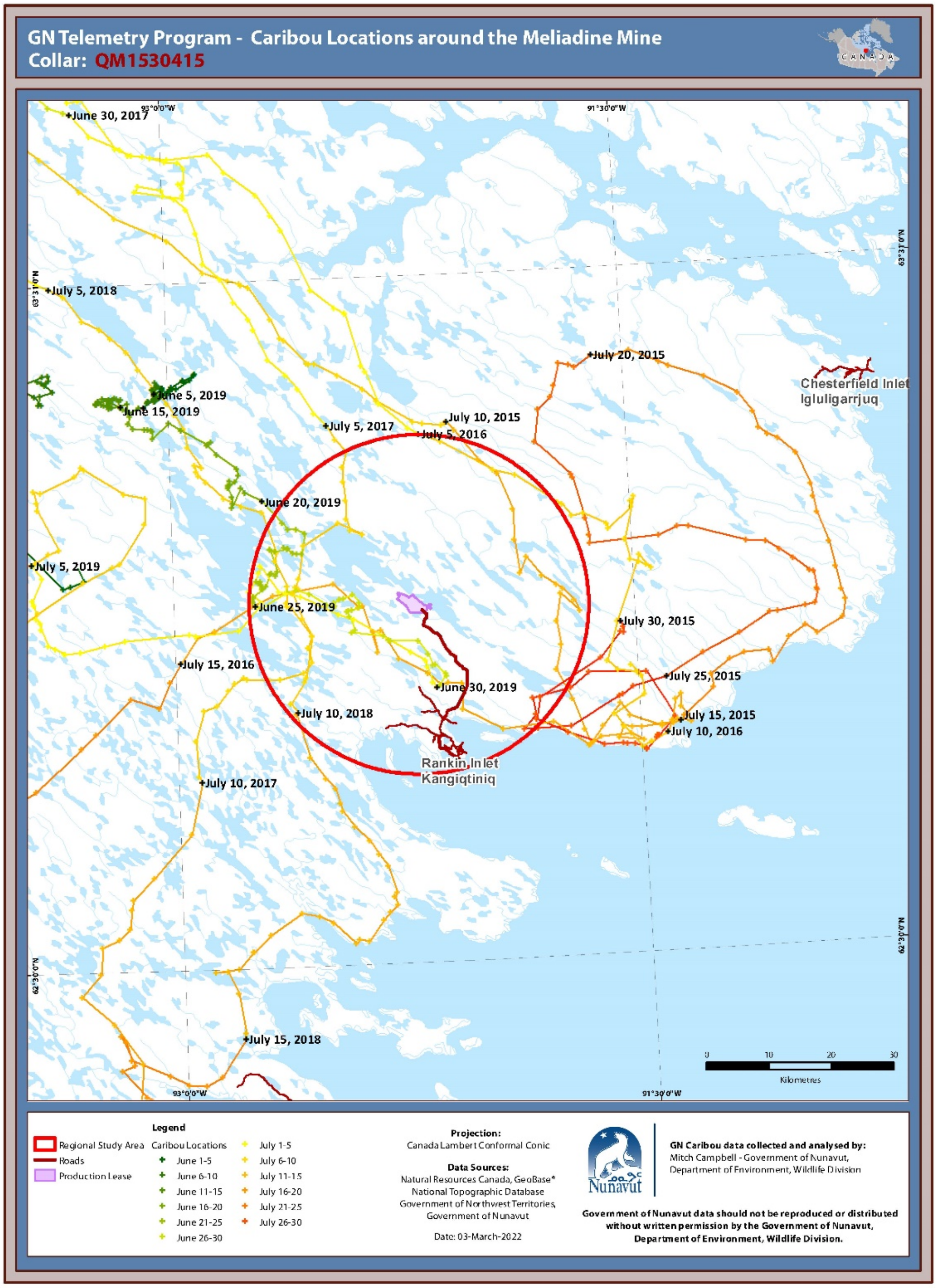


Figure 15. Ongoing analysis on the impacts of the Meliadine all season mining road and other linier infrastructure on caribou movements and use of Rankin Inlet Inuit traditional caribou hunting grounds and water crossings.

Management Implications:

At present the results of this study suggest more effort is needed to address impacts to migratory caribou from industrial linier infrastructure as current mitigation measures along this infrastructure is falling short of resolving significant impacts to caribou distribution and movements. We strongly recommend that accelerated research into the mechanisms of disturbance along roads and other linear infrastructure within caribou habitat be advanced as soon as possible. We further suggest more accountability of industrial developments to their impacts on northern wildlife, specifically caribou in this case, and their effective mitigation. We also recommend a protected areas strategy be developed and actioned for Barren-ground caribou before critical areas such as calving grounds and key access corridors, are lost to regulatory “existing rights” developed following permissions for exploration within these critical areas for caribou. Each year more and more existing rights are being secured within caribou critical habitat. As industrial development accelerates across caribou range, we will start to see behavioural, distributional, and abundance changes within our caribou populations that if left unchecked, will likely lead to range/herd fragmentation, lower long-term abundance, loss of local hunting areas, and loss of Inuit harvesting opportunities and rites.

Composition results suggest a continued slow decline in Qamanirjuaq abundance. A survey flown in June 2022 supports composition findings by suggesting a continued slow decline in abundance, supported by a lower mean estimate, and lower densities on the annual core calving ground. The currently indicated declines support continued monitoring at the present level. Accurate timely information is critical to the co-management process, and allows for communities to internally adjust harvesting practices, if necessary, to ease current declines in an effort to avoid more restrictive management actions.

Reporting to communities/resource users:

Initial composition results and collard caribou movements have been presented at the KWB (Kivalliq Wildlife Board) fall annual general meeting (2020-2022) and to the BQCMB (Beverly and Qamanirjuaq caribou Management Board) (2020-2022), and other stakeholders for management and mitigation purposes. A consultation tour to all Kivalliq HTOs was completed February 2022 and 2023 during which study results were presented and discussed. All communities and the KWB were in agreement with study findings and requested monitoring programs be continued and their results communicated to, and discussed with, all Kivalliq HTOs as they become available. All programs have received unanimous support from the KWB as well as support from the Arviat, Whale Cove, Rankin Inlet, Naujaat, and Baker

Lake HTOs. Information on caribou seasonal movements is provided to HTOs on request when for management purposes and engagement in the land use planning process. A collaborative study into the effects of mining infrastructure on caribou movements in the vicinity of Rankin Inlet is being developed with the KWB, Rankin Inlet, and Baker Lake HTO (all other Kivalliq HTOs welcome to take part) and begin mid-winter (2022/23) and is ongoing. The BQCMB, an interjurisdictional caribou management board represented by Government and Indigenous members from the NWT, NU, Manitoba, and Saskatchewan, are in full support of this ongoing monitoring program.

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