MARCH 2023 LATE-WINTER COMPOSITION SURVEYS OF BATHURST, BLUENOSE-EAST AND BEVERLY BARREN-GROUND CARIBOU HERDS

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ABSTRACT

This report describes the results of late-winter composition survey of the Bathurst, Bluenose-East and Beverly barren-ground caribou herds conducted in March 2023. The main purpose of the survey was to estimate the proportion of females in each herd that were still accompanied by a calf, which is an index of calf survival through the first nine to ten months of life.

The survey focused on flying to locations of female and male collared Bathurst, Bluenose-East and Beverly caribou, and classifying caribou (cows, calves, young bulls and prime bulls) nearby or between collars. Extensive mixing of the three herds, based on collared caribou locations, created challenges in deriving herd-specific calf:cow ratios.

Across the survey area there were in total 9,928 caribou classified and a ratio of 43.4 calves:100 cows was estimated (95% CI 41.5 - 45.4). Given the extensive herd mixing, two methods were used to estimate herd-specific calf:cow ratios. In the first method, eight regional survey sectors were defined based on collar locations and a calf:cow ratio was estimated for each sector. The numbers of collars from each herd as a percentage of available collars were used in combination with herd size to estimate likely proportions of each herd represented in each sector. The second method used a finer-scale approach where each group surveyed was assessed based on a buffer around the group, proximity of known herd collars within the buffer, and relative herd size to derive an estimated proportion or weighting of each herd in the group-specific buffer area. Numbers of cows and calves in each group specific to each herd were then used to estimate a calf:cow ratio for each herd.

Bathurst collars were found in seven of the eight survey sectors and the estimated proportion of the herd in each sector varied between 0 and 11.5%, which reflected the widely scattered distribution of Bathurst collars and the fact that this herd was by far the smallest of the three herds. Given this distribution and the lack of any areas that could be confidently assigned as having a high Bathurst component, a Bathurst calf:cow ratio was not estimated based on the sectors. Using the second method, a ratio of 48.4 calves:100 cows (95% CI 10.0 - 79.0) was estimated for the Bathurst herd but the variance was high (Coefficient of Variation, CV, 37.3%). This estimate was not considered reliable, again because the Bathurst was the smallest of the three herds and was outnumbered widely in all portions of the survey area, as reflected in the high variance.

For the Bluenose-East herd, three sectors in the northwestern part of the survey area contained 30 of 56 total available Bluenose-East collars (53.6%) and were estimated to have 74.9% of the Bluenose-East herd. A ratio of 40.9 calves:100 cows (95% CI 37.5 - 44.5) based on 1,927 caribou classified was derived for the Bluenose-East herd from these three sectors. This can be considered an estimate of the herd's calf:cow ratio with moderate confidence, given the herd mixing and that nearly half of the Bluenose-East collars were found outside the three sectors. Using the second approach, an identical ratio of 40.9 calves:100 cows (95% CI 26.0 - 58.0) was estimated for the Bluenose-East herd with a substantial variance (CV 20.2%). As with the estimate based on the first method, this estimate has moderate confidence given the substantial variance.

For the Beverly herd, five sectors had primarily Beverly caribou, based on collars and herd size. Of 29 total Beverly collars available, 18 (62%) were in these sectors. The estimated proportion of Beverly caribou varied between 74.9 and 90.1% across these sectors and was 81.8% for the five sectors combined. The calf:cow ratio was 44.3 calves:100 cows (95% CI 42.1 - 46.7). This can be considered an estimate of the herd's calf:cow ratio with moderate confidence, given the herd mixing and the percentage of Beverly collars found in these sectors. Using the second approach, a ratio of 42.8 calves: 100 cows (95% CI 36.0 - 50.0) was estimated with a relatively good variance (CV 8.8%). The similarity of the two estimates (44.3 and 42.8) and moderate variance suggests moderate-good confidence in these ratios.

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INTRODUCTION

The Bathurst caribou herd has a calving ground west of Bathurst Inlet and the Bluenose-East herd has a calving ground west of Kugluktuk in Nunavut (NU), with portions of their summer ranges in NU and the remainder of the ranges in the Northwest Territories (NWT) (Figure 1). The Beverly[1] herd has a calving ground in the Queen Maud Gulf lowlands and also has much of its range in NU and the NWT. Historically the Bathurst and Beverly herds have ranged as far south as northern Saskatchewan.
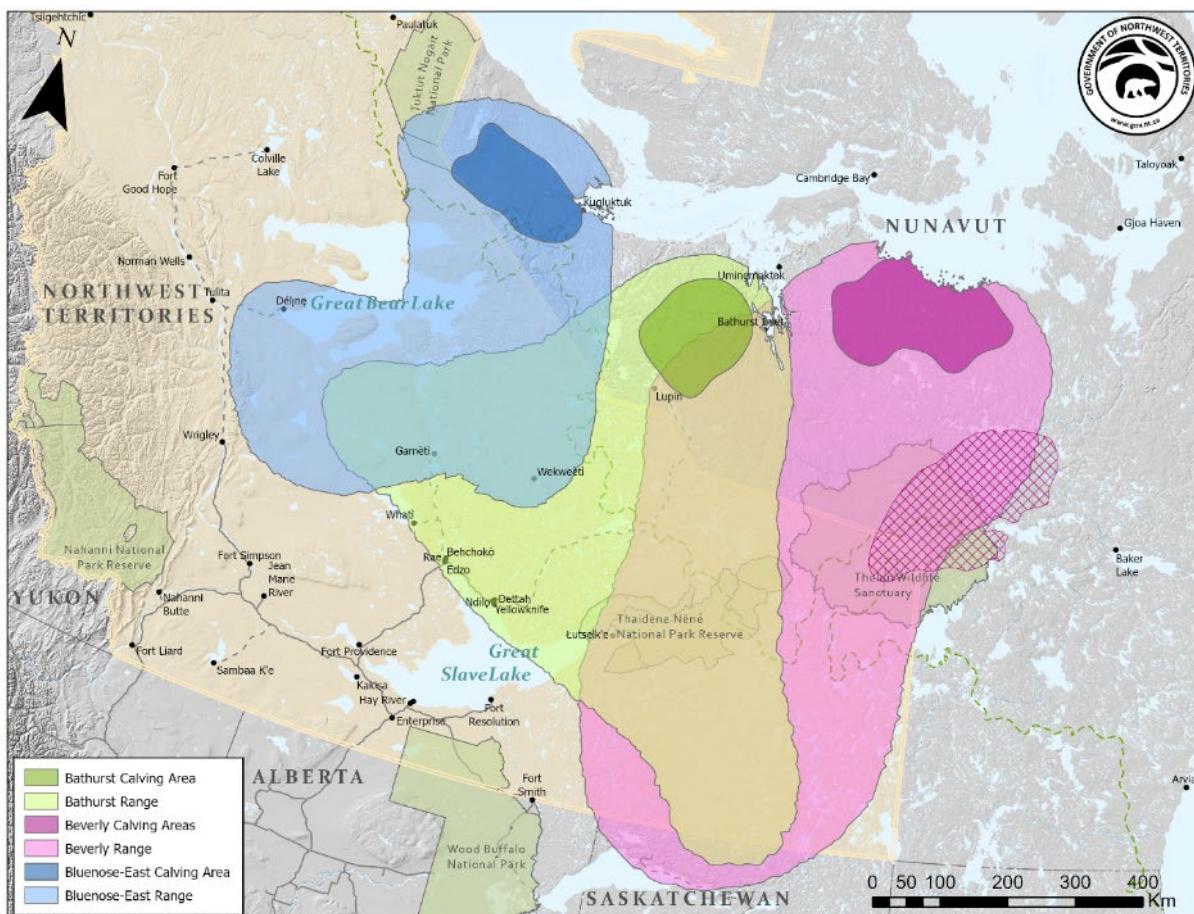
Figure 1. Annual ranges and calving grounds of the Bluenose-East, Bathurst, and Beverly herds, based on accumulated radio collar locations of cows (Nagy et al. 2011). The calving ground used up to about 2009 by the inland-calving Beverly herd is shown as a cross-hatched area.

In 2022, the Bathurst caribou herd was estimated at about 6,800 caribou (Adamczewski et al. 2023a), similar to the 2021 estimate of 6,200 (Adamczewski et al. 2022), after a decline of about

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[1] The Beverly herd described in this report is the herd defined by the Government of Nunavut (GN) as calving in the central and western Queen Maud Gulf. This herd may not correspond exactly to the Beverly herd defined prior to 2009 with an inland calving ground south of Garry Lakes (Adamczewski et al. 2015).

99% from its peak numbers estimated at 470,000 in 1986. Its rate of decline slowed between 2018 and 2021 to about 8%/year and the herd showed some improvement in demographic indicators (Adamczewski et al. 2022). The Bluenose-East herd stabilized between 2018 and 2021 after a steep decline 2010-2018 and was estimated at about 23,200 caribou in 2021. The herd's demographic indicators improved between 2018 and 2021 (Boulanger et al. 2022). The Beverly herd was estimated at about 104,000 in 2018 (Campbell et al. 2019) with a slow declining trend of about 5%/year. March calf:cow ratios for this herd in recent years have been very good (Adamczewski et al. 2023b,c).

March estimates of calf:cow ratios have been monitored as an index of calf survival through the first nine to ten months of life in all three herds, although these ratios are also influenced by pregnancy rate or initial productivity of young in June. Calves of the year generally survive at much lower rates than caribou at least one year old; after the first year their survival rates are usually higher and similar to those of older caribou (Bergerud 2000, Bergerud et al. 2008). At a year of age, surviving calves are considered to be "recruited" into the adult segment of the population, hence these surveys are sometimes called recruitment surveys.

In recent winters, these three caribou herds have wintered primarily in the North Slave region of the NWT, based on satellite collared caribou. Monitoring of the Bathurst and Bluenose-East herds has been more intensive in recent years because of the extensive declines in both herds (see WRRB 2019a and b); this has included annual late-winter composition surveys to estimate the calf:cow ratio at about nine and a half months of age (e.g. Adamczewski et al. 2023b). Monitoring of the Beverly herd has been somewhat less intensive due to its much larger size and lower rate of decline; however late-winter composition surveys have been flown annually for this herd in recent years to monitor calf recruitment.

Mixing of these three caribou herds on the winter range since about 2018 has created challenges for composition surveys as it can be difficult to ascribe calf:cow ratios to an individual herd in mixed areas. Estimating Bathurst calf:cow ratios in late winter has been particularly challenging in recent winters due to extensive overlap with the much larger Beverly herd, which outnumbers the Bathurst herd about 15:1. Mixing of the Bathurst, Bluenose-East and Beverly herds was extensive through fall 2022 and winter 2022-2023. The main objective of the surveys in March 2023 was to estimate the late-winter calf:cow ratios in the Bluenose-East, Beverly and Bathurst herds as on-going monitoring of demographic health in these populations.

METHODS

The survey began in Yellowknife on March 13, 2023 with a an A-Star B3 owned by Acasta Heliflight Inc., call sign C-GUTI, piloted by J. Metz and with Department of Environment and Natural Resources (ENR) staff J. Williams and J. Adamczewski on board (Figure 2a). Wekweètì was the main base of operations. The survey crew included videographer M. Dumond (Umingmak Productions, Kugluktuk) on March 15 and 16 (Figure 2b). Dumond recorded video of caribou on the ground and from the air, and the survey operation, as part of developing an educational video on caribou composition surveys. The survey crew returned to Yellowknife late on March 19. Fuel was used mainly at Wekweètì, but was also used from caches at Daring Lake, Lockhart Lake, Little Crapeau Lake, Lac de Gras, and MacKay Lake.

The survey flying was focused on routes that included the most recent locations of Bluenose-East (BNE), Bathurst and Beverly collared caribou. Caribou groups near collared caribou were classified along with other groups found nearby or between collared caribou. There was extensive mixing of collared caribou from all three herds.

Figure 2a. March 2023 North Slave barren-ground caribou composition survey crew of (left to right): pilot J. Metz, J. Williams, J. Adamczewski, and engineer T. Vautour. Photo M. Dumond.

Figure 2b. Videographer M. Dumond, part of the caribou survey crew on March 15 and 16. Photo M. Dumond.

Additional collars were placed on caribou from these herds in March 2023 by a capture crew also operating from Wekweètì but were not used in planning the survey as their herd identity would not be known until June (cows) or July (bulls).

Caribou were classified from the front seat of the helicopter using motion-stabilized Canon 10x42 binoculars (Figure 3). Caribou were classified as calves (based on smaller size and short face), cows (based on presence of a vulva patch), young bulls (based on absence of a vulva patch and presence of hard antlers), and prime bulls (based on absence of a vulva patch and no antlers). Identification of prime bulls as lacking antlers assumes that mature males shed their antlers soon after the fall breeding season while younger bulls retain them longer into winter (Nagy et al. 2021). Yearling caribou (about 21 months old) were not distinguished and were included with cows and young bulls. In smaller groups (<20) it was usually possible to classify all or nearly all the caribou. In larger groups the focus was on recording an unbiased cross-section of the caribou.

Figure 3. Motion-stabilized Canon 10x42 binoculars used in classifying caribou in March 2023.

Group sizes recorded were the numbers of caribou classified, thus for larger groups the groups under-represent actual groups of caribou seen, particularly in areas where hundreds or thousands of caribou were present.

Trimble Yuma 2 tablet computers were used to record observations with a GPS waypoint taken for each observation. Garmin GPS model 276Cx units were used to plan flights and record flight lines. In addition to caribou, we also recorded observations of other large mammals, including moose, muskoxen, and wolves.

RESULTS

Survey Conditions and Daily Flying

In general, field conditions were good through much of the survey (Figure 4). Survey flying occurred on March 13-17 and 19. There was no flying on the morning of March 16 and on March 18 due to poor weather in the planned survey areas.
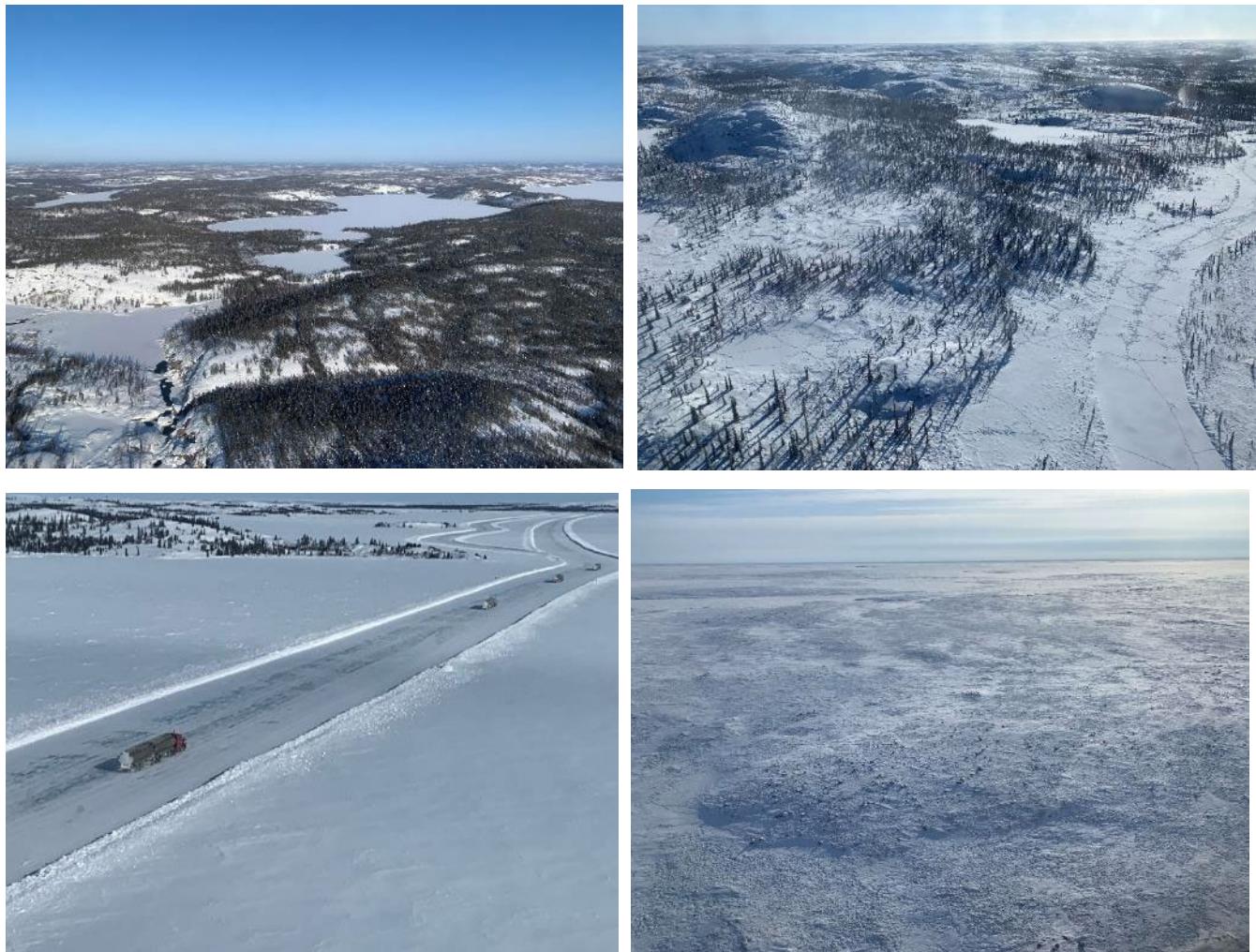
Figure 4. Field conditions during March 2023 composition surveys of Bathurst, Bluenose-East and Beverly caribou herds in the North Slave Region. Top photos in forested and taiga transition areas; bottom left at winter road near Lac de Gras; bottom right on tundra.

