

NWRT Project Number: NWRT-027

TITLE:

Line-transect sampling: Abundance estimate for the Dolphin and Union caribou herd (*Rangifer tarandus groenlandicus x pearyi*) - Fall 2023

PROJECT LEADER:

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SUMMARY:

Dolphin and Union caribou herd (*Rangifer tarandus groenlandicus x pearyi*) are of central importance for the Western Kitikmeot communities for subsistence and cultural needs. The Dolphin and Union population declined to 4,105 animals in 2018 and remained at best stable in 2020 with 3,815 caribou (95%, CI = 2,758-4,644, CV = 13%). These population estimates are concerning, due to the serious decline from 2015 to 2018, with no sign of recovery in 2020. Soon after the last survey, a Total Allowable Harvest of 105 was established. Therefore, there is a need to monitor every 2 to 3 years the population estimate, as a change in number has important consequences. This project proposes to conduct a followup population estimate to closely monitoring the trend in the Dolphin and Union herd. Following the recommendation of the last survey, we will use a combination of real-time collar data (~35 collars) to monitor the change in movement and established transect lines inland (50 to 100 km) on Victoria Island and on the mainland. Caribou observations will be recorded using a dependant double-observer method (mark-recaptures) consistent with previous population surveys. This monitoring approach will allow us to respond promptly to change in the population trends and to make sure that current management actions in place are adequate.

PROJECT OBJECTIVES:

The main goal of this study has remained consistent, and it is to monitor the population of the Dolphin and Union caribou herd. The main objectives are:

- 1) Establish a new 2023 population estimate and monitor the population trend.
- 2) Review the current management action and propose new recommendations if needed.

MATERIALS AND METHODS:

Integration of IQ in the Survey Design:

In the Dolphin and Union range, the communities of Ulukhaktok, Cambridge Bay (Ekaluktutiak), Kugluktuk, Bay Chimo, and Bathurst Inlet were consulted on May 1, June 1, July 14, and on September 07, 2023, to review the 2020 study area and stratification to determine if this design accurately represents the distribution of the Dolphin and Union herd in the fall, knowing recent shifts in their distribution (Hanke and Kutz, 2020; Kuptana 2022) and that telemetry data may not represent fully the seasonal distribution of this herd (Campbell et al., 2021). During consultation, feedbacks were captured on a digital map. The final map representing the HTOs/HTC areas of interest (Figure 1B) can be compared to the 2020 design map (Figure 1A). Consistently with previous surveys (1997 to 2020), there is a common consensus that the bulk of the distribution of caribou, between October 13 to November 07, is on the south coast of Victoria Island from Cape Peel to Lady Franklin Point (pink, yellow). Knowledge holders agreed that the northern and southern strata (dark grey) should be surveyed with minimal effort. *IQ* has mentioned that the Dolphin and Union caribou migrate to Gjoa Haven from the east side of Victoria Island and that caribou have been spotted in the middle of the island in the fall and winter there. To acknowledge this information, these areas were given a medium-low survey effort (blue).