Temperatures during the survey were between -28° and -7°C with little wind; the coldest temperatures occurred in the early mornings. Western portions of the survey area, particularly where many of the Bluenose-East collars were found, were generally forested or taiga transition areas, while eastern and central portions were largely above treeline. From a number of ground stops, it appeared that snow cover was generally one to two feet deep and relatively soft.

A summary of daily flying and areas surveyed is in Table 1. In total 34.0 hours were flown during the surveys, including ferry flying of 2.3 hours between Yellowknife and Wekweètì and survey flying of 31.7 hours.

Table 1. Flying hours and main tasks during March 2023 North Slave barren-ground caribou composition surveys.

Date	Flying Hours	Tasks and Notes
March 13	4.3	Ferry Yellowknife to Wekweètì 1.2 hours; survey east and south of Wekweètì; survey 3.1 hours.
March 14	6.8	Survey flying mostly Bluenose-East herd north and west; 6.8 hours survey.
March 15	4.5	Survey flying north and west, mostly Bluenose-East herd, and close to Wekweètì. 4.5 hours survey.
March 16	4.3	Survey mixed herds; 4.3 hours survey.
March 17	7.2	Survey mixed herds east; 7.2 hours survey.
March 19	6.9	Survey mixed herds east; 5.8 hours survey; ferry 1.1 hours Wekweètì to Yellowknife.
Totals	34.0	Ferry hours 2.3 total; 31.7 hours survey time

Flight Lines and Collared Caribou

Collared caribou from the BNE, Bathurst and Beverly herds were more extensively mixed in March 2023 than we had experienced previously (Figure 5). Collars from each herd were distributed across a very large area and there were few areas that had only collars from one herd. We used two methods to estimate herd-specific calf:cow ratios. One method was based on sub-sampling the overall survey area into eight regional survey sectors and estimating herd representation in each sector based on proportions of available herd collars and relative herd sizes. Results for this method are described first. A second method was focused on individual groups classified with a buffer; proximity of known herd collars and relative herd size were used to assign likely representation of each herd within each buffered group polygon. Results for this method are included further on.
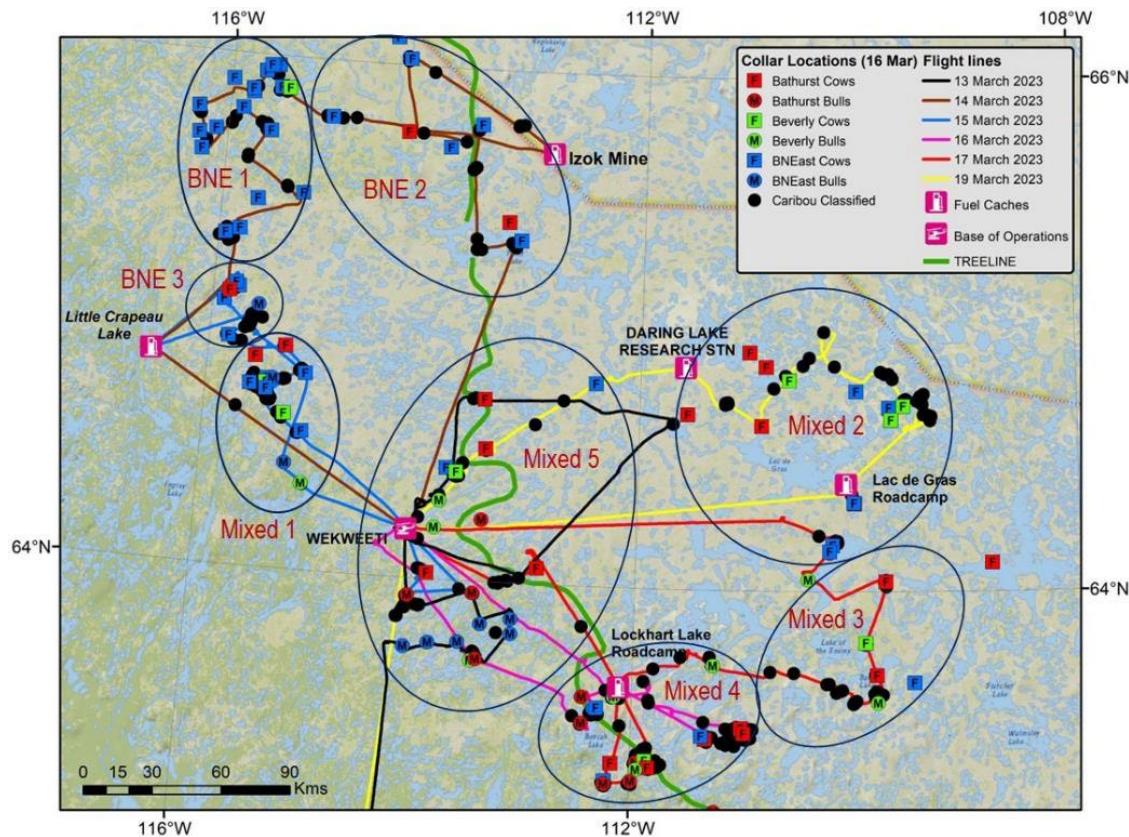
Figure 5. Collared caribou locations, fuel caches, and flight lines March 13-19, 2023 on North Slave Region caribou composition survey. Collar locations are from March 16. Circled areas represent eight survey sectors defined to assess regional variation in classification results.

Estimation Based on Survey Sectors (Method 1)

We defined three spatial sectors that had primarily BNE collars (BNE 1, 2 and 3). We further identified five sectors where there were collared caribou from all three herds (Mixed 1, 2, 3, 4 and 5). To assist in assessing what the classification results in each of the eight sectors likely represented, we listed for each sector the numbers of male and female collared caribou from each of the three herds present (Table 2). We then used the proportion of available collar numbers for each herd and the most recent herd size estimates to estimate the likely numbers of caribou from each herd found in each sector, and thus the relative proportions of each herd found in each sector[2] (Table 3). These proportions should be considered approximations only as the numbers of caribou from any herd associated with one collared caribou are highly variable. We had also observed during previous March surveys that groups of several hundred or several thousand caribou sometimes occurred with no collar present. Given that the Beverly herd is by far the largest of the

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[2] As an example, sector BNE 2 had seven of 56 available BNE collars. 7/56 x herd size of 23,200=2,900 BNE caribou present. This sector also had two Bathurst collars of 36 available Bathurst collars. 2/36 x herd size of 6,800=378 Bathurst caribou present; total 2,900+378=3,278 caribou. This sector would thus have had an estimated 2,900/3,278 or 88.5% BNE caribou and an estimated 11.5% Bathurst caribou.

three herds and has had generally the fewest collars, we assumed that these substantial caribou groups with no collars were most likely predominantly Beverly caribou. Herd sizes used were 6,800 (Bathurst herd in 2022, Adamczewski et al. 2023a); 23,200 (Bluenose-East herd in 2021, Boulanger et al. 2022; and 104,000 (Beverly herd in 2018, Campbell et al. 2019).

Table 2. Numbers of collared caribou from the BNE, Bathurst (B) and Beverly (BEV) caribou herds in each survey sector during March 2023 composition surveys. Collars newly placed in March 2023 were not included here.

Survey Sector	BNE Collars in Sector		B Collars in Sector		BEV Collars in Sector	
	F	M	F	M	F	M
BNE1	18	0	0	0	1	0
BNE2	7	0	2	0	0	0
BNE3	4	1	1	0	0	0
Mixed 1	5	1	2	0	2	1
Mixed 2	5	0	5	1	3	1
Mixed 3	1	0	2	0	1	1
Mixed 4	3	1	5	5	2	3
Mixed 5	2	6	4	4	1	3
All Sectors Total	45	9	21	10	10	9
All Collars Available	46	10	23	13	16	13

Table 3. Estimated representation of BNE, Bathurst and Beverly caribou in each survey sector during March 2023 composition surveys, based on the percentage of available collars for each herd and the last estimated herd size for each herd.

Survey Sector	Estimated % BNE Caribou Present	Estimated % Bathurst Caribou Present	Estimated % Beverly Caribou Present
BNE 1	67.5	0	32.5
BNE 2	88.5	11.5	0
BNE 3	91.6	8.4	0
BNE 1,2&3	74.9	3.4	21.7
Mixed 1	18.2	2.8	79.0
Mixed 2	11.8	6.5	81.7
Mixed 3	5.2	4.7	90.1
Mixed 4	7.7	8.8	83.5
Mixed 5	17.2	7.9	74.9
Mixed 1,2,3,4&5	11.5	6.7	81.8

Bluenose-East Results (Survey Sectors)

The three BNE sectors had a total of 30 of an available 56 BNE collars (53.6%) and the estimated representation of BNE caribou in these sectors was about 75% (Figure 6). Estimated representation of the three herds in each sector is shown in Figure 6 as pie charts. There were three Bathurst collared cows and one Beverly collared cow in the BNE sectors, accounting for the remaining 25% of estimated numbers of caribou.
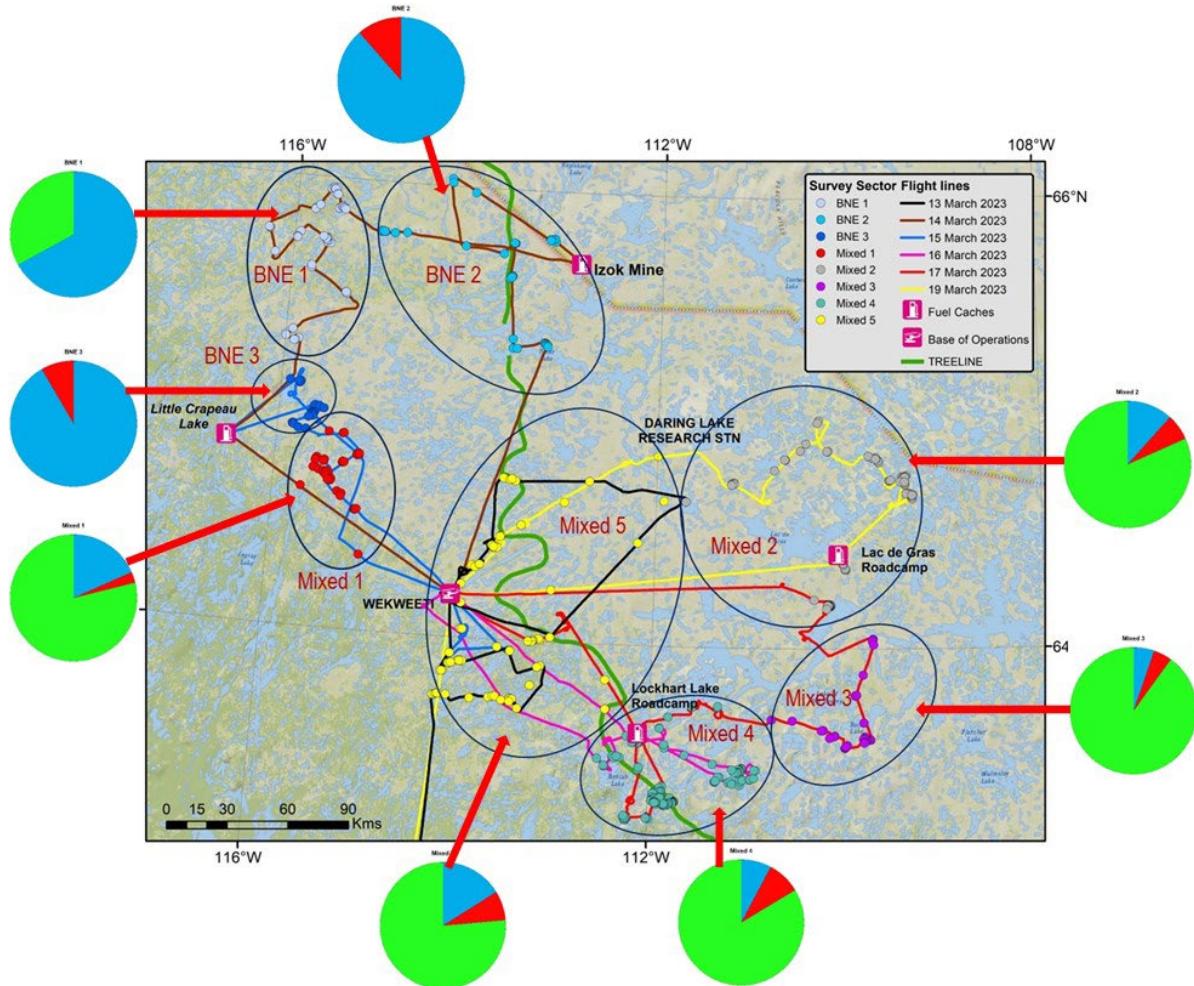
Figure 6. Survey sectors defined to assess regional variation in classification results from March 2023 composition surveys of Bathurst, BNE and Beverly herds. Flight lines and locations of groups classified are shown. The pie charts show the relative proportions (percentage) of each herd estimated in each sector (Beverly - green, BNE - blue and Bathurst - red) from Table 3.

Calf:cow ratios were estimated at 39.2, 45.4, and 33.6 calves:100 cows in these BNE sectors and the combined ratio was 40.9 calves:100 cows (confidence intervals lower and upper, CIL & CIU, 37.5, 44.5) based on 1,927 caribou classified. This can be considered an estimate of the BNE herd's calf:cow ratio with moderate confidence, given that nearly half of the BNE collars were found outside the three BNE sectors and that an estimated 25% of the caribou in the three BNE sectors were from the Beverly and Bathurst herds.

Beverly Results (Survey Sectors)

There were five sectors in the central and eastern portions of the survey area that had primarily Beverly caribou, based on collar representation and herd size. These were named Mixed 1, 2, 3, 4 and 5 and 8,001 caribou were classified in them. Of 29 total Beverly collars available, 18 (62%) were in the five Mixed sectors. The estimated proportion of Beverly caribou varied between 74.9 and 90.1% across these sectors and was 81.8% for the five sectors combined. All five of these sectors each had at least 1-2 Bathurst and 1-2 BNE collars present.

Calf:cow ratios in these five sectors varied between 40.4 and 56.1 calves:100 cows and the overall combined calf:cow ratio was 44.3 calves:100 cows (42.1, 46.7). This can be considered an estimate of the Beverly herd's calf:cow ratio with moderate confidence, given the herd mixing and the percentage of Beverly collars found in these Mixed sectors.

Bathurst Results (Survey Sectors)

There was at least one Bathurst collared caribou in seven of eight survey sectors, and they accounted for less than 10% of estimated caribou numbers in six of the seven sectors and 11.5% in the seventh (Tables 4a, 4b). There was thus no concentrated representation of Bathurst caribou in any part of the survey area. Of 36 total Bathurst collars available, 31 were in the survey sectors (86.1%). Because the Bathurst collared caribou were widely dispersed across the overall survey area and there were no substantial areas with a high representation of Bathurst caribou, no estimate of Bathurst calf:cow ratios in March 2023 was generated based on the eight survey sectors.

Table 4a. Results of March 2023 composition surveys of BNE, Bathurst and Beverly caribou herds for sectors BNE 1, 2, 3, BNE sectors 1, 2, and 3 combined, and all sectors combined. SE = Standard Error; CIL = 95% Confidence Interval Lower; CIU = 95% Confidence Interval Upper.

Measurement	Survey Sector				
	BNE 1	BNE 2	BNE 3	BNE 1, 2 & 3 Combined	All Sectors Combined
# Caribou	977	729	221	1,927	9,928
# Cows	612	414	119	1,145	4,032
# Calves	240	188	40	468	1,748
# Young Bulls	114	105	50	269	1,988
# Prime Bulls	11	22	12	45	2,150
All Bulls	125	127	62	314	4,138
# Groups	41	38	20	99	428
Mean Group Size	23.8	19.2	11.0	19.5	23.2
Median Group Size	22	20.5	8.5	15	17
Calves:100 Cows	39.2	45.4	33.6	40.9	43.4
SE Calves:100 Cows	2.2	2.6	6.4	1.8	1.0
CIL & CIU Calf:Cow	34.7, 43.5	40.6, 50.8	22.3, 46.6	37.5, 44.5	41.5, 45.4
Bulls:100 Cows	20.4	30.7	52.1	27.4	102.6
SE Bulls:100 Cows	3.0	5.3	17.6	2.9	8.3
CIL & CIU Bull:Cow	15.1, 27.0	21.4, 42.2	30.7, 98.6	22.2, 33.8	88.5, 120.8

Table 4b. Results of March 2023 composition surveys of BNE, Bathurst and Beverly caribou herds for sectors Mixed 1, 2, 3, 4 and 5 & Mixed 1,2,3,4 & 5 combined. SE = Standard Error; CIL = Confidence Interval Lower; CIU = 95% Confidence Interval Upper.

Measurement	Survey Sector					
	Mixed 1	Mixed 2	Mixed 3	Mixed 4	Mixed 5	Mixed 1,2,3,4,5 Combined
# Caribou	575	3,127	1,052	2,168	1,079	8,001
# Cows	207	1,655	321	328	376	2,887
# Calves	106	675	180	167	152	1,280
# Young Bulls	175	545	293	528	178	1,719
# Prime Bulls	87	245	255	1,145	373	2,105
All Bulls	262	790	548	1,673	551	3,824
# Groups	38	79	30	113	69	329
Mean Group Size	15.1	39.6	35.1	19.2	15.6	24.3
Median Group Size	11.0	36.0	25.5	15.0	9.0	17
Calves: 100 Cows	51.2	40.8	56.1	50.9	40.4	44.3
SE Calves: 100 Cows	5.3	1.2	4.0	3.4	3.3	1.2
CIL & CIU Calf:Cow	40.7, 61.7	38.4, 43.3	48.4, 64.2	44.7, 58.0	36.0, 47.9	42.1, 6.7
Bulls: 100 Cows	126.6	47.7	170.7	510.1	146.5	132.5
SE Bulls: 100 Cows	30.0	5.2	31.7	90.3	62.5	12.5
CIL & CIU Bull:Cow	81.4, 200.0	39.1, 59.1	126.0, 248.9	365.2, 720.7	87.0, 323.5	112.2, 158.7

Estimation Based on Groups Classified, Collar Proximity and Herd Size (Method 2)

We developed a method that uses collars of known herd membership relative to group observations to weight each group classified as to herd representation, based on proximity of known collars and relative herd size. The procedure is described in steps below. We note that this method included the known collars for each herd in March 2023 and included in the survey sectors described earlier, and also included collars newly placed in March 2023. By fall 2023 when these further analyses were carried out, the new collars had been assigned to herds based on locations in June (females) and July (males).

1. Daily movement rates of individual female collared caribou during the survey were estimated. The 95th percentile of daily distances moved was used to define the area that any one collared caribou (and caribou from the herd represented by the collar) may have traversed within a given day. Collared males were not included in estimates given that the target group was cows and their associated calves.

2. The composition observations were then buffered by the 95th percentile of distance moved within a day. The 95th percentile distance is used in habitat selection studies to define "habitat" available to a caribou in each day (Arthur et al. 1996). In this case the distance was defining collared caribou "available" to be counted in the composition group. Frequencies of

collared caribou from each herd were then tallied in the buffer area on the day the composition survey occurred. The result was a count of Bathurst, Bluenose-East, and Beverly collared caribou (if they were within the buffer distance) for each composition group observed. This count was compared to the total collars available (regardless of whether they were in the vicinity of the composition survey) for each herd which amounted to 27, 44, and 53 adult female collars for the Bathurst, Beverly, and Bluenose-East herds. Using all the collars available accounted for cases where a proportion of the herd was not in the vicinity of the composition survey area.

3. The second component that determined the probability that a caribou classified in a group belonged to an individual herd was the relative size of each herd. For example, a Beverly collar likely represented more caribou than a Bathurst collar. To account for this estimated adult female size was used from recent surveys to estimate relative herd size around each observation point. Estimated adult numbers of females were 61,070, 13,991, and 4,179 from the Beverly (2018), Bluenose-East (2021) and Bathurst (2022) surveys.

4. The following calculations were used to derive a weight for each herd. The weight was the estimated proportion of caribou in a buffer area from each herd. These weights summed to 1.
   a. Relative N for each herd= collars in buffer from a herd/total collars available * Adult female N for the herd
   b. Total N for all herds = sum of Relative N for each herd
   c. Weight for each herd = Relative N for each herd / Total N for all herds

5. The number of cows and calves for each herd were then estimated using the weight for each herd.
   a. Calves for each herd=Weight for each herd * calves observed in composition group
   b. Cows for each herd = Weight for each herd * cows observed in composition group

6. The numbers from Step 5 were then used to derive calf-cow ratios using a bootstrap approach, as used previously in other calculations. This approach effectively weighted each observation based on the number of caribou observed in each composition group, the proportion of collars from a herd in the buffer area, as well as the estimated number of adult females from the herd.

7. The proportion of caribou from a given herd in each group had uncertainty based on the sample size of collars available for each herd as well as uncertainty in herd size. This uncertainty was added to the bootstrap variance using the delta method (Buckland et al. 1993) to derive adjusted confidence limits under the assumption that proportion of collars/relative herd size from each group could be described by a binomial distribution, therefore allowing estimation of binomial variance based on weightings for each group.

Estimates were derived in the R statistical software (R Development Core Team 2009) with use of the *dplyr, ggplot2,* lubridate, *sf* (simple features), and *mapview* packages (Wickham 2009, Grolemund and Wickham 2011, Wickham 2011, Appelhans et al. 2023)

Based on the 95th percentile of daily movements of collared adult females a buffer distance of 18.7 km (SD=6.5, min=0.21, max=42.1, n=124 collared caribou) was put around each composition observation. Weightings (the proportion of caribou from each herd in the buffer) for each composition group were then estimated based on the proportion of collars from a given herd in the buffer as well as the relative size of the given herd. The buffers used and weightings are shown in the next three figures.

BNE caribou were most evident in the northern observations (Figure 7). Observations in the northwest had moderate weightings despite the fact that many BNE collars were present in this area. The reason for this is that Beverly collars were also evident in this area. These observations were given a higher Beverly weighting since the Beverly adult female estimate is approximately four times the size of the Bluenose-East estimate.
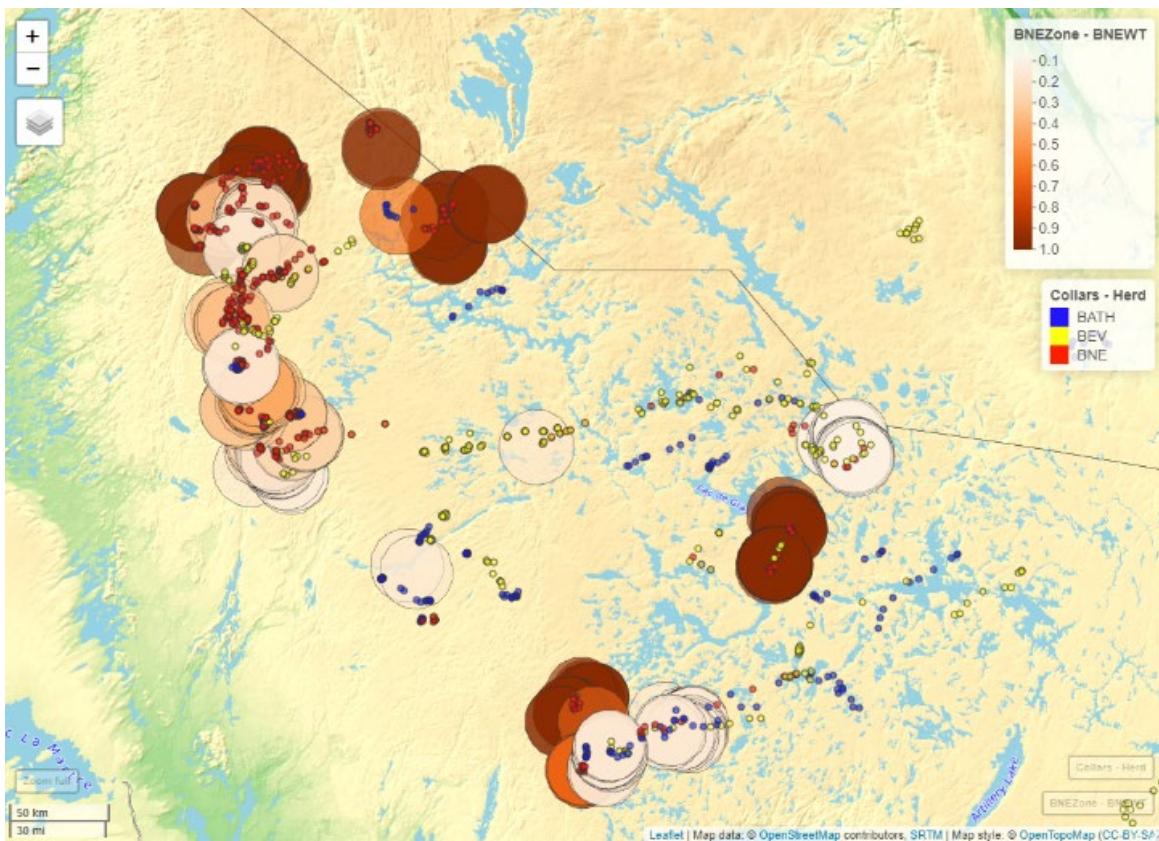
Figure 7. The estimated proportion of BNE caribou (BNEWT) in each composition group classified in March 2023. Only groups where at least 1 BNE collar was present in the 18.7 km buffer are shown. Also shown are daily collar locations for all herds. Weightings were influenced by relative herd size and the proportion of collars from a given herd in the buffer. Darker circles indicate a higher BNE presence.

Dominance of the Beverly herd in much of the survey area is shown with Beverly weightings (Figure 8). Basically, if Beverly collars were evident than the observations were usually given a higher weight, given that this herd outnumbered the BNE herd by about 4:1 and the Bathurst herd by about

15:1. In contrast, the Bathurst herd had low weightings across the survey area except when an area was primarily occupied by Bathurst collars (Figure 9).
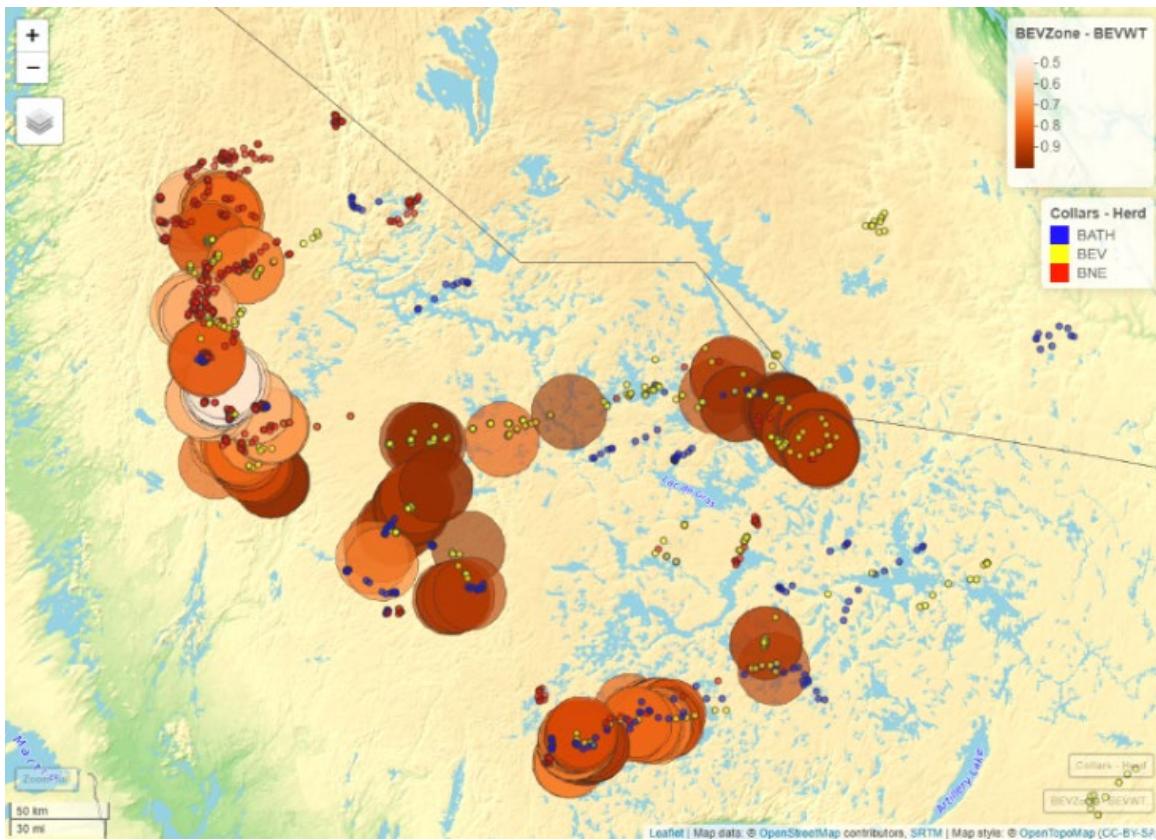
Figure 8. The estimated proportion of Beverly caribou (BEVWT) in each composition group observed in March 2023. Only groups where at least one BEV collar was present in the 18.7 km buffer are shown. Also shown are daily collar locations for all herds. Weightings were influenced by relative herd size and the proportion of collars from a given herd in the buffer.
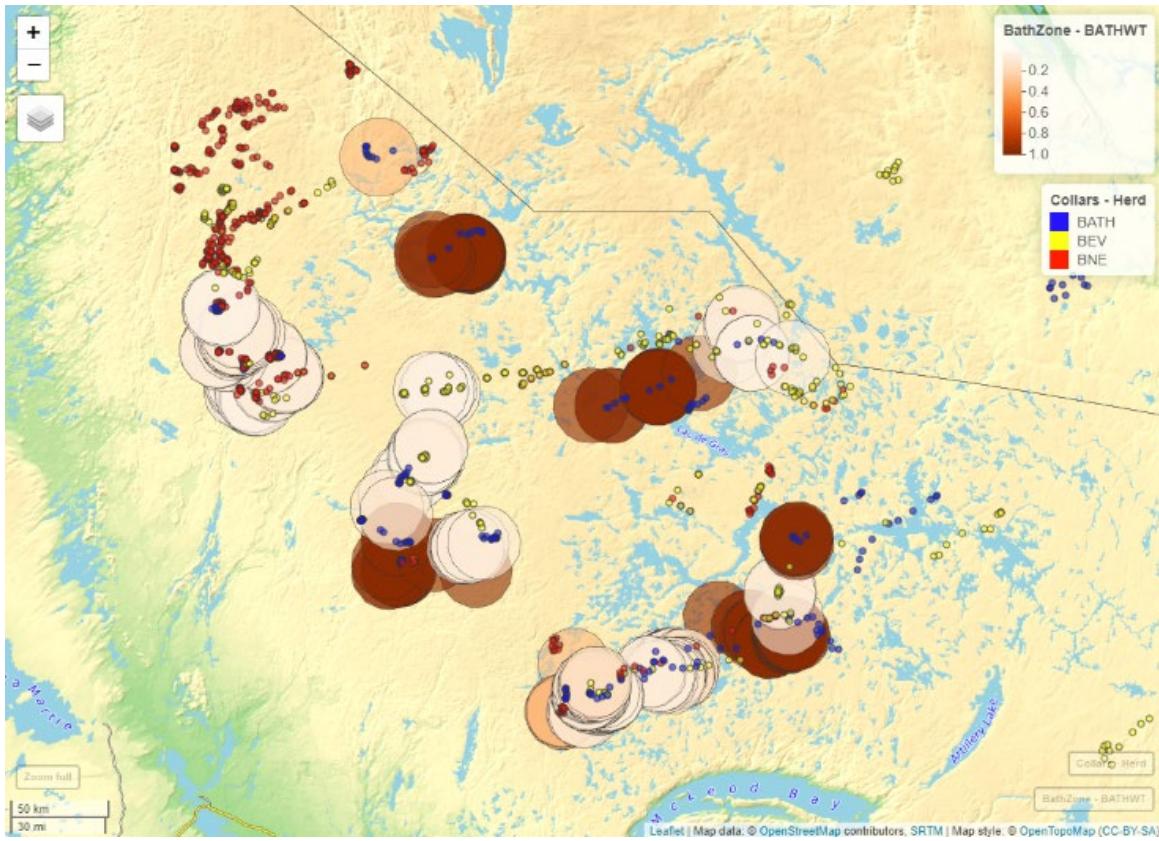
Figure 9. The estimated proportion of Bathurst caribou (BATHWT) in each composition group observed in March 2023. Only groups where at least one BATH collar was present in the 18.7 km buffer are shown. Also shown are daily collar locations for all herds. Weightings were influenced by relative herd size and the proportion of collars from a given herd in the buffer.