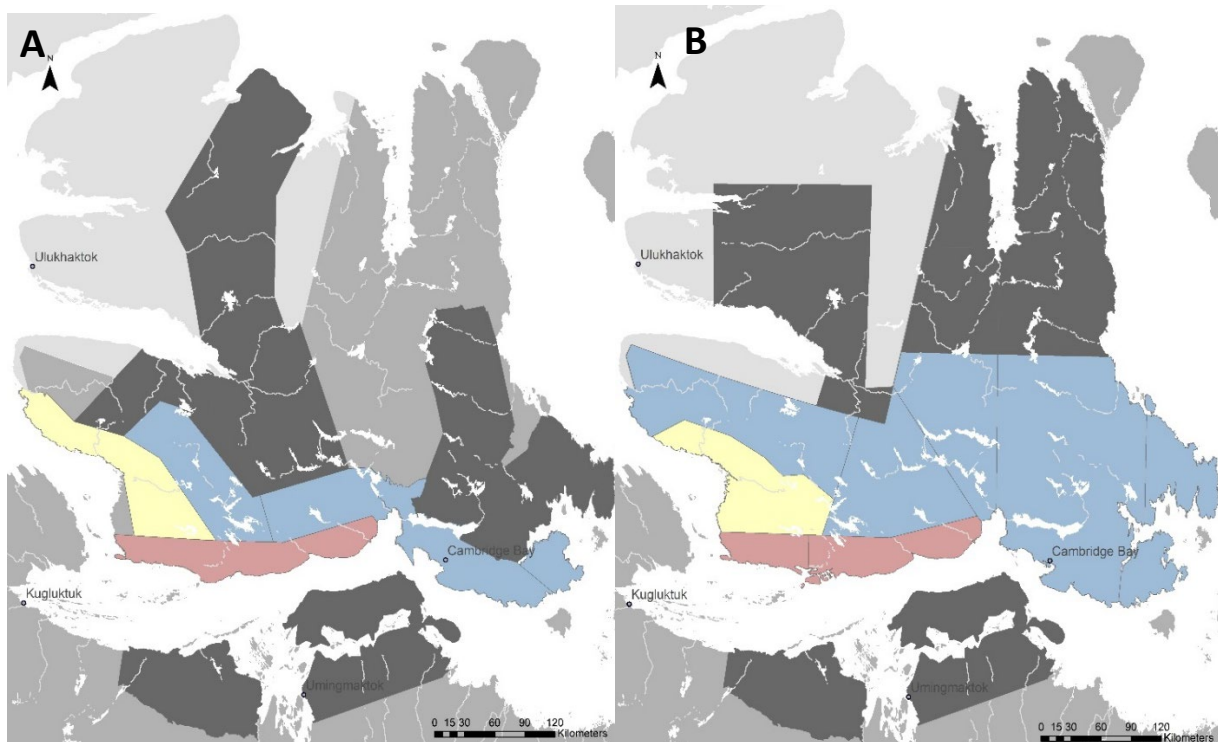


Figure 1: A) 2020 Dolphin and Union strata placement and effort (dark grey= low effort, blue= medium effort, yellow = high effort and pink= very high effort) based on historic survey observations, cumulative caribou telemetry data, *IQ*, predicted windows and budgetary constraints. B) Based on *IQ*, revised strata boundaries, and 2023 consultations.

Final Design:

Based on *IQ*, the survey area was delimited to encompass all possible Dolphin and Union caribou locations during the fall, resulting in a final study area of 137,549 km². Based on known variation

in density, both *IQ* and spatial analysis guided the stratification of this area into 15 strata of unequal effort allocations, 13 on Victoria Island and three on the mainland. Following Buckland et al., (2015), an unequal amount of effort was set in each strata following a budget limit of 19,000 km of transect lines. This resulted in a minimum of 10 to 59 transect lines allocated in each stratum. There was at least 19% coverage in the low-density strata and up to 74% in the high-density strata, taking into consideration a truncation distance of 1.5 kilometer on each side of the plane. The transects, spanning the full width of the strata, were set perpendicular to known density and/or to maintain the axes of the strata and assure transects of relative equal length (Buckland et al., 2001). A total of 277 transect lines were randomly set using the package *dssd* in the R Statistical Platform (R Development Core Team 2009, Marshall, 2020) in the study area for 18,973 km on transects (Figure 2, Table1).

Table1: Summary of the survey design with the area, number of transect, distance between transect, transect length and the percentage of the stratum cover.

| Stratum | Area (km ²) | Number of transects | Distance between Transect (km) | Transect Length (km) | Strata Coverage (%) |
|---------|-------------------------|---------------------|--------------------------------|----------------------|---------------------|
| D | 25,224 | 17 | 14 | 2,310 | 20.94 |
| A | 15,439 | 16 | 13.5 | 1,558 | 21.89 |
| C | 9,787 | 10 | 10 | 1,383 | 29.5 |
| E | 5,622 | 17 | 8.5 | 958 | 34.93 |
| B | 8,101 | 42 | 5.5 | 1,990 | 53.94 |
| O | 2,375 | 11 | 8 | 495 | 36.36 |
| F | 6,581 | 16 | 8.5 | 1,036 | 35.24 |
| G | 6,972 | 59 | 4 | 2,258 | 74.32 |
| I | 13,297 | 12 | 14 | 1,336 | 21.51 |
| H | 7,577 | 21 | 9.5 | 1,310 | 30.67 |
| J | 11,064 | 12 | 14 | 1,177 | 21.3 |
| K | 2,151 | 8 | 8 | 426 | 38.07 |
| M | 9,402 | 11 | 15 | 953 | 19.8 |
| L | 5,716 | 13 | 12 | 820 | 24.76 |
| N | 8,248 | 12 | 15 | 962 | 19.55 |
| --- | 137,549 | 277 | | 18,973 | 28.74 |