A composite plot shows the weighting of the three herds using pie-charts and combines the information from the previous three figures (Figure 10). Note that weightings were assigned based on collars present on the day a composition survey occurred and this correspondence may be less evident on plots that show collar locations for the entire duration of the survey. The figure below also shows some classification locations that were not classified by herd given that no collars were in the immediate region of the composition observation. This points out one shortcoming of this method in that it relies on collared caribou in the proximity of composition observations for classification.
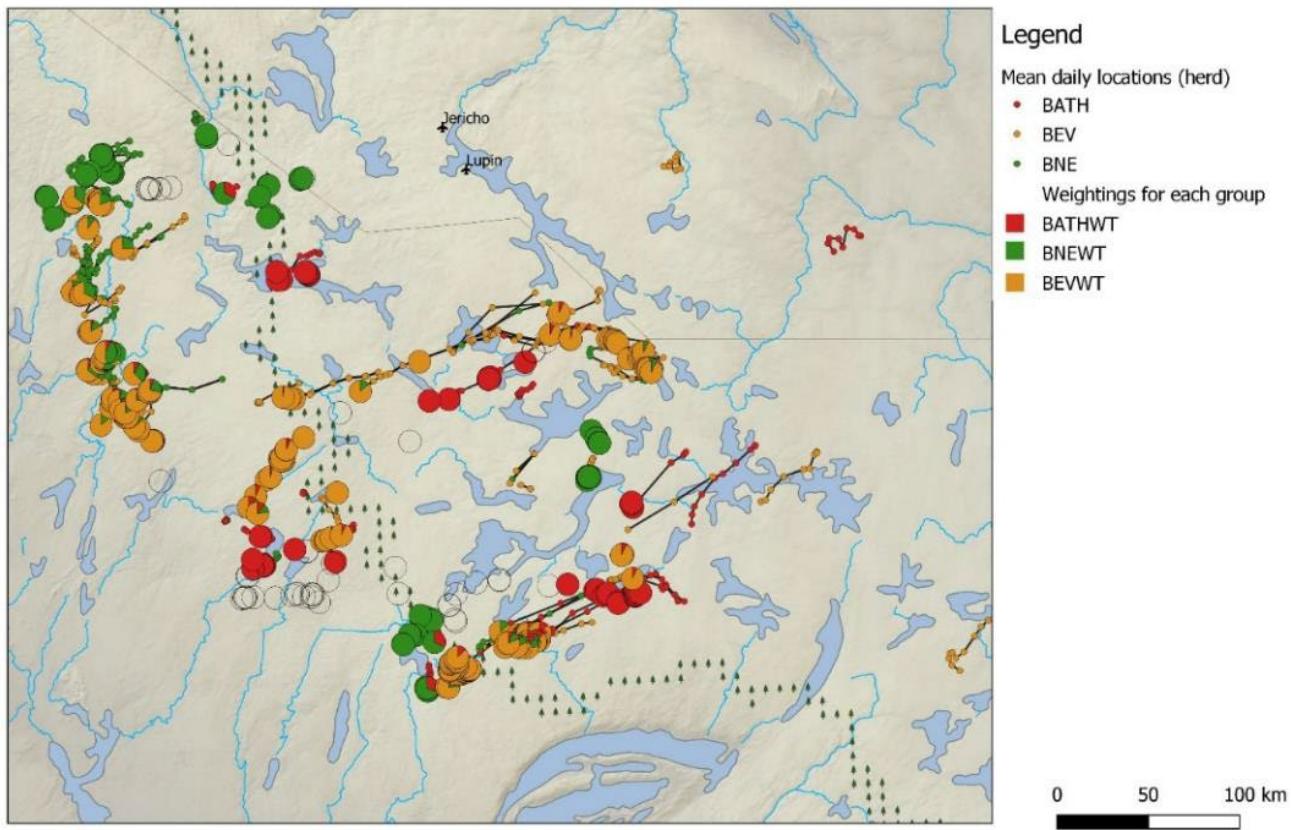
Figure 10. Pie charts depicting the weightings for each caribou composition group observed during March 2023 surveys. Weightings were based on proportion of collars from each herd in the 18.7 km buffer and the relative size of each herd. Observations that were not classified are shown as empty circles.

Using the weightings, the numbers of cows and calves were estimated across all composition observations to derive calf-cow ratios for each herd (Table 5). The number of groups was based upon composition observations where caribou from the given herd were estimated to be present (weighting >0).

Table 5. The number of groups for each herd (based on weightings >1), estimated calves, cows, and resulting calf-cow ratios from March 2023 surveys. These values do not consider other sources of uncertainty; adjusted variance values are in Table 7 below. Calf-cow ratios are unchanged. SE = Standard Error; CV = Coefficient of Variation.

Herd	Number of groups	Estimated # calves	Estimated # cows	Calf-cow ratio	SE	95% Confidence limits		CV (%)
BATH	231	324.4	670.1	48.4	2.3	44.2	53.1	4.7
BEV	231	788.5	1844.3	42.8	1.3	40.5	45.3	3.0
BNE	239	509.1	1243.6	40.9	1.6	37.9	44.1	3.8

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The estimates of variance in Table 5 do not include uncertainty based on proportions of collars in buffers as well as adult female estimates. Table 6 below summarizes collar sample sizes for each group, mean weightings, and coefficients of variation for weightings. The CV of mean weightings was highest for the Bathurst which had lower weighting values.

Table 6. Summary of the number of collars available, mean number of collars for a given herd in a buffer, and assumed adult female estimates, from March 2023 surveys. Collars available corresponds to adult female collars from each herd, in this case including collars placed in March 2023. SE = Standard Error; CV = Coefficient of Variation.

Herd	Collars available	Mean collars in buffer	SD (Mean collars)	Mean weighting	SE weighting	CV weighting	Adult Female estimate	Adult Female CV (%)
BATH	27	1.43	0.6	0.34	0.06	0.27	4,179	25.6
BEV	44	1.64	0.8	0.83	0.06	0.07	61,070	4.7
BNE	53	2.64	2.3	0.46	0.07	0.15	13,991	1.3

Adjusted variances based on the additive variance of the composition estimate, the proportion of collars in the buffer, and relative herd size are given in Table 7 below, along with the calf:cow ratios. The Bathurst herd estimate was the most imprecise, with moderate precision for the BNE herd and higher precision for the Beverly herd. The main contributing factor to higher precision of the Beverly was the larger number of caribou in this herd, increasing overall precision compared to smaller herds. These estimates suggest that the Bathurst estimate is not statistically reliable given the higher CV for this estimate.

Table 7. Calf-cow ratios from March 2023 surveys with variance adjusted for variance due to collar and population estimate uncertainty. SE = Standard Error; CV = Coefficient of Variation.

Herd	Calf cow ratio	SE	95% Confidence limits		CV
BATH	48.4	15.0	19.0	79.0	37.3
BEV	42.8	4.0	36.0	50.0	8.8
BNE	40.9	8.0	26.0	58.0	20.2

The distribution of weightings (the proportion of each herd in composition groups) also illustrates that in most cases estimated Bathurst caribou comprised a relatively low proportion of caribou in composition groups (Figure 11). In contrast, the Beverly was often estimated to be of higher proportion and BNE of moderate proportion.
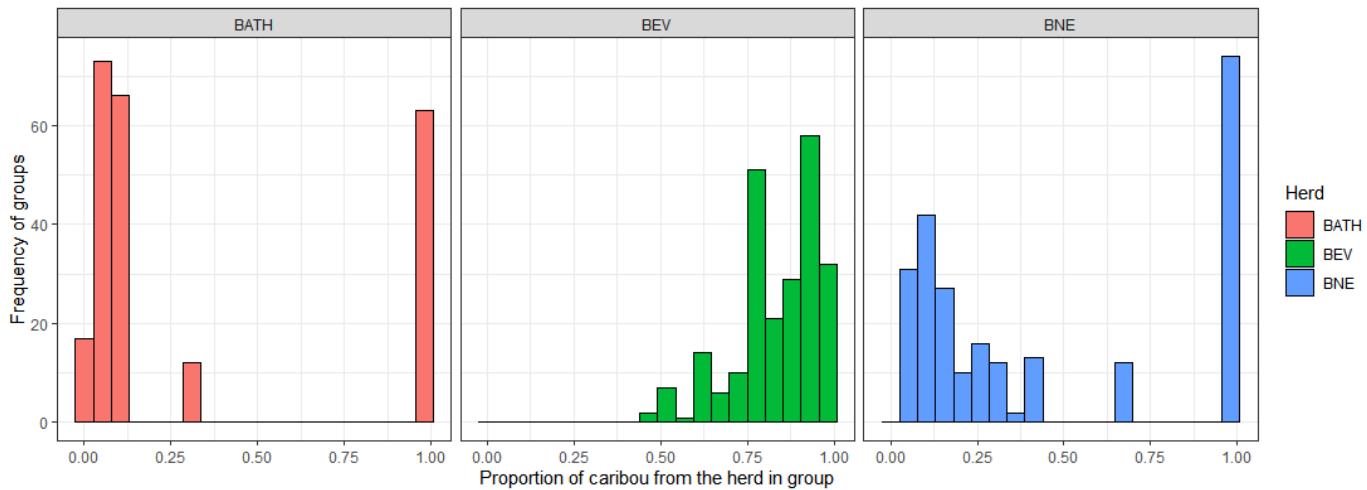
Figure 11. The distribution of weightings (proportion of caribou in a composition group) for each herd from March 2023 surveys.

One potential alternate method explored was to only use only groups for a given herd that had a weighting of 1. The results of this analysis are shown below (Table 8). The number of groups (and subsequent coverage) was substantially reduced for each herd; however, estimates were relatively similar to estimates from the full data set.

Table 8. Calf cow ratios if only groups that were estimated to have only members of the given herd present (weightings=1) are included in the analysis, from March 2023 surveys. SE = Standard Error; CV = Coefficient of Variation.

Herd	# groups	Calf cow ratio	SE	95% Confidence limits		CV
BATH	63	48.3	0.025	43.5	53.3	5.2
BEV	14	40.6	0.043	35.7	51.7	10.6
BNE	74	40.2	0.019	36.8	43.9	4.7

Overall, the calf:cow ratio estimate derived from the group-specific estimation for the BNE herd (40.9:100) was identical to the estimate using only the BNE survey sectors (40.9:100) but had a higher variance. This suggested that estimates for the BNE herd were relatively robust to how estimation occurred. The estimate for the Beverly herd from the group-specific estimation (42.8:100) was very similar to the ratio derived from the five survey sectors (44.3:100), suggesting that this estimate was also robust to how estimation occurred. The Beverly group-specific estimate had the lowest variance of the three herds, likely because it was the largest herd by far and dominated the representation of caribou in much of the survey area. The Bathurst group-specific estimate is not reliable given that in all survey areas weighting suggested Bathurst were dominated by other herds; the survey sector method did not generate a Bathurst-specific calf:cow ratio, again because Bathurst caribou were outnumbered throughout the survey area. Further evaluations are in the discussion.

Regional Variation in Representation of Cows, Calves, Young Bulls and Prime Bulls

Survey coverage across the eight sectors included flying to almost every collared caribou, including bulls. This coverage allowed for an assessment of regional variation in proportions of cows, calves, young bulls and prime bulls (Table 9, Figure 12). Bulls were concentrated in the southern portion of the distribution and accounted for 77.2% of caribou classified in the Mixed 4 sector, 52.1% in Mixed 3, 51.1% in Mixed 5, 45.5% in Mixed 1, and 25.2% in Mixed 2. Bulls accounted for much lower percentages of caribou in the three BNE sectors further north and west: 12.8, 17.4 and 28.0% in sectors BNE 1, 2 and 3. Prime bulls were particularly concentrated at the southern end of the overall distribution and outnumbered young bulls in sectors 4 and 5. Prime bulls were a low percentage of the caribou classified in the three BNE sectors (1.1, 3.0 and 5.4%) and were outnumbered by young bulls in Mixed sectors 1, 2 and 3.

Table 9. Percentages of cows, calves, young bulls and prime bulls classified in each survey sector during March 2023 composition surveys of Bathurst, BNE and Beverly herds. Percentages are calculated from numbers in Table 4 and these percentages are shown as pie charts in Figure 11.

	Survey Sector							
Class	**BNE 1**	**BNE 2**	**BNE 3**	**Mixed 1**	**Mixed 2**	**Mixed 3**	**Mixed 4**	**Mixed 5**
% Cows	62.6	56.8	53.8	36.0	52.9	30.5	15.1	34.8
% Calves	24.6	25.8	18.1	18.4	21.6	17.1	7.7	14.1
% Young Bulls	11.7	14.4	22.6	30.4	17.4	27.9	24.3	16.5
% Prime Bulls	1.1	3.0	5.4	15.1	7.8	24.2	52.8	34.6
% Bulls	12.8	17.4	28.0	45.5	25.2	52.1	77.1	51.1
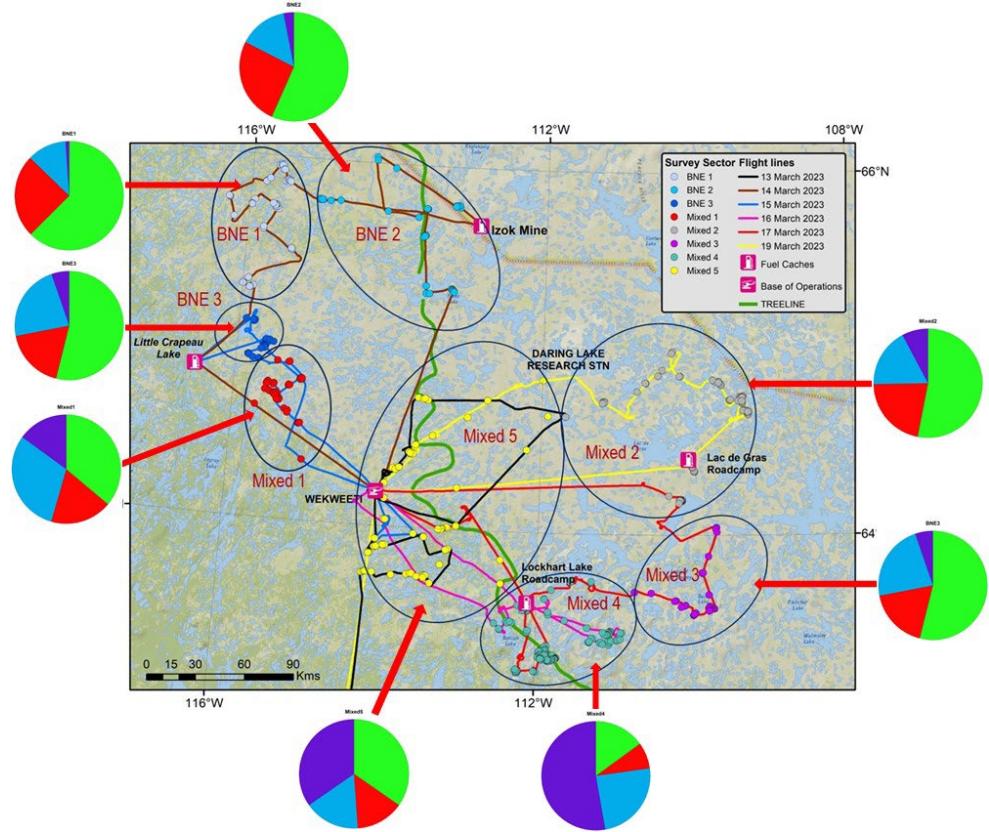
Figure 12. Survey sectors defined to assess regional variation in classification results from March 2023 composition surveys of Bathurst, BNE and Beverly herds. Flight lines and locations of groups classified are shown. The pie charts show the relative proportions of cows (green), calves (red), young bulls (blue) and prime bulls (purple) estimated in each sector from Table 4.

Incidental Sightings of Other Large Mammals and Eagles

Incidental sightings of other large mammals and one eagle during March 2023 composition surveys of the Bathurst, BNE and Beverly herds are shown in Table 10. The eagle was seen at a caribou kill site (Figure 13). Locations of these sightings are shown in Figure 14. In total 13 wolves were seen either as singles or groups of two, three and five; one wolverine, four moose and 37 muskoxen were also recorded.

Table 10. Numbers of other large mammals and an eagle observed during March 2023 composition surveys of the Bluenose-East, Bathurst and Beverly caribou herds.

Survey Sector							
Species	**BNE1,2,3**	**Mixed 1**	**Mixed 2**	**Mixed 3**	**Mixed 4**	**Mixed 5**	**Total**
Eagle					1		1
Wolf	1,2,3				1,1,5		13
Muskox				7	30		37
Moose	1,1	1,1					4
Wolverine		1					1

Figure 13. An eagle observed during March 2023 composition surveys of the BNE, Bathurst and Beverly caribou herds. Photo M. Dumond.
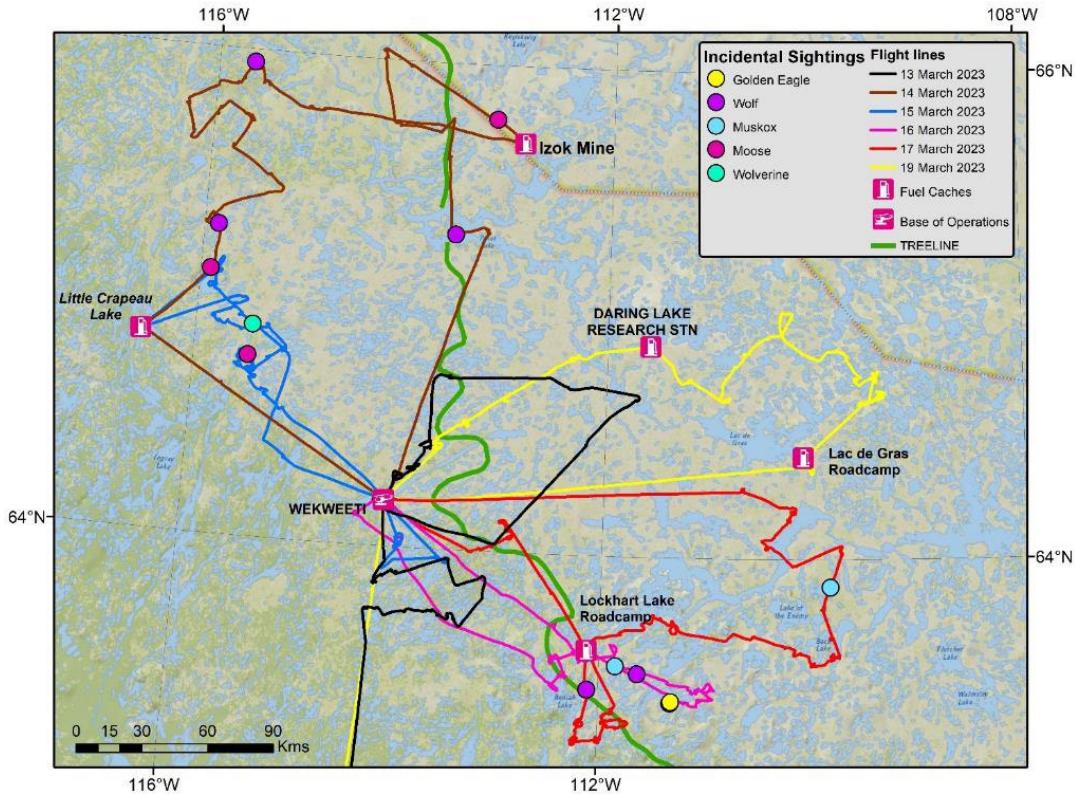
Figure 14. Locations of other large mammals and an eagle observed during March 2023 composition surveys of the BNE, Bathurst and Beverly caribou herds.

DISCUSSION

Survey Considerations Using Survey Sectors

The extensive mixing of the Bathurst, BNE and Beverly herds in March 2023 created challenges in interpreting the survey results and in particular meant that estimating herd-specific calf:cow ratios with confidence was difficult. Nonetheless, the results did make possible estimates of the March calf:cow ratio in the BNE herd and Beverly herds that we have moderate confidence in, recognizing that each of these estimates included portions of the other two herds and that the estimates included a limited percentage of each herd.

For the Beverly herd, 11 of 29 collared caribou (37.9%) were in areas not contained in the Mixed 1, 2, 3, 4 and 5 sectors, which creates uncertainty give the possibility that the calf-cow ratios could have been higher or lower in those areas. The estimated proportion of Beverly caribou in these five sectors was 81.8%, which means that 18.2% of the caribou were from the Bathurst and BNE herds. This also creates uncertainty in that the estimated calf:cow ratio might be higher or lower for the other two herds.

For the BNE herd, 26 of 56 collared caribou (46.4%), or nearly half, were in areas not contained in the BNE 1, 2 and 3 sectors, which creates uncertainty give the possibility that the calf-cow ratios could have been higher or lower in those areas. The estimated proportion of BNE caribou in the three BNE sectors was 74.9%, which means that about a quarter of the caribou surveyed might have been from from the Bathurst and Beverly herds. This also creates uncertainty in that the estimated calf:cow ratio might be higher or lower for the other two herds.

For the Bathurst herd, the wide distribution of the herd based on collars and the fact that the Bathurst herd was outnumbered by the Beverly herd by about 15:1 and by the BNE herd by about 4:1 meant that there were no areas where presence of mostly or solely Bathurst caribou could be inferred. As a result, no estimate of a Bathurst calf:cow ratio was possible based on analysis of the eight survey sectors.

Survey Considerations Using Individual Groups

The new approach to estimating calf:cow ratios using individual groups, collar proximity and herd representation attempted to refine the estimation of calf-cow ratios at a finer scale than the relatively large survey sectors. This approach was fundamentally similar to the use of survey sectors, in the sense that locations of collared caribou from each herd and relative herd sizes were used in both cases to infer herd representation in sample areas. However, the new approach was used to estimate the relative abundance of caribou from each herd associated with each composition observation, rather than pooling on a large scale by survey sector. The buffer zone distance (18.7 km) was based on the 95th percentile of daily distances moved by caribou during the survey. This approach, which is also used in habitat selection studies to define available habitat (Arthur et al 1996), basically assumes that the 95th percentile distance will define caribou from each

herd that are "available" to be classified. If this assumption is correct then the distribution of collars within the buffer area can be used to estimate the relative proportions of caribou from each herd being classified. This approach relies upon collars in the proximity of each composition observation; in this study 48 of 428 observations total could not be classified as they had no collars nearby and therefore were not used in the calculations.

The main assumption of the individual group-based approach is that the estimated proportion of caribou from each herd in the buffer area is an unbiased index of herd membership of caribou classified in the composition count. This assumption may be violated if smaller scale segregation by herds does occur, however the relative weightings may be robust as long as the scale of segregation is larger than the buffer area used to classify groups. The main potential bias could be a situation for herds like the Bathurst that are vastly outnumbered by other herds. In this case the data may not have the resolution to estimate differences in calf cow ratios. For example, say the Bathurst has a lower calf cow ratio (20:100) but the Beverly has a higher calf cow ratio (50:100). If the Beverly outnumbers the Bathurst in all groups then it is likely that this difference will be obscured. A simulation study that looks at the relationship between differences in calf cow ratios, relative herd sizes, and levels of intermixing of herds is a logical next step in testing the robustness of this approach to estimate calf-cow ratios.

Confidence intervals are wider using the individual group-based approach since uncertainty in herd membership based on collars as well as uncertainty in relative herd size is incorporated into estimates of standard error. Therefore, using this approach will likely result in less precise estimates, however, this imprecision is likely a reality given the uncertainty caused by mixing of herds. Imprecise data can still be used in Integrated Population Models given that the level of precision of estimates is used to weight the influence of estimates on model predictions.

There are other possible approaches to define herd membership that might also be worth considering. One approach could be based on nearest-neighbor analysis where the distance of each collar to the composition observation is utilized. This approach would require more exact matching of collar data and composition data as well as development of weighting schemes based on distance. However, it may have higher resolution than the buffer-based method used in this analysis.

The approach to estimating calf:cow ratios based on relatively large survey sectors can be considered relatively coarse-scaled. In addition, estimating a BNE calf:cow ratio only from only three of eight survey sectors (or a Beverly ratio from only five of eight sectors) does not make use of the information from the other sectors. However, summing results across a larger area is less vulnerable to local variation in herd representation and variability in numbers of caribou associated with a single collar. In our experience in several fall and late-winter composition surveys of these three herds with varying degrees of mixing, the number of caribou associated with a single collared caribou varies widely, and there can be many caribou groups with no collar nearby. A single Bathurst collared cow may have several thousand caribou and many groups in its vicinity. In such a

situation, assuming these groups and thousands of caribou are most likely Bathurst because of a single Bathurst collar nearby is likely false, indicating one of the limitations of a fine-scale analysis.

In the end the ratio estimated for the Bluenose-East herd (40.9 calves:100 cows) was identical between the survey sector, individual group-based approach, and individual group-based approach with weightings = 1, suggesting that the BNE estimate was robust to how classification results were analysed.

The Beverly estimate (42.8 calves:100 cows) from the individual group-based approach was very similar to the estimate summed from fived mixed sectors (44.3), suggesting that these estimates were also robust to how the data were analysed. The Beverly herd dominated the weightings in the individual group-based approach when Beverly collars were present in the proximity of groups classified.

The Bathurst estimate (48.4 calves:100 cows) from the individual group-based approach was least reliable given that in most cases Bathurst caribou were swamped by other herds in composition groups. This was reflected in the very high variance around this estimate. We note that an estimate of 38.4 calves:100 cows (31.3, 46.9) was derived in fall 2022 (Adamczewski et al. 2023d) for the Bathurst herd based on two survey sectors. These sectors contained 23 of 35 female Bathurst collars and 11 of 18 male Bathurst collars available at the time, and included no BNE or Beverly collars. Confidence in this fall 2022 Bathurst ratio should be higher than any estimate from the March 2023 surveys for this herd. The ratio of 48.4 calves:100 cows from March 2023 appears questionable as an increase in calf:cow ratio from 38.4 to 48.4 over winter seems unlikely.

Overall, the calf:cow ratio across all survey sectors in March 2023 was 43.4 calves:100 cows (41.5, 45.4) and the range of estimated calf:cow ratios for the eight sectors was between 33.6 and 56.1 calves:100 cows. Calf:cow ratios in the range of 40:100 or higher can generally be considered healthy, although the calf:cow ratio associated with herd stability depends in part on the cow survival rate (Boulanger et al. 2011, Boulanger and Adamczewski 2016). For the Beverly (44.3 or 42.8) and BNE (40.9) herds, the estimates of calf:cow ratios have uncertainties associated with them, however, the overall results across the survey area and these herd-specific ratio estimates suggest healthy recruitment for the calf cohorts born to these two herds in 2022.

Locations and counts of individual caribou groups recorded during March 2023 composition surveys are listed in Appendix 1.

Regional Distribution of Cows, Calves, Young Bulls and Prime Bulls in March 2023

The regional distribution of cows, calves, young bulls and prime bulls in Figure 7 demonstrated some strong gradients, mostly in a north-south direction. Prime bulls were most concentrated at the southern end of the distribution and were more than half of all caribou classified in sector Mixed 4. Collared bulls of all three herds also tended to be concentrated at the southern end of the distribution. Prime bulls were scarce at the northern end of the distribution and were outnumbered by young bulls in all sectors except Mixed 4 and 5. Given the extensive mixing of three herds in

March 2023 and the mixing that began in the fall of 2022 and continued through winter 2022-2023, it is possible that the prime bulls from all three herds were concentrated at the south end of the distribution. It is also possible that other sex and age classes of all three herds also tended to congregate in similar areas, and potentially the distribution documented in Figure 7 represents a stratified distribution of sex and age classes from all three herds aggregating in similar areas distributed over a large winter landscape.

Bluenose-East Herd Calf:Cow Ratios

Late-winter calf:cow ratios in the Bluenose-East herd since 2008 have varied, with relatively high ratios mostly over 40 calves:100 cows 2008-2011, low-moderate ratios 2012-2018 when the herd was declining, then increased ratios starting in 2018 and ratios 2020-2023 over 40:100 (Figure 15). The March 2023 estimate was slightly lower than in 2021 and 2022, but overall continued a trend of healthy recruitment in the herd since 2020.
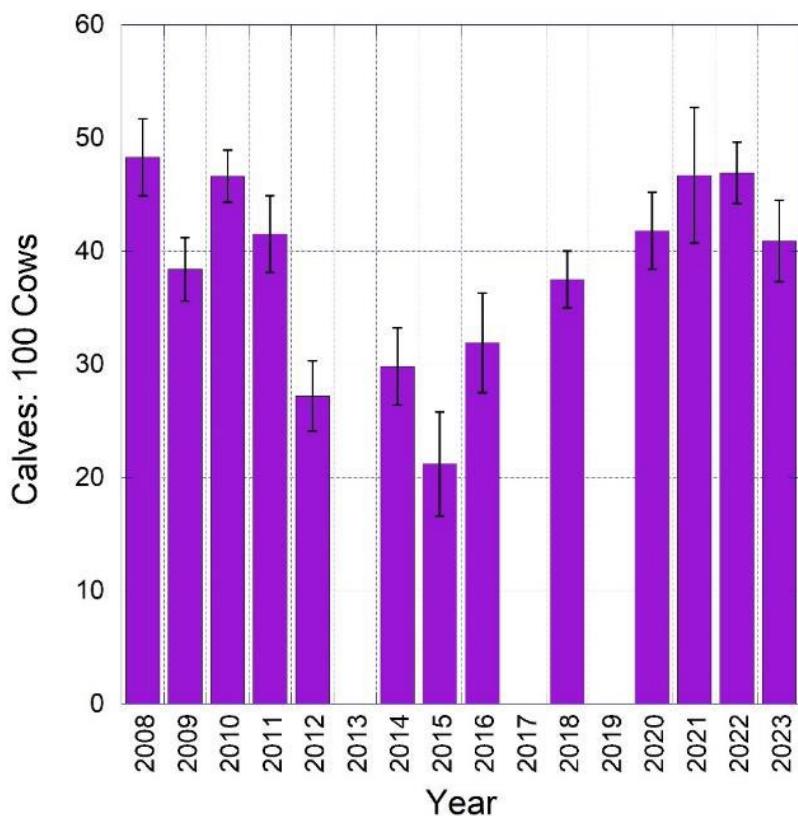
Figure 15. Late-winter calf:cow ratios (with 95% CIU) in the Bluenose-East caribou herd 2008-2023.

A fall 2022 composition survey of the BNE herd resulted in an estimated 52.3 calves:100 cows (48.5, 56.3) (Adamczewski et al. 2023d). In general, when calf:cow ratios in the BNE and Bathurst herds have been estimated in late October and then in March a few months later, the ratios have generally been similar or have shown a slight decrease (Adamczewski et al. 2023c). This suggested that over-winter mortality of Bathurst and BNE caribou calves was generally similar to that of adults, and that

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most calf mortality occurred between June and October (Adamczewski et al. 2023c). The reduction of BNE calf:cow ratio from October 2022 (52.3) to March 2023 (40.9) is somewhat higher than has generally been observed over this period. The fall 2022 BNE composition survey included a high proportion of available BNE collars and there were just two Bathurst collars in the BNE survey area, thus confidence in those results was relatively high. Collar mixing in March 2023 was much greater than in October 2022, thus confidence in the March 2023 calf:cow ratio is somewhat lower. Overall, the March 2023 BNE calf:cow ratio appears plausible, with the considerations noted earlier due to herd mixing.