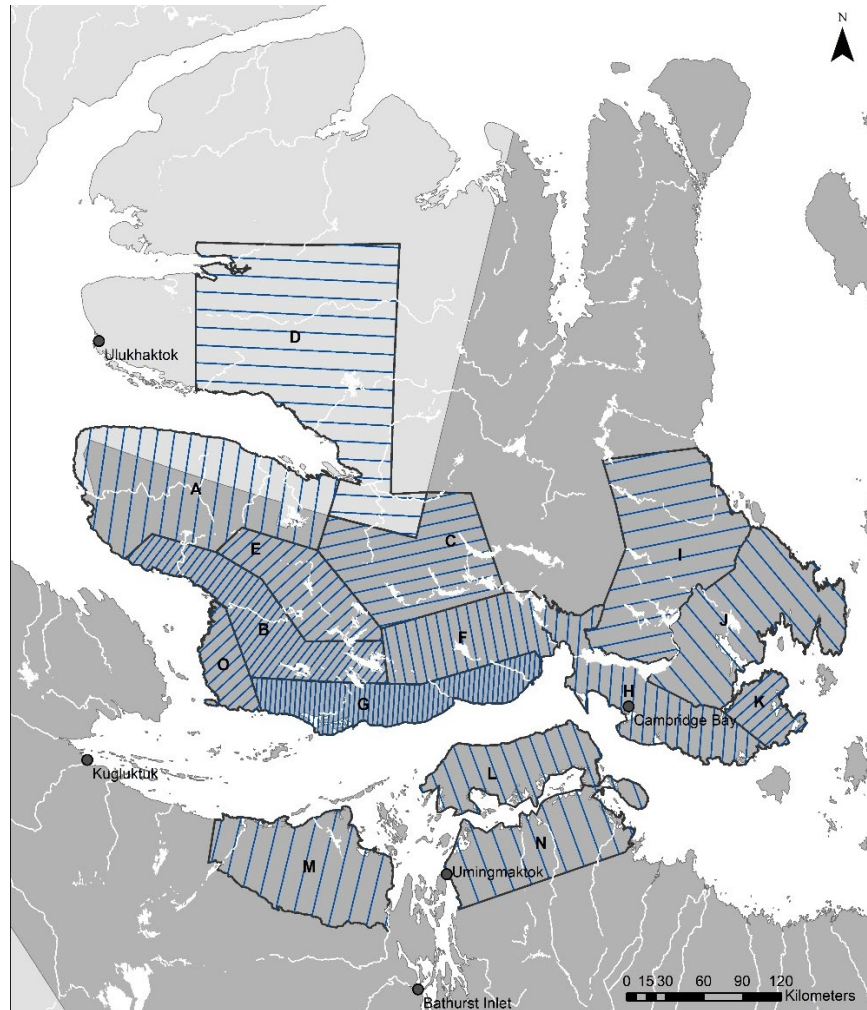


Figure 2: Final survey design, with A to O strata and the transect line locations in the survey area for the Dolphin and Union caribou herd.

Three Twin Otters were used to fly the survey. One based in Kugluktuk, one in Cambridge Bay (Nunavut), and the last one in Ulukhaktok (Northwest Territories). They flew the transects at a speed of around 160-180 km/hr while maintaining an altitude of 122 m (400 feet). Wing struts were equipped with ropes to set spacing bins at 0-200 meters, 200-400 meters, 400-600 meters, 600-1,000 meters, and 1,000-1,500 meters. We used a dependent double-pair observer configuration to increase the probability of the observers at detecting more conspicuous lone individuals. One recorder recorded the observations for both left front and back observers, and the second recorder recorded for the right front and back observers. Data recorders' task was to only record, such as the GPS locations of the observation (group), distance from the line, the number of animals, and sighting conditions, to name a few. During the fieldwork, we hired and trained 27 observers: 11 from Kugluktuk, 5 from Ulukhaktok, and 11 from Cambridge Bay.

Analysis Density Surface Model (DSM)

Applying Distance Sampling for estimating the abundance of animals occurring in a large study area where distribution is not random pose a challenge for the accuracy of the estimate. Following a two-step approach, Miller (2012, 2013) and Winiarsky et al., (2013), we built on the best model from the Mark-Recapture Distance Sampling (MRDS) approach by adding spatial components to get a Density Surface Model (DSM). Besides deriving an abundance estimate, the DSM provides some clues to the environmental covariates potentially driving the spatial distribution and the locations of high density, while increasing the precision of the estimate.

The spatial distribution of the Dolphin and Union caribou during staging was thought to be driven by the following covariate: the distance from the historical crossing locations as they seem to express fidelity to these areas (XingDist), distance to water bodies such as lake (LakeDist) and river (RivDist), topography indices (Slope), and the terrain roughness index (TRI). For the vegetation, we used the normal difference vegetation index (NDVI) as an index of plant productivity and vegetation biomass left for grazing after the fall. Although published suitable habitat analysis for the Dolphin and Union is non-existent, to help guide variable selections, we defaulted to variables that influenced spatial distribution of other caribou herds (MacNearney et al., 2016).

RESULTS:

The Figures 3 below shows the area being surveyed from October 24 to November 1. There was some area in stratum D close to Ulukhaktok and north of Cambridge Bay (stratum I) that were left unsurveyed because of fog and weather prohibiting us from completing these strata fully. Since these transect lines are in a very-low-density areas and the number of observations made on the transect close by are marginal to null, we are confident that we did not miss any important groups of caribou. In stratum I, no caribou were seen in 2020, which is consistent in 2023 (Figure 3). In order to address the optimum time to survey the coastal strata (high density), we closely monitored the collar locations and daily movement rate. On October 31 and November 1, most of the collars were in stratum B inland and in stratum G. Since the collars had a daily movement rate inferior to 5 km/day, we surveyed all the strata that included all the collars the same day, targeting this area simultaneously with three planes. East of Baron Bay (stratum G), we experienced some fog and very low visibility. We flew the area again (light red transects) on November 02 to make sure that no caribou group was missed.

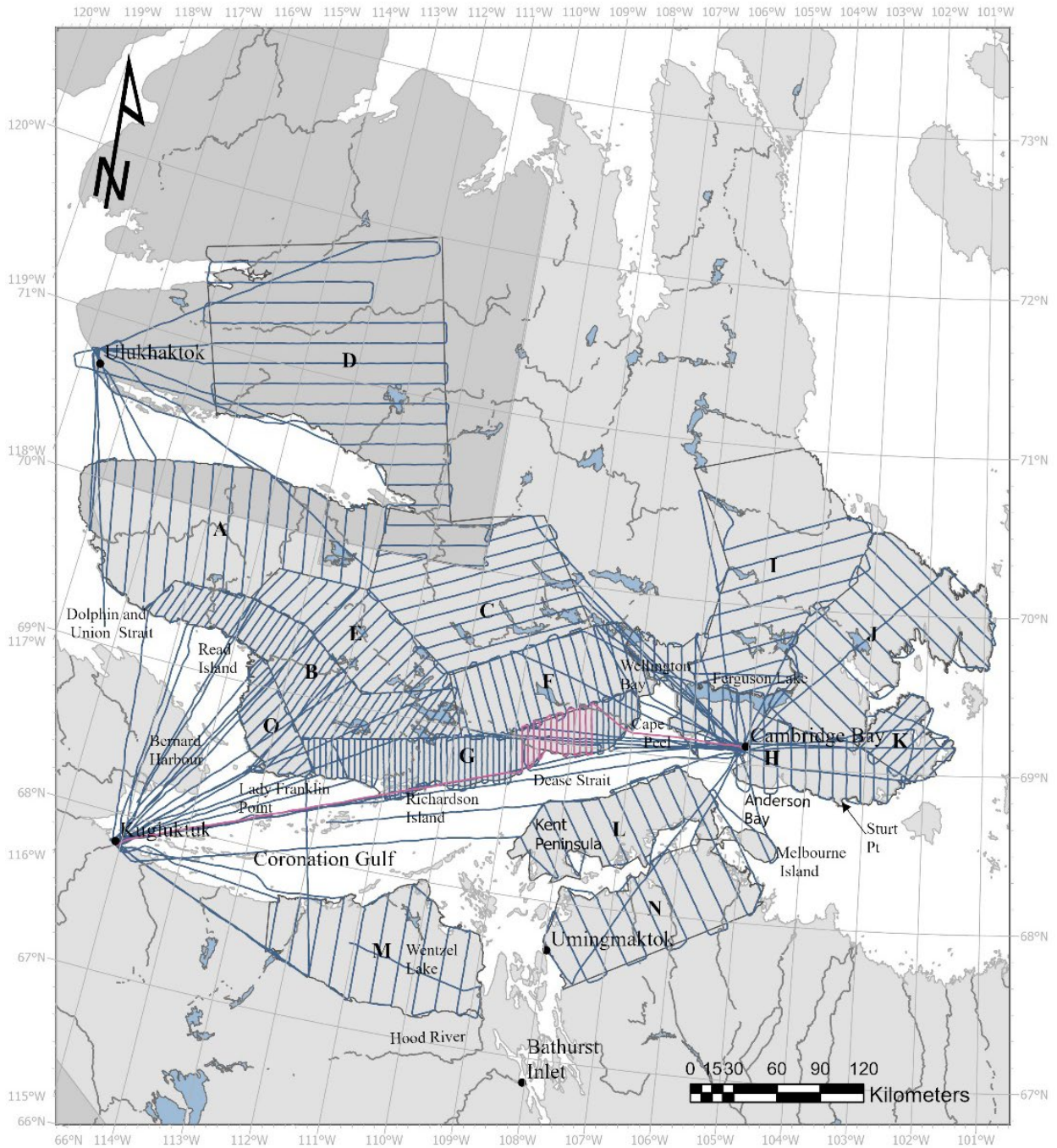


Figure 3: Completed daily flight tracks (blue) between October 23rd and November 1st, 2023. A section of G stratum was re-flown (light pink) on November 2nd, because of poor visibility during the first attempt.