Beverly Herd Calf Cow Ratios

Late winter calf:cow ratios in the Beverly herd have generally been above 40 calves:100 cows since 2008, and ratios 2020-2023 have all been over 40:100 (Figure 16). These ratios have been healthy and are a positive indicator for the herd's likely trend since the last population estimate in 2018.
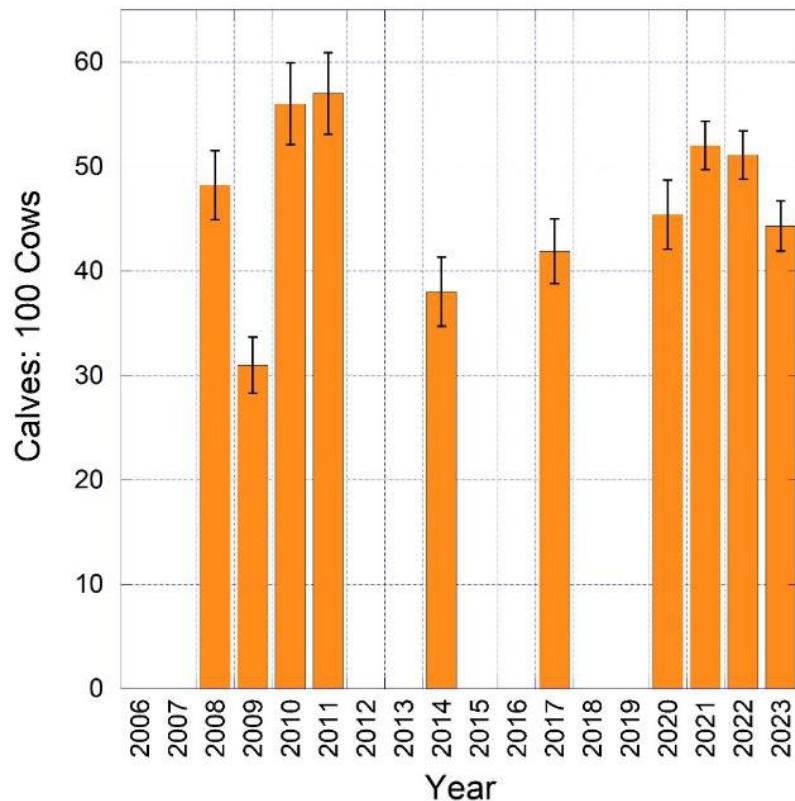
Figure 16. Late-winter calf:cow ratios (with 95%CIU) for the Beverly herd 2008-2023. Missing years of late-winter composition surveys mostly reflect the herd's remote and scattered winter distribution in those years.

A composition survey of the Beverly herd in fall 2022 resulted in an estimate of 46.5 calves:100 cows (43.8, 49.2) (Adamczewski et al. 2023d). Confidence in those results was relatively high based on coverage of available collars and limited mixing with the much smaller Bathurst herd (Adamczewski et al. 2023d). A small decrease of the calf-cow ratio between fall and late winter from

46.5 to 44.3 would be consistent with a small drop in calf-cow ratios documented in the Bathurst and BNE herds from fall to late winter (Adamczewski et al. 2023c). Fall composition surveys of the Beverly herd have been too infrequent to allow for a larger comparison of fall and late winter calf-cow ratios. A slightly lower ratio in March 2023 compared to October 2022 in the calf-cow ratio is plausible and suggests that the March 2023 Beverly calf-cow ratio is reliable, with the considerations noted earlier due to herd mixing.

ACKNOWLEDGEMENTS

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APPENDIX 1.

Observations of caribou groups on composition surveys of Bathurst, Bluenose-East and Beverly caribou in March 2023. Wpt = Waypoint Number. Survey sectors are as defined in Figure 5.

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
3/14/2023 6:08:51 PM	64.62179	-115.702609	89	Mixed1	0	0	1	10	11	11	
3/15/2023 9:43:59 AM	64.53671	-115.104741	90	Mixed1	0	0	5	7	12	12	
3/15/2023 9:44:19 AM	64.53618	-115.115675	91	Mixed1	1	0	2	0	2	3	
3/15/2023 9:44:54 AM	64.53395	-115.121938	92	Mixed1	0	0	0	2	2	2	
3/15/2023 9:45:26 AM	64.5348	-115.127747	93	Mixed1	0	0	1	0	1	1	
3/15/2023 9:49:30 AM	64.58851	-115.278666	94	Mixed1	2	1	2	1	3	6	
3/15/2023 9:51:31 AM	64.60068	-115.273804	95	Mixed1	5	4	4	0	4	13	
3/15/2023 9:53:28 AM	64.60858	-115.320188	96	Mixed1	0	0	1	4	5	5	
3/15/2023 9:57:47 AM	64.65748	-115.428077	97	Mixed1	2	2	2	0	2	6	
3/15/2023 9:59:51 AM	64.6552	-115.421247	98	Mixed1	16	11	14	2	16	43	
3/15/2023 10:00:20 AM	64.65469	-115.396711	99	Mixed1	6	3	2	0	2	11	
3/15/2023 10:02:05 AM	64.66203	-115.392027	100	Mixed1	6	4	8	2	10	20	
3/15/2023 10:06:10 AM	64.67554	-115.446942	101	Mixed1	11	1	22	10	32	44	collar cow
3/15/2023 10:09:01 AM	64.68708	-115.453766	102	Mixed1	6	5	19	1	20	31	
3/15/2023 10:09:35 AM	64.68557	-115.470859	103	Mixed1	0	0	1	4	5	5	
3/15/2023 10:10:20 AM	64.69068	-115.482171	104	Mixed1	1	1	0	0	0	2	
3/15/2023 10:12:23 AM	64.69935	-115.529983	105	Mixed1	0	0	1	8	9	9	
3/15/2023 10:16:05 AM	64.70836	-115.586173	106	Mixed1	4	1	1	0	1	6	
3/15/2023 10:18:46 AM	64.74032	-115.572545	107	Mixed1	1	1	0	0	0	2	
3/15/2023 10:19:00 AM	64.74288	-115.570522	108	Mixed1	4	1	1	0	1	6	
3/15/2023 10:19:54 AM	64.75397	-115.556937	109	Mixed1	1	0	0	0	0	1	
3/15/2023 10:23:43 AM	64.73747	-115.484723	110	Mixed1	7	3	5	1	6	16	
3/15/2023 10:29:31 AM	64.69534	-115.431249	112	Mixed1	2	1	0	0	0	3	
3/15/2023 10:32:06 AM	64.68912	-115.441581	113	Mixed1	1	1	15	8	23	25	
3/15/2023 10:37:03 AM	64.67945	-115.44202	114	Mixed1	3	2	9	4	13	18	
3/15/2023 10:37:06 AM	64.69371	-115.46844	115	Mixed1	0	0	1	3	4	4	
3/15/2023 10:39:46 AM	64.67887	-115.418824	116	Mixed1	0	0	1	4	5	5	
3/15/2023 10:44:59 AM	64.74165	-115.269045	117	Mixed1	8	1	9	0	9	18	
3/15/2023 10:46:54 AM	64.74292	-115.282711	118	Mixed1	11	1	10	1	11	23	
3/15/2023 10:47:08 AM	64.73876	-115.28686	119	Mixed1	5	3	2	0	2	10	
3/15/2023 10:53:27 AM	64.78272	-115.116922	120	Mixed1	27	13	14	2	16	56	
3/15/2023 10:56:47 AM	64.77704	-115.117113	121	Mixed1	27	11	8	0	8	46	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
3/15/2023 10:57:53 AM	64.77604	-115.138123	122	Mixed1	10	8	5	0	5	23	
3/15/2023 10:59:29 AM	64.77839	-115.142961	123	Mixed1	12	11	5	0	5	28	
3/15/2023 11:00:58 AM	64.78572	-115.125016	124	Mixed1	15	9	2	0	2	26	
3/15/2023 11:06:35 AM	64.87054	-115.291908	125	Mixed1	10	5	1	0	1	16	
3/15/2023 11:07:33 AM	64.8686	-115.301775	126	Mixed1	3	2	0	0	0	5	
3/15/2023 3:35:35 PM	64.33563	-115.046827	149	Mixed1	0	0	1	13	14	14	collar bull
13/03/2023 4:01:16 PM	64.64553	-111.693488	34	Mixed2	31	10	26	11	37	78	22117 Bat F
13/03/2023 4:05:21 PM	64.64592	-111.695806	36	Mixed2	16	6	9	3	12	34	
17/03/2023 6:05:21 PM	64.19648	-110.190139	50	Mixed2	8	2	0	0	0	10	
17/03/2023 6:06:03 PM	64.19513	-110.186967	52	Mixed2	5	4	0	2	2	11	
17/03/2023 6:10:40 PM	64.19318	-110.197839	53	Mixed2	13	5	4	0	4	22	
17/03/2023 6:11:50 PM	64.19216	-110.195457	54	Mixed2	15	6	6	0	6	27	
17/03/2023 6:14:42 PM	64.19028	-110.193709	55	Mixed2	42	17	11	2	13	72	
17/03/2023 6:16:53 PM	64.1886	-110.185831	56	Mixed2	14	7	0	0	0	21	
17/03/2023 6:17:48 PM	64.19199	-110.185927	57	Mixed2	9	5	3	0	3	17	
19/03/2023 11:03:08 AM	64.72456	-111.21999	71	Mixed2	27	12	6	0	6	45	
19/03/2023 11:05:10 AM	64.72844	-111.196146	72	Mixed2	27	16	10	1	11	54	
19/03/2023 11:07:44 AM	64.72888	-111.211096	73	Mixed2	20	12	5	1	6	38	
19/03/2023 11:08:59 AM	64.73214	-111.216295	74	Mixed2	20	6	5	3	8	34	
19/03/2023 11:10:04 AM	64.73454	-111.197755	75	Mixed2	11	4	5	0	5	20	
19/03/2023 11:12:26 AM	64.72688	-111.214497	76	Mixed2	3	3	13	7	20	26	
19/03/2023 11:14:15 AM	64.72645	-111.216721	77	Mixed2	25	12	4	2	6	43	
19/03/2023 11:30:35 AM	64.79124	-110.777099	79	Mixed2	0	0	3	16	19	19	
19/03/2023 11:35:31 AM	64.8401	-110.670751	80	Mixed2	5	8	1	0	1	14	
19/03/2023 11:41:10 AM	64.83958	-110.665043	81	Mixed2	2	4	0	0	0	7	
19/03/2023 11:43:06 AM	64.88033	-110.510822	82	Mixed2	23	11	14	0	14	48	
19/03/2023 11:44:13 AM	64.91204	-110.453257	83	Mixed2	13	4	6	0	6	23	
19/03/2023 11:36:59 AM	65.00431	-110.334391	84	Mixed2	0	0	0	0	0	1	
19/03/2023 11:50:48 AM	65.01363	-110.32233	86	Mixed2	2	1	4	11	15	18	
19/03/2023 11:46:14 AM	64.8788	-110.232688	87	Mixed2	0	0	0	0	0	1	
19/03/2023 11:59:46 AM	64.87868	-110.222097	89	Mixed2	1	1	3	9	12	14	
19/03/2023 12:12:21 PM	64.85776	-109.797754	90	Mixed2	66	30	21	2	23	119	
19/03/2023 12:14:14 PM	64.84945	-109.760315	91	Mixed2	23	10	5	4	9	42	
19/03/2023 12:02:03 PM	64.84438	-109.724172	92	Mixed2	12	3	2	1	3	18	
19/03/2023 12:15:46 PM	64.84893	-109.723459	93	Mixed2	14	5	6	1	7	26	
19/03/2023 12:16:54 PM	64.84512	-109.717787	94	Mixed2	21	9	6	0	6	36	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
19/03/2023 12:18:40 PM	64.83694	-109.698655	95	Mixed2	26	9	2	0	2	37	
19/03/2023 12:19:54 PM	64.82938	-109.690366	96	Mixed2	4	3	3	1	4	11	
19/03/2023 12:25:08 PM	64.75102	-109.567793	97	Mixed2	0	0	2	5	7	7	
19/03/2023 12:26:32 PM	64.74838	-109.577573	98	Mixed2	19	5	4	4	8	32	
19/03/2023 12:27:48 PM	64.74737	-109.58497	99	Mixed2	33	15	8	3	11	59	
19/03/2023 12:36:52 PM	64.7439	-109.466697	101	Mixed2	39	18	11	15	26	83	
19/03/2023 12:24:13 PM	64.74316	-109.42313	102	Mixed2	0	0	2	2	4	4	
19/03/2023 12:25:30 PM	64.76341	-109.419062	103	Mixed2	15	8	11	0	11	34	
19/03/2023 12:40:00 PM	64.73683	-109.423346	104	Mixed2	28	10	7	2	9	47	
19/03/2023 12:41:02 PM	64.73019	-109.416583	105	Mixed2	1	0	4	15	19	20	
19/03/2023 12:43:44 PM	64.74469	-109.425448	106	Mixed2	48	17	14	2	16	81	
19/03/2023 12:44:37 PM	64.74686	-109.433231	107	Mixed2	18	6	3	0	3	27	
19/03/2023 12:33:42 PM	64.76071	-109.431266	108	Mixed2	40	18	4	1	5	63	
19/03/2023 12:47:49 PM	64.76054	-109.428824	109	Mixed2	28	13	3	0	3	44	
19/03/2023 12:49:00 PM	64.7609	-109.43792	110	Mixed2	21	7	2	4	6	34	
19/03/2023 12:37:28 PM	64.76543	-109.451607	111	Mixed2	31	11	13	0	13	55	
19/03/2023 12:52:19 PM	64.76337	-109.418909	112	Mixed2	17	7	3	0	3	27	
19/03/2023 12:53:09 PM	64.7654	-109.418619	113	Mixed2	15	4	4	0	4	23	
19/03/2023 12:54:22 PM	64.77044	-109.405823	114	Mixed2	27	9	2	0	2	38	
19/03/2023 1:22:14 PM	64.68986	-109.408214	115	Mixed2	24	9	3	0	3	36	
19/03/2023 1:36:12 PM	64.69006	-109.407412	116	Mixed2	23	10	7	1	8	41	
19/03/2023 1:38:17 PM	64.69085	-109.388166	117	Mixed2	29	13	10	1	11	53	
19/03/2023 1:41:59 PM	64.69064	-109.374195	118	Mixed2	78	25	25	2	27	130	
19/03/2023 1:42:45 PM	64.68484	-109.33582	119	Mixed2	9	3	5	1	6	18	
19/03/2023 1:30:51 PM	64.68446	-109.345836	120	Mixed2	22	6	17	3	20	48	
19/03/2023 1:47:13 PM	64.67756	-109.344217	121	Mixed2	58	27	19	13	32	118	
19/03/2023 1:48:49 PM	64.67818	-109.352878	122	Mixed2	26	14	4	1	5	45	
19/03/2023 1:49:34 PM	64.68172	-109.338166	123	Mixed2	18	7	7	0	7	32	
19/03/2023 1:53:15 PM	64.68285	-109.356696	124	Mixed2	40	15	22	7	29	84	
19/03/2023 1:55:07 PM	64.68555	-109.373211	125	Mixed2	31	12	11	1	12	55	
19/03/2023 1:58:05 PM	64.66772	-109.345982	126	Mixed2	30	14	10	0	10	54	
19/03/2023 2:53:38 PM	64.41901	-110.109949	127	Mixed2	2	0	0	0	0	5	
19/03/2023 3:02:45 PM	64.38038	-110.060089	128	Mixed2	54	25	16	2	18	97	
19/03/2023 3:05:07 PM	64.37449	-110.05808	129	Mixed2	43	15	8	3	11	69	
19/03/2023 3:10:14 PM	64.37772	-110.063712	131	Mixed2	29	12	12	0	12	53	
19/03/2023 3:13:27 PM	64.35746	-110.039767	132	Mixed2	49	21	4	1	5	75	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
19/03/2023 3:14:49 PM	64.35315	-110.040154	133	Mixed2	38	11	7	0	7	56	
19/03/2023 3:16:43 PM	64.35243	-110.033454	134	Mixed2	31	6	11	1	12	49	
17/03/2023 5:58:05 PM	64.17753	-110.227726	515	Mixed2	0	0	7	30	37	37	
17/03/2023 6:00:32 PM	64.19212	-110.216477	516	Mixed2	4	2	4	26	30	36	
17/03/2023 6:02:44 PM	64.19355	-110.219467	517	Mixed2	18	12	12	16	28	58	
17/03/2023 6:03:30 PM	64.19182	-110.207732	518	Mixed2	5	2	0	0	0	7	
17/03/2023 6:04:18 PM	64.19311	-110.206581	519	Mixed2	23	5	4	0	4	32	
17/03/2023 6:05:04 PM	64.19657	-110.211347	520	Mixed2	2	2	2	1	3	7	
17/03/2023 6:05:54 PM	64.19776	-110.205236	521	Mixed2	5	1	2	0	2	8	
17/03/2023 6:09:53 PM	64.19705	-110.200199	522	Mixed2	26	8	10	0	10	44	
17/03/2023 6:11:41 PM	64.19226	-110.205427	523	Mixed2	16	8	14	2	16	40	
17/03/2023 6:12:14 PM	64.19283	-110.201631	524	Mixed2	10	5	5	0	5	20	
17/03/2023 6:13:47 PM	64.19302	-110.200364	525	Mixed2	34	12	7	3	10	56	
17/03/2023 3:23:28 PM	63.68295	-110.780642	484	Mixed3	38	16	22	24	46	100	
17/03/2023 3:28:41 PM	63.67949	-110.570492	485	Mixed3	12	8	6	3	9	29	
17/03/2023 3:35:47 PM	63.63659	-110.277095	486	Mixed3	4	0	0	0	0	4	
17/03/2023 3:37:23 PM	63.6378	-110.256908	487	Mixed3	7	2	1	0	1	10	
17/03/2023 3:40:53 PM	63.60348	-110.193186	488	Mixed3	0	0	3	14	17	17	
17/03/2023 3:42:39 PM	63.61037	-110.151535	489	Mixed3	2	2	7	0	7	11	
17/03/2023 3:43:08 PM	63.61325	-110.139859	490	Mixed3	8	4	5	4	9	22	
17/03/2023 3:47:33 PM	63.56639	-110.032843	491	Mixed3	3	2	0	0	0	5	
17/03/2023 3:48:38 PM	63.5713	-110.013277	492	Mixed3	4	3	1	6	7	14	
17/03/2023 3:50:49 PM	63.56273	-110.029932	493	Mixed3	4	4	4	13	17	25	
17/03/2023 3:51:38 PM	63.56069	-110.036639	494	Mixed3	7	5	3	4	7	19	
17/03/2023 3:52:03 PM	63.55961	-110.040672	495	Mixed3	5	3	3	0	3	11	
17/03/2023 3:58:14 PM	63.5831	-109.845851	496	Mixed3	13	8	9	8	17	38	
17/03/2023 3:58:27 PM	63.58429	-109.844981	497	Mixed3	0	0	2	4	6	6	
17/03/2023 4:00:40 PM	63.58712	-109.841784	498	Mixed3	8	3	8	17	25	36	
17/03/2023 4:03:10 PM	63.59888	-109.854847	499	Mixed3	21	12	23	5	28	61	
17/03/2023 4:04:11 PM	63.60402	-109.844869	500	Mixed3	11	6	3	0	3	20	
17/03/2023 4:07:33 PM	63.60922	-109.836906	501	Mixed3	33	12	23	15	38	84	
17/03/2023 4:13:56 PM	63.59737	-109.826353	502	Mixed3	24	11	20	5	25	60	
17/03/2023 4:16:08 PM	63.59228	-109.819407	503	Mixed3	10	4	16	25	41	55	
17/03/2023 4:20:06 PM	63.59786	-109.815782	504	Mixed3	33	23	27	4	31	87	
17/03/2023 4:20:53 PM	63.59654	-109.792444	505	Mixed3	6	3	9	0	9	18	
17/03/2023 4:22:06 PM	63.59574	-109.780367	506	Mixed3	6	3	8	1	9	18	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
17/03/2023 4:27:49 PM	63.67203	-109.849002	507	Mixed3	11	9	9	5	14	35	
17/03/2023 4:36:25 PM	63.79447	-109.923219	508	Mixed3	33	24	32	2	34	91	
17/03/2023 4:36:52 PM	63.79213	-109.938179	509	Mixed3	2	2	1	0	1	5	
17/03/2023 4:49:48 PM	64.01899	-109.74888	511	Mixed3	5	2	11	42	53	60	
17/03/2023 4:51:25 PM	64.03415	-109.763561	512	Mixed3	0	0	6	29	35	35	
17/03/2023 4:53:31 PM	64.03986	-109.76253	513	Mixed3	7	5	18	20	38	50	
17/03/2023 4:54:40 PM	64.04422	-109.753636	514	Mixed3	4	4	13	5	18	26	
16/03/2023 2:47:38 PM	63.58764	-112.17554	350	Mixed4	7	6	0	0	0	13	
16/03/2023 2:50:06 PM	63.56897	-112.172811	351	Mixed4	1	0	0	4	4	5	
16/03/2023 2:51:06 PM	63.57164	-112.166835	352	Mixed4	4	2	5	13	18	24	collar cow scattered low #s
16/03/2023 2:52:03 PM	63.5723	-112.157706	353	Mixed4	3	2	3	7	10	15	
16/03/2023 2:52:21 PM	63.57249	-112.15272	354	Mixed4	0	0	0	9	9	9	
16/03/2023 2:54:54 PM	63.57242	-112.112138	355	Mixed4	4	3	4	0	4	11	
16/03/2023 2:55:17 PM	63.57377	-112.106245	356	Mixed4	6	6	7	0	7	19	
16/03/2023 2:56:24 PM	63.56742	-112.108703	357	Mixed4	2	0	1	0	1	3	
16/03/2023 3:04:01 PM	63.63576	-111.898185	358	Mixed4	2	0	2	1	3	5	collar cow few grps small
16/03/2023 3:04:21 PM	63.6371	-111.900345	359	Mixed4	7	2	2	0	2	11	
16/03/2023 3:10:35 PM	63.56411	-111.85263	360	Mixed4	3	3	1	0	1	7	
16/03/2023 3:16:23 PM	63.55331	-111.846123	363	Mixed4	0	0	2	18	20	20	
16/03/2023 3:31:30 PM	63.48272	-111.364927	366	Mixed4	0	0	2	23	25	25	
16/03/2023 3:36:01 PM	63.4584	-111.169193	367	Mixed4	0	0	0	3	3	3	
16/03/2023 3:38:16 PM	63.44673	-111.145175	368	Mixed4	1	0	2	5	7	8	collar cow
16/03/2023 3:39:30 PM	63.44583	-111.121662	369	Mixed4	13	6	7	1	8	27	
16/03/2023 3:40:13 PM	63.44733	-111.112914	371	Mixed4	2	1	1	5	6	9	
16/03/2023 3:41:48 PM	63.44768	-111.111218	372	Mixed4	17	9	12	1	13	39	
16/03/2023 3:43:26 PM	63.44994	-111.093166	373	Mixed4	0	0	3	20	23	23	
16/03/2023 3:45:39 PM	63.44339	-111.096901	374	Mixed4	3	2	17	4	21	26	
16/03/2023 3:46:26 PM	63.45944	-111.104249	375	Mixed4	1	1	2	5	7	9	
16/03/2023 3:47:18 PM	63.45908	-111.095419	376	Mixed4	2	2	6	14	20	24	
16/03/2023 3:48:25 PM	63.45983	-111.090005	377	Mixed4	4	3	3	7	10	17	
16/03/2023 3:48:56 PM	63.46372	-111.078074	378	Mixed4	13	6	1	0	1	20	
16/03/2023 3:50:34 PM	63.46572	-111.071563	379	Mixed4	6	2	4	0	4	12	
16/03/2023 3:51:15 PM	63.45862	-111.070884	380	Mixed4	3	2	0	0	0	5	
16/03/2023 3:51:37 PM	63.45839	-111.067655	381	Mixed4	6	4	1	0	1	11	
16/03/2023 3:56:28 PM	63.4585	-111.06749	382	Mixed4	8	4	15	14	29	41	
16/03/2023 3:57:23 PM	63.4585	-110.949393	383	Mixed4	9	5	13	13	26	40	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
16/03/2023 4:05:20 PM	63.45699	-110.932335	384	Mixed4	36	12	28	16	44	92	
16/03/2023 4:07:13 PM	63.42203	-110.950249	385	Mixed4	3	1	3	16	19	23	
16/03/2023 4:08:13 PM	63.41789	-110.981546	386	Mixed4	2	0	8	11	19	21	
16/03/2023 4:11:18 PM	63.41568	-110.991204	387	Mixed4	0	0	3	12	15	15	
16/03/2023 4:13:07 PM	63.41352	-111.062351	388	Mixed4	6	3	8	16	24	33	
16/03/2023 4:14:17 PM	63.41732	-111.090467	389	Mixed4	0	0	1	16	17	17	
16/03/2023 4:14:39 PM	63.41897	-111.078997	390	Mixed4	0	0	2	16	18	18	
16/03/2023 4:16:51 PM	63.41881	-111.076068	391	Mixed4	9	8	7	41	48	65	
16/03/2023 4:19:13 PM	63.40568	-111.087992	392	Mixed4	1	2	11	26	37	40	
16/03/2023 4:21:44 PM	63.39094	-111.089298	393	Mixed4	0	0	4	15	19	19	
16/03/2023 4:23:05 PM	63.39477	-111.16476	394	Mixed4	0	0	12	11	23	23	
16/03/2023 4:24:46 PM	63.40564	-111.183119	395	Mixed4	0	0	3	11	14	14	
16/03/2023 4:28:12 PM	63.40179	-111.205166	396	Mixed4	9	5	25	31	56	70	
16/03/2023 4:30:27 PM	63.40495	-111.333441	398	Mixed4	12	3	6	0	6	21	
16/03/2023 4:33:38 PM	63.42473	-111.310096	400	Mixed4	13	6	3	0	3	22	
16/03/2023 5:48:10 PM	63.42325	-111.288696	401	Mixed4	8	7	0	0	0	15	
16/03/2023 6:01:14 PM	63.59733	-112.230809	402	Mixed4	0	0	6	8	14	14	near winter road
16/03/2023 6:03:36 PM	63.50602	-112.322035	403	Mixed4	10	4	8	8	16	30	
16/03/2023 6:06:08 PM	63.502	-112.294029	404	Mixed4	4	0	6	0	6	10	
16/03/2023 6:08:38 PM	63.49876	-112.347181	405	Mixed4	11	5	2	0	2	18	
16/03/2023 6:08:53 PM	63.50703	-112.363411	406	Mixed4	2	1	0	0	0	3	
16/03/2023 6:12:50 PM	63.50593	-112.364043	407	Mixed4	6	4	6	0	6	16	
16/03/2023 6:13:41 PM	63.46472	-112.44747	408	Mixed4	1	2	1	0	1	4	
16/03/2023 6:18:28 PM	63.46111	-112.442704	409	Mixed4	0	0	0	4	4	4	
17/03/2023 12:01:39 PM	63.46019	-112.098884	420	Mixed4	0	0	8	14	22	22	
17/03/2023 12:16:54 PM	63.24428	-112.232976	422	Mixed4	0	0	1	7	8	8	
17/03/2023 12:18:02 PM	63.23534	-112.221106	423	Mixed4	0	0	0	15	15	15	
17/03/2023 12:19:30 PM	63.23606	-112.207857	424	Mixed4	0	0	3	50	53	53	
17/03/2023 12:20:30 PM	63.23076	-112.207838	425	Mixed4	1	1	1	6	7	9	
17/03/2023 12:20:49 PM	63.2301	-112.207184	426	Mixed4	0	0	0	8	8	8	
17/03/2023 12:21:47 PM	63.22438	-112.217121	427	Mixed4	0	0	1	10	11	11	
17/03/2023 12:22:55 PM	63.22487	-112.222501	428	Mixed4	0	0	3	36	39	39	
17/03/2023 12:25:09 PM	63.23525	-112.219125	429	Mixed4	0	0	0	15	15	15	
17/03/2023 12:26:12 PM	63.23843	-112.237322	430	Mixed4	0	0	1	6	7	7	
17/03/2023 12:30:51 PM	63.23823	-112.218878	431	Mixed4	0	0	3	19	22	22	
17/03/2023 12:36:25 PM	63.2356	-112.011945	432	Mixed4	0	0	3	4	7	7	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
17/03/2023 12:38:08 PM	63.23511	-112.008305	433	Mixed4	0	0	7	14	21	21	
17/03/2023 12:39:09 PM	63.23235	-111.986798	434	Mixed4	0	0	2	17	19	19	
17/03/2023 12:46:52 PM	63.30563	-111.93037	435	Mixed4	0	0	23	42	65	65	
17/03/2023 12:47:39 PM	63.30718	-111.934231	436	Mixed4	0	0	0	9	9	9	
17/03/2023 12:48:13 PM	63.3098	-111.932536	437	Mixed4	0	0	4	14	18	18	
17/03/2023 12:49:24 PM	63.30808	-111.915586	438	Mixed4	4	2	2	0	2	8	
17/03/2023 12:49:44 PM	63.30656	-111.913132	440	Mixed4	0	0	1	7	8	8	
17/03/2023 12:54:41 PM	63.29897	-111.913676	441	Mixed4	3	3	17	34	51	57	
17/03/2023 12:55:30 PM	63.30022	-111.841623	442	Mixed4	0	0	6	13	19	19	
17/03/2023 12:56:51 PM	63.29877	-111.837203	443	Mixed4	4	4	12	14	26	34	
17/03/2023 12:59:14 PM	63.29382	-111.83199	444	Mixed4	4	2	24	13	37	43	
17/03/2023 12:59:49 PM	63.29667	-111.819354	445	Mixed4	1	0	10	18	28	29	
17/03/2023 1:01:45 PM	63.29363	-111.840344	446	Mixed4	3	1	7	21	28	32	
17/03/2023 1:03:02 PM	63.29764	-111.802473	447	Mixed4	0	0	1	7	8	8	
17/03/2023 1:03:50 PM	63.30171	-111.791623	448	Mixed4	0	0	1	7	8	8	
17/03/2023 1:04:04 PM	63.30212	-111.79077	449	Mixed4	0	0	1	3	4	4	
17/03/2023 1:05:35 PM	63.3034	-111.783267	451	Mixed4	0	0	12	5	17	17	
17/03/2023 1:06:34 PM	63.30259	-111.760781	452	Mixed4	0	0	1	7	8	8	
17/03/2023 1:07:47 PM	63.30692	-111.75404	453	Mixed4	0	0	4	19	23	23	
17/03/2023 1:07:58 PM	63.30871	-111.752645	454	Mixed4	0	0	0	5	5	5	
17/03/2023 1:08:55 PM	63.30951	-111.750984	455	Mixed4	0	0	11	26	37	37	
17/03/2023 1:10:11 PM	63.31034	-111.74462	456	Mixed4	5	2	10	17	27	34	
17/03/2023 1:12:43 PM	63.312	-111.732644	457	Mixed4	1	0	13	16	29	30	
17/03/2023 1:15:08 PM	63.31356	-111.736718	458	Mixed4	1	0	0	5	5	6	
17/03/2023 1:16:13 PM	63.32849	-111.779479	459	Mixed4	0	0	3	9	12	12	
17/03/2023 1:20:02 PM	63.32766	-111.877895	460	Mixed4	6	3	12	3	15	24	
17/03/2023 1:21:26 PM	63.32948	-111.871321	461	Mixed4	0	0	0	9	9	9	
17/03/2023 1:21:42 PM	63.32876	-111.874219	462	Mixed4	0	0	0	4	4	4	
17/03/2023 1:22:53 PM	63.32321	-111.901458	463	Mixed4	0	0	0	6	6	6	
17/03/2023 1:23:49 PM	63.32264	-111.903699	464	Mixed4	2	1	3	14	17	20	
17/03/2023 1:25:37 PM	63.32674	-111.920489	465	Mixed4	4	1	8	7	15	20	
17/03/2023 1:29:14 PM	63.31347	-111.964196	466	Mixed4	0	0	3	25	28	28	
17/03/2023 1:29:17 PM	63.31332	-111.962296	467	Mixed4	0	0	0	6	6	6	
17/03/2023 1:30:52 PM	63.31768	-111.95376	468	Mixed4	0	0	0	12	12	12	
17/03/2023 1:32:16 PM	63.31908	-111.9532	469	Mixed4	0	0	2	34	36	36	
17/03/2023 1:35:57 PM	63.34682	-111.948825	471	Mixed4	1	0	3	5	8	9	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
17/03/2023 1:36:42 PM	63.34917	-111.945494	472	Mixed4	2	2	0	0	0	4	
17/03/2023 1:37:28 PM	63.35299	-111.931042	473	Mixed4	0	0	1	1	2	2	
17/03/2023 1:39:51 PM	63.35244	-111.892105	474	Mixed4	0	0	3	8	11	11	
17/03/2023 1:40:33 PM	63.35637	-111.875775	475	Mixed4	0	0	1	3	4	4	
17/03/2023 1:40:52 PM	63.35656	-111.874886	476	Mixed4	0	0	2	3	5	5	
17/03/2023 1:41:36 PM	63.35742	-111.869017	477	Mixed4	1	1	2	8	10	12	
17/03/2023 1:45:09 PM	63.37173	-111.886355	478	Mixed4	0	0	2	10	12	12	
17/03/2023 1:45:38 PM	63.37759	-111.860838	479	Mixed4	1	1	3	10	13	15	
17/03/2023 2:46:46 PM	63.68678	-111.815609	480	Mixed4	2	0	3	0	3	5	
17/03/2023 2:53:42 PM	63.73425	-111.578734	481	Mixed4	8	2	3	3	6	16	
17/03/2023 3:04:14 PM	63.7385	-111.319907	482	Mixed4	7	3	12	17	29	39	21177
17/03/2023 3:05:28 PM	63.73404	-111.321636	483	Mixed4	7	4	0	0	0	11	
13/03/2023 11:14:42 AM	63.73975	-114.192335	2	Mixed5	1	1	1	0	1	3	
13/03/2023 11:16:21 AM	63.74245	-114.167926	3	Mixed5	1	0	2	8	10	11	
13/03/2023 11:17:07 AM	63.74582	-114.155721	4	Mixed5	0	0	0	1	1	1	
13/03/2023 11:17:22 AM	63.74582	-114.144873	5	Mixed5	0	0	0	2	2	2	
13/03/2023 11:20:08 AM	63.7438	-114.063511	6	Mixed5	0	0	0	16	16	16	
13/03/2023 11:25:52 AM	63.73435	-113.820779	7	Mixed5	0	0	0	10	10	10	near BNE collar
13/03/2023 11:30:17 AM	63.74177	-113.632289	8	Mixed5	0	0	5	13	18	18	
13/03/2023 11:31:58 AM	63.74717	-113.590251	9	Mixed5	0	0	1	20	21	21	BNE bull collar
13/03/2023 11:33:10 AM	63.74852	-113.565843	10	Mixed5	4	0	5	6	11	15	
13/03/2023 11:36:12 AM	63.73232	-113.502109	11	Mixed5	0	0	0	6	6	6	
13/03/2023 11:52:23 AM	63.72711	-113.420773	12	Mixed5	0	0	0	16	16	16	
13/03/2023 11:40:23 AM	63.74245	-113.418034	13	Mixed5	0	0	0	8	8	8	
13/03/2023 11:40:47 AM	63.73907	-113.407186	14	Mixed5	0	0	0	4	4	4	
13/03/2023 11:40:56 AM	63.73975	-113.393625	15	Mixed5	0	0	0	1	1	1	
13/03/2023 11:43:30 AM	63.69926	-113.336671	16	Mixed5	0	0	3	5	8	8	
13/03/2023 12:07:56 PM	63.80448	-113.220616	17	Mixed5	0	0	0	6	6	6	
13/03/2023 11:55:47 PM	63.89293	-113.126485	18	Mixed5	0	0	4	7	11	11	
13/03/2023 11:56:36 PM	63.88618	-113.156318	19	Mixed5	0	0	1	3	4	4	
13/03/2023 12:18:17 PM	63.95252	-113.439029	20	Mixed5	0	0	1	14	15	15	
13/03/2023 12:19:34 PM	63.9541	-113.440482	21	Mixed5	0	1	3	5	8	9	
13/03/2023 12:32:10 PM	63.89728	-113.91719	22	Mixed5	1	1	3	20	23	25	
13/03/2023 12:33:44 PM	63.89439	-113.927882	23	Mixed5	0	0	3	19	22	22	
13/03/2023 12:34:24 PM	63.89659	-113.939011	24	Mixed5	1	0	3	0	3	4	
13/03/2023 12:21:47 PM	63.88753	-114.030965	25	Mixed5	3	1	0	0	0	4	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
13/03/2023 12:35:25 PM	63.89792	-113.953992	26	Mixed5	0	0	3	6	9	9	
13/03/2023 12:23:46 PM	63.89697	-113.944179	27	Mixed5	0	0	3	1	4	4	
13/03/2023 12:40:04 PM	63.88407	-114.050392	28	Mixed5	10	6	6	0	6	22	
13/03/2023 12:47:46 PM	63.84893	-114.118925	30	Mixed5	3	0	3	4	7	10	
13/03/2023 12:49:27 PM	63.84885	-114.110023	31	Mixed5	5	2	2	8	10	17	
13/03/2023 12:53:55 PM	63.9293	-114.047928	32	Mixed5	0	0	0	13	13	13	
13/03/2023 3:32:58 PM	64.4557	-112.179966	33	Mixed5	0	0	0	1	1	1	
13/03/2023 3:51:01 PM	64.64616	-111.920092	35	Mixed5	22	7	4	2	6	35	large group near 22117
13/03/2023 4:40:03 PM	64.70808	-113.469564	37	Mixed5	0	0	9	6	15	15	
13/03/2023 4:56:49 PM	64.72176	-112.702258	38	Mixed5	48	16	8	5	13	77	
13/03/2023 4:59:27 PM	64.71685	-113.50957	39	Mixed5	66	21	13	0	13	100	
13/03/2023 5:02:31 PM	64.71239	-113.529907	40	Mixed5	22	9	0	0	0	31	near 21169
13/03/2023 4:51:46 PM	64.71887	-113.597032	41	Mixed5	19	6	3	0	3	28	
13/03/2023 5:24:20 PM	64.41162	-113.662227	42	Mixed5	4	3	0	0	0	7	
13/03/2023 5:11:50 PM	64.41724	-113.663478	43	Mixed5	2	1	0	0	0	3	
13/03/2023 5:26:48 PM	64.41736	-113.680098	44	Mixed5	6	2	1	2	3	11	
13/03/2023 5:27:17 PM	64.41799	-113.673165	45	Mixed5	3	2	0	0	0	5	
13/03/2023 5:23:19 PM	64.31805	-113.841119	47	Mixed5	5	3	0	0	0	8	21164
13/03/2023 5:25:27 PM	64.32952	-113.79637	48	Mixed5	0	0	4	8	12	12	21164
13/03/2023 5:38:56 PM	64.32973	-113.795971	49	Mixed5	2	2	2	7	9	13	
19/03/2023 9:17:25 AM	64.23896	-113.975298	59	Mixed5	0	0	0	8	8	8	
19/03/2023 9:18:54 AM	64.40841	-113.627289	60	Mixed5	0	0	0	3	3	3	
19/03/2023 9:20:02 AM	64.40645	-113.651733	61	Mixed5	5	3	0	0	0	8	
19/03/2023 9:21:49 AM	64.40822	-113.662085	62	Mixed5	3	3	1	0	1	7	
19/03/2023 9:23:17 AM	64.41944	-113.652919	63	Mixed5	2	1	2	0	2	5	
19/03/2023 9:28:32 AM	64.45861	-113.60064	64	Mixed5	3	4	3	0	3	10	
19/03/2023 9:29:17 AM	64.46114	-113.596135	65	Mixed5	4	0	4	0	4	8	
19/03/2023 9:34:13 AM	64.5138	-113.390543	66	Mixed5	7	6	1	0	1	14	
19/03/2023 9:34:31 AM	64.51376	-113.390018	67	Mixed5	2	2	1	0	1	5	
19/03/2023 9:48:43 AM	64.62352	-112.953549	68	Mixed5	59	26	19	0	19	104	
19/03/2023 09:57:34 AM	64.84303	-111.994188	69	Mixed5	0	1	0	0	0	1	
19/03/2023 2:42:12 PM	64.23115	-113.051388	130	Mixed5	60	21	17	0	17	98	
3/15/2023 4:35:36 PM	64.03841	-113.935089	150	Mixed5	0	0	3	2	5	5	
3/15/2023 5:11:47 PM	64.03952	-113.950545	151	Mixed5	0	0	3	2	5	5	
3/15/2023 5:29:39 PM	63.96722	-113.570365	152	Mixed5	0	0	5	1	6	6	
16/03/2023 1:44:39 PM	64.18714	-114.060798	347	Mixed5	0	0	2	25	27	27	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
16/03/2023 2:21:39 PM	63.71305	-112.45314	349	Mixed5	2	0	8	7	15	17	
17/03/2023 10:24:49 AM	64.15481	-113.96509	411	Mixed5	1	1	1	9	10	12	
17/03/2023 10:39:08 AM	63.99897	-113.258587	412	Mixed5	0	0	2	10	12	12	
17/03/2023 10:41:16 AM	63.99815	-113.22423	413	Mixed5	0	0	1	22	23	23	bull colllar
17/03/2023 10:41:36 AM	64.00245	-113.213692	414	Mixed5	0	0	1	2	3	3	
17/03/2023 10:41:40 AM	64.00294	-113.21047	415	Mixed5	0	0	0	1	1	1	
17/03/2023 10:43:30 AM	64.01149	-113.153575	416	Mixed5	0	0	3	4	7	7	
17/03/2023 10:48:08 AM	64.02129	-113.039283	418	Mixed5	0	0	3	2	5	5	
17/03/2023 11:15:19 AM	63.8433	-112.464791	419	Mixed5	0	0	2	22	24	24	
3/14/2023 2:21:18 PM	65.86047	-115.474296	44	BNE1	16	8	3	0	3	27	
3/14/2023 2:22:27 PM	65.86532	-115.490219	45	BNE1	16	4	1	1	2	22	
3/14/2023 2:23:13 PM	65.8699	-115.493627	46	BNE1	2	1	1	0	1	4	
3/14/2023 2:25:00 PM	65.87298	-115.508613	47	BNE1	29	8	1	0	1	38	
3/14/2023 2:27:27 PM	65.87082	-115.519721	48	BNE1	35	17	2	3	5	57	
3/14/2023 2:32:07 PM	65.9234	-115.569877	50	BNE1	33	11	2	0	2	46	
3/14/2023 2:34:42 PM	65.92441	-115.584504	51	BNE1	10	2	2	0	2	14	
3/14/2023 2:35:24 PM	65.94704	-115.605959	52	BNE1	7	5	0	0	0	12	
3/14/2023 2:36:54 PM	65.94688	-115.609486	53	BNE1	19	6	0	0	0	25	
3/14/2023 2:38:37 PM	65.95196	-115.619526	54	BNE1	23	3	2	0	2	28	
3/14/2023 2:39:17 PM	65.95325	-115.589976	55	BNE1	9	4	0	0	0	13	
3/14/2023 2:40:18 PM	65.95011	-115.598204	56	BNE1	5	5	2	0	2	12	
3/14/2023 2:41:54 PM	65.94811	-115.60634	57	BNE1	23	8	4	0	4	35	
3/14/2023 2:50:24 PM	65.8711	-115.753242	59	BNE1	32	8	11	0	11	51	
3/14/2023 2:51:56 PM	65.85226	-115.80156	60	BNE1	4	1	1	0	1	6	
3/14/2023 3:04:29 PM	65.85535	-115.801772	61	BNE1	9	5	1	0	1	15	
3/14/2023 3:05:15 PM	65.75413	-116.287143	62	BNE1	4	1	2	0	2	7	
3/14/2023 3:05:58 PM	65.75196	-116.279829	63	BNE1	2	1	0	0	0	3	
3/14/2023 3:11:48 PM	65.74909	-116.274206	64	BNE1	0	0	3	0	3	3	
3/14/2023 3:19:46 PM	65.64684	-116.196555	65	BNE1	14	7	0	0	0	21	
3/14/2023 3:20:30 PM	65.72017	-115.970522	66	BNE1	5	3	1	0	1	9	
3/14/2023 3:23:50 PM	65.7224	-115.971292	67	BNE1	21	9	1	0	1	31	
3/14/2023 3:29:55 PM	65.7472	-115.938828	68	BNE1	18	8	0	1	1	27	
3/14/2023 3:32:21 PM	65.73383	-115.689902	69	BNE1	28	8	10	1	11	47	
3/14/2023 3:32:50 PM	65.72401	-115.65829	70	BNE1	5	4	2	0	2	11	
3/14/2023 3:33:14 PM	65.72618	-115.652329	71	BNE1	4	2	0	0	0	6	
3/14/2023 3:34:44 PM	65.72667	-115.650164	72	BNE1	22	11	7	0	7	40	