A very minimal number of observations were made east of Cambridge Bay (one group), which is consistent with the past three surveys. On the mainland, consistently with 2020, no caribou were observed on the west side of Bathurst Inlet, and most observations were made on the Kent Peninsula. As reflected in the collar locations, strata B and G (Figure 4) were the high-density strata. Particular to this survey year, the Dolphin and Union caribou were found more inland and most of them were relatively slow to reach the coast. Post-survey, we kept on monitoring the collar

movement. As of November 27, the collars finally gather around Richardson Island and none of them had crossed. Thus, 854 caribou were seen on transect, and this information will be used to model the detection function and calculate the abundance estimate.

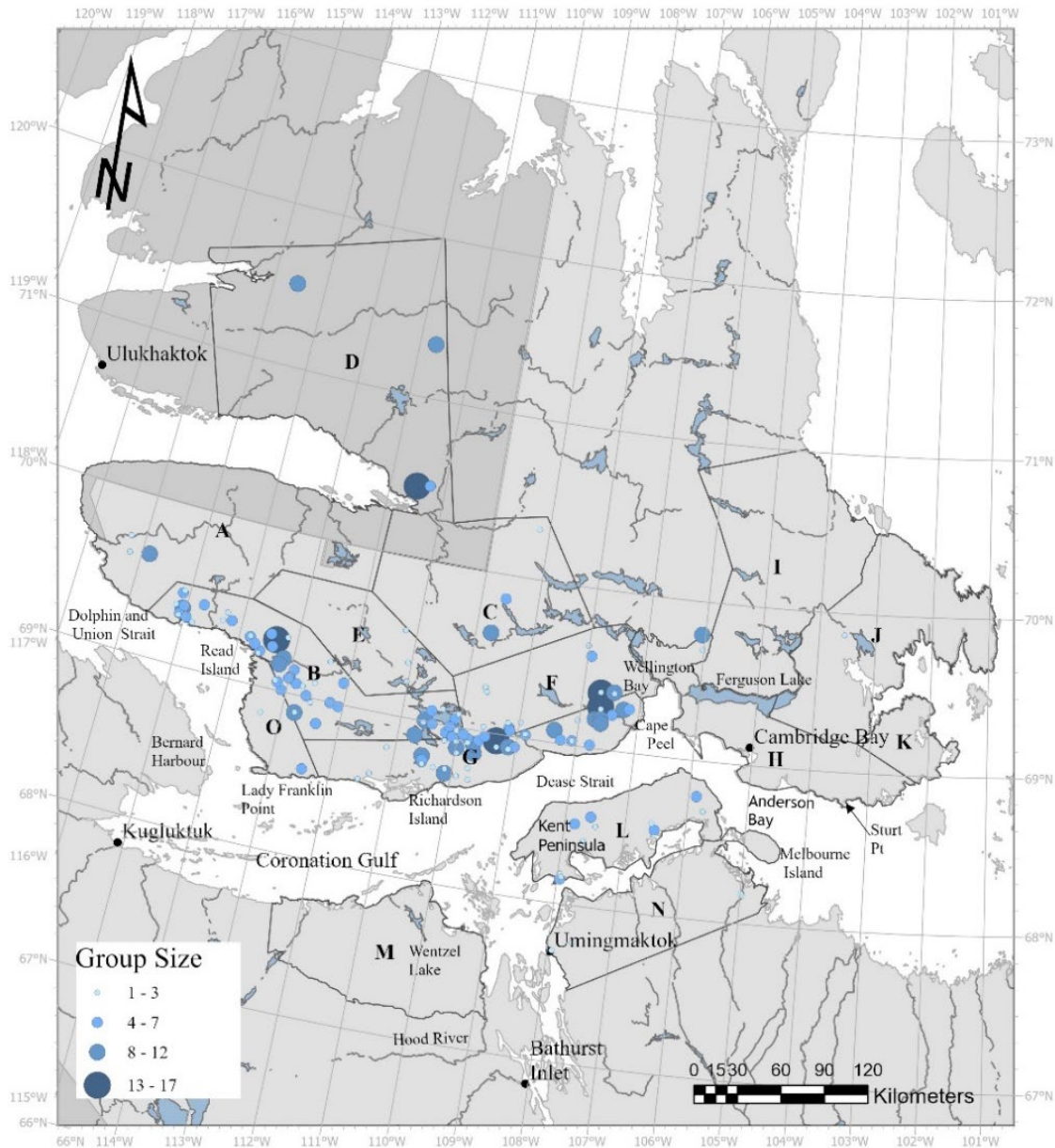


Figure4: Overview of the 148 Dolphin and Union caribou groups' locations observed on transects during the survey.

The group sizes encountered varied from a minimum of 1 to a maximum of 17, where most of the groups seen were relatively small, with a mean of 4.85 (sd= 3.47) (Figure5). As the maximum group size was 17, it suggests that the Dolphin and Union did not aggregate in large groups in 2023. The data were skewed toward the first bin, 1-3, which reflects the asymmetry of the dataset.

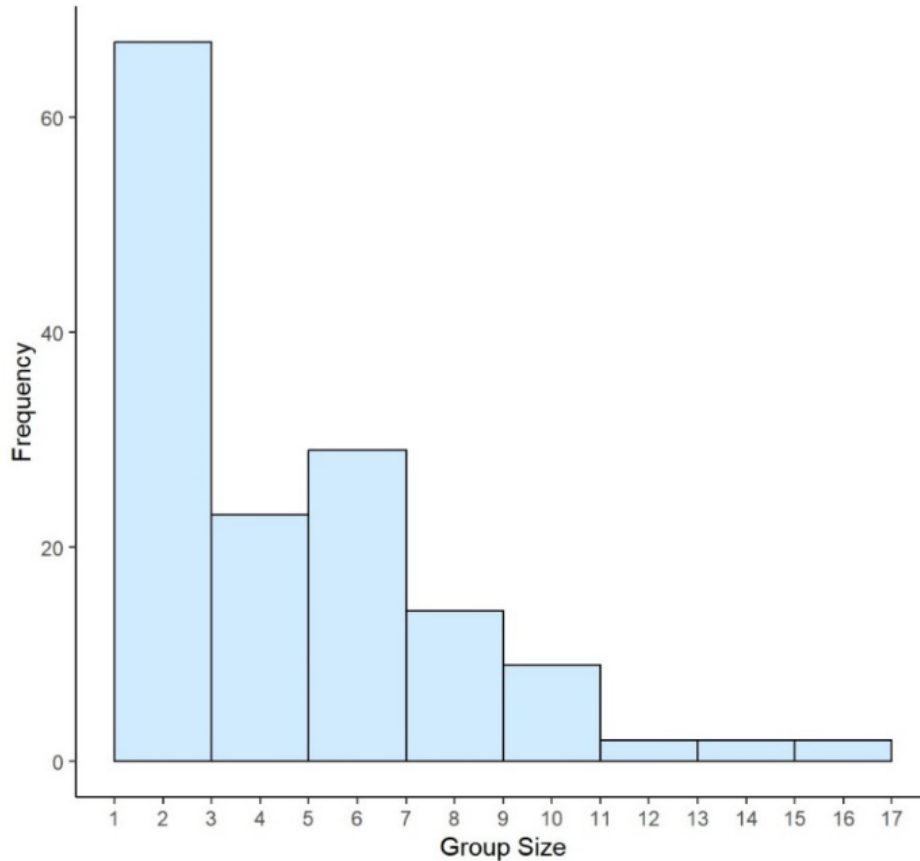


Figure5: Histogram displaying the Dolphin and Union group size (n=148) seen during the survey, where the bins varied from 1 to 17.

Analysis:

The best performing model was used to predict the abundance in our large study area (137,549 km²). Having made a prediction for each cell (9 km²), we plotted a density map and respective coefficient of variation (Figure 6). There were two main locations where the abundance was high. One of them was the north coast of the Dolphin and Union Strait around Read Island, which could be an indicator of how historically the Dolphin and Union caribou were distributed in the fall when they crossed the Dolphin and Union Strait. The second location, which has been very well documented, is found between Richardson Island and Cape Peel. However, at this location, the peak in the highest abundance was found 39 km inland from the coast (Figure6).

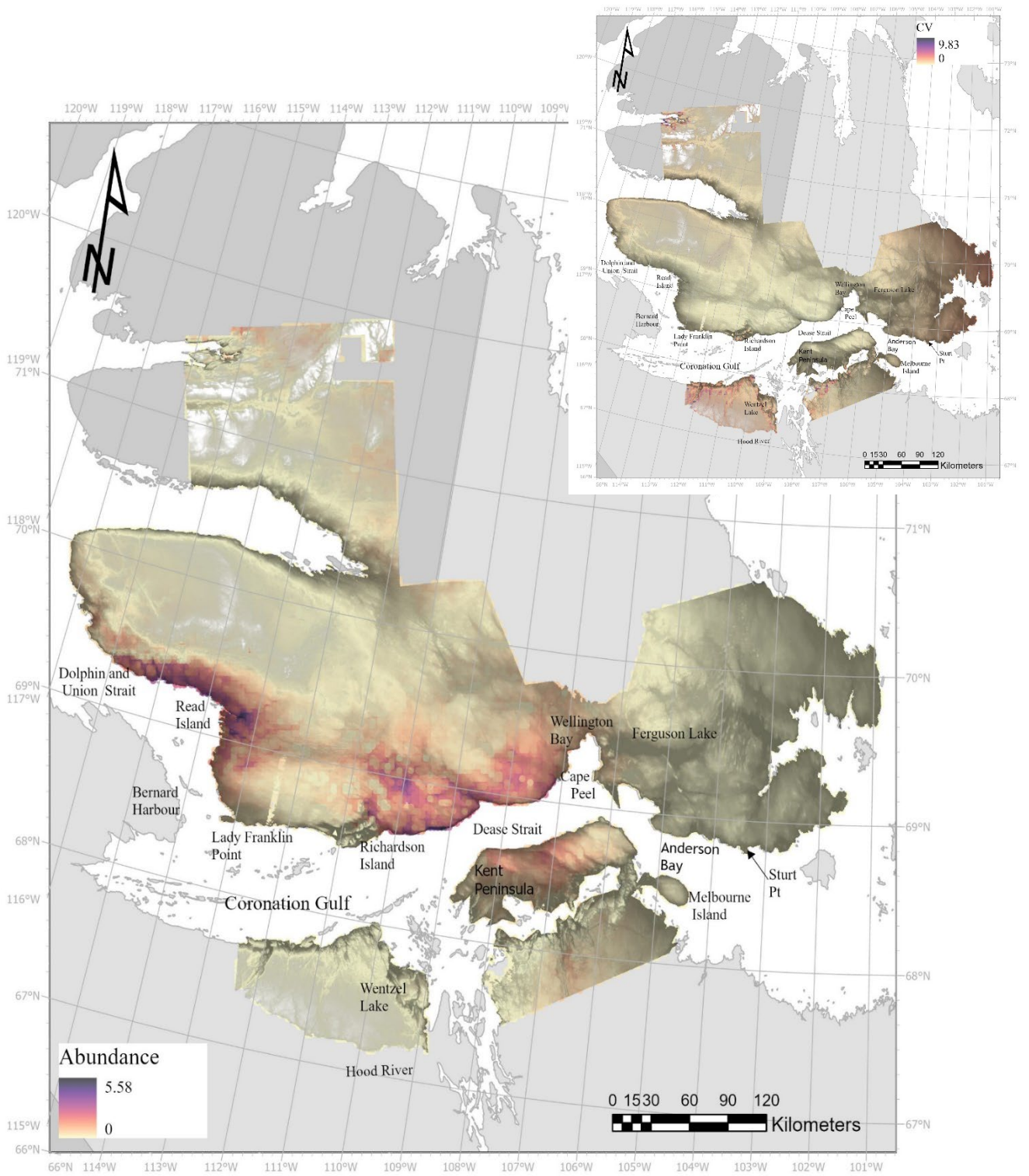


Figure6: Predicted density surface with NDVI and Slope as bivariate smooth for x and y location as predictor. The density of caribou is shown within the predicted grid cell of size 9 km^2 . The smaller map shows the coefficient of variation per predicted grid cell over the study area to inform the area of higher uncertainty.

DISCUSSION/MANAGEMENT IMPLICATIONS

In 2020, the study area was expanded from previous coastal strip surveys to include additional areas of inland Victoria Island and of the mainland (east and west of Bathurst Inlet and Kent Peninsula) (Campbell et al. 2021). The survey area was extended in 2020, because the number of collared caribou ($n=4$) did not infer the overall herd distribution, especially with Traditional Knowledge reported a recent change in the distribution of Dolphin and Union caribou herd. During the spring migration, hunters noticed some individuals not crossing back to Victoria Island and remained on the Kent Peninsula (Hanke and Kutz, 2020). In addition, in the fall, the caribou moved west from Cambridge Bay and are no longer seen close to the hamlet (Leclerc and Boulanger, 2020). Despite having more collars ($n=21$) in 2023, the same level of effort was applied, and the same area was surveyed with minor modifications.

In 2023, the mean group size was 4.85 ($sd= 3.47$), and no group larger than 17 was observed. Since the groups of animals were small, observers could accurately count the number of caribou in each group (Heard 1985; Heard and Jackson 1990). Prior to 2015, groups with over 100 individuals were seen, as the caribou aggregated into bigger groups along the shoreline (Leclerc and Boulanger, 2018). Smaller groups might have been observed in this survey because the caribou did not reach the coastline and were more inland than in previous years. 60 to 80 observations are needed to fit a detection function (Buckland et al., 2005; Campbell et al., 2021). The number of groups seen in each stratum was less than 60, even in the two higher density strata B and G. Therefore, all the observations, 148 groups of caribou, were pooled together. This is less than in 2020 with 202 groups, but still more than 2018 with 91 groups (Campbell et al., 2021; Leclerc and Boulanger, 2020).

The distribution of caribou in 2023 differed from what was recorded in previous coastal surveys, as the caribou were not within 20 km inland from the coast and none of the collars started the migration over the sea-ice. Patterns of habitat used are found to fluctuate with population size (Gill et al., 2001). The unexpected distribution created some clustering, high densities in some parts of the stratum. This scenario should be avoided as it increases the uncertainty of the estimate. Therefore, like the 2015 and 2018 survey methods, a combination of a reconnaissance survey paired with real-time collar locations could be a good approach to better adjust the visual strata based on caribou presence, as their distribution pattern on the coast might become unpredictable.

The current estimate will be assessed with the threshold establish in the current management plan, which is the threshold used to determine the low point in their population cycle (Worthington et al., 2018). Thus, the Dolphin and Union caribou herd might still be in a state of vulnerability and management recommendations should be reviewed to keep supporting the overall recovery of this herd, while they are adapting to unpredictable climatic conditions under a warming Arctic. Preserving this herd is a critical conservation priority, as it is central to the preservation of Inuit subsistence and perpetuation of the traditional way of life.

REPORT BY INUIT PARTICIPANTS

To get a report by Inuit participants, we developed a small questionnaire (Appendix I). Between September 20th and September 26th 2024, observers from Kugluktuk and Cambridge Bay were interviewed by phone to gather insights into their experiences with the 2023 DU Caribou Survey. Eight participants from Kugluktuk and nine participants from Cambridge Bay were called, with four and two respectively were available to provide answers. All the participants felt they had enough training before the survey and knew their role and responsibilities. While it was easy to detect muskox and caribou, 66% found that there were between 10 to 30 groups of caribou on a transect lines and a group was composed of 10 to 20 animals. Interestingly, 50% of the candidate think that the Dolphin and Union is increasing while 33% think that they are decreasing. Although this report was completed with a few observers (n=6), it provides an additional perspective on what the participants have seen. In the future, such a questionnaire will be conducted at the end of the survey, so the observations would still be fresh in the participant’s memory.

REPORTING TO COMMUNITIES/RESOURCE USERS:

| Community/HTO | Before | During Research | Completion of research |
|-----------------|--------------------|--|------------------------|
| EHTO, KAA, KRWB | May 1, 2023 | | |
| EHTO, KAA, KRWB | June 1, 2023 | | |
| OHTC | July 14, 2023 | | |
| KAA, KRWB | August 18, 2023 | | |
| EHTO, KRWB | September 07, 2023 | | |
| All HTOs, KRWB | | October 23 to November 03, 2023 daily reporting | |
| All HTOS, KRWB | | | Tentative winter, 2024 |

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APPENDIX I:

DU Population Survey NWRT-027

Government of Nunavut, Wildlife Research, Dolphin & Union Population Survey

1. Name
 - a. _____

2. Location
 - a. Kugluktuk
 - b. Cambridge Bay
 - c. Other _____

3. Did you participate in the DU Population Survey in 2023?
 - a. Yes
 - b. No
 - c. Other _____

4. Did you feel like you received adequate training before going into the Twin Otter Plane?
 - a. Yes
 - b. No

5. Was it easy to spot animals while you were in the plane?
 - a. Yes
 - b. No
 - c. Mixed

6. According to your experience during the survey, on each line, how many caribou's did you see?
 - a. 0 to 5 groups
 - b. 5 to 10 groups
 - c. More than 100 groups
 - d. More than 10 but less than 30 groups

7. Was the caribou/muskox easy to detect?
 - a. Very easy
 - b. Easy
 - c. Someone difficult
 - d. Difficult
 - e. Difficult to detect due to weather

8. When you saw the groups (Caribou/muskox), was the group big or small?
 - a. 0 to 10 per group
 - b. 10 to 20 per group
 - c. 20 to 50 per group
 - d. 50 to 100 per group

9. How do you think the population trend for the DU Caribou is doing?
 - a. Increasing
 - b. Decreasing