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
3/14/2023 3:37:05 PM	65.71791	-115.647917	73	BNE1	43	16	5	0	5	64	
3/14/2023 3:38:10 PM	65.72888	-115.634607	74	BNE1	7	2	1	0	1	10	
3/14/2023 3:40:48 PM	65.71814	-115.62438	75	BNE1	16	8	2	0	2	26	
3/14/2023 3:43:47 PM	65.70584	-115.604658	76	BNE1	45	21	16	2	18	84	
3/14/2023 3:50:19 PM	65.70735	-115.640468	77	BNE1	4	2	0	0	0	6	
3/14/2023 3:53:05 PM	65.60184	-115.789638	78	BNE1	27	13	5	0	5	45	
3/14/2023 4:01:55 PM	65.59129	-115.791821	79	BNE1	17	7	5	0	5	29	2 collar cows 1 antl 1 no antl maybe 20
3/14/2023 4:03:19 PM	65.49394	-115.397007	80	BNE1	2	1	5	0	5	8	
3/14/2023 4:52:47 PM	65.48854	-115.388647	81	BNE1	15	3	5	0	5	23	
3/14/2023 4:55:37 PM	65.31276	-115.929243	82	BNE1	2	0	1	0	1	3	
3/14/2023 4:58:39 PM	65.28177	-115.994876	83	BNE1	15	3	7	0	7	25	
3/14/2023 5:00:25 PM	65.263	-115.904342	84	BNE1	8	4	1	0	1	13	
3/14/2023 5:02:40 PM	65.26505	-115.893321	85	BNE1	16	10	2	0	2	28	collar cow calf collar bull group 20
3/14/2023 5:03:11 PM	65.27286	-115.858404	86	BNE1	0	0	0	3	3	3	
3/14/2023 10:50:06 AM	65.31063	-113.205393	1	BNE2	17	9	8	0	8	34	
3/14/2023 10:50:45 AM	65.31391	-113.21514	2	BNE2	6	3	4	0	4	13	1000s scattered BNE cow 21180 big calves wpts 1-10 same area
3/14/2023 10:51:57 AM	65.31761	-113.209316	3	BNE2	17	4	7	0	7	28	
3/14/2023 10:53:50 AM	65.3148	-113.206231	4	BNE2	8	4	8	3	11	23	
3/14/2023 10:55:28 AM	65.31235	-113.209982	5	BNE2	9	5	4	6	10	24	
3/14/2023 10:56:41 AM	65.31888	-113.225275	6	BNE2	11	9	2	0	2	22	
3/14/2023 10:57:20 AM	65.32147	-113.230106	7	BNE2	17	7	1	0	1	25	
3/14/2023 10:58:12 AM	65.325	-113.231287	8	BNE2	9	1	1	0	1	11	
3/14/2023 10:59:02 AM	65.32582	-113.230092	9	BNE2	13	5	3	0	3	21	
3/14/2023 11:00:29 AM	65.32308	-113.226083	10	BNE2	7	3	0	0	0	10	
3/14/2023 11:02:21 AM	65.32754	-113.245689	11	BNE2	10	5	2	0	2	17	
3/14/2023 11:11:52 AM	65.29683	-113.531308	14	BNE2	21	8	2	7	9	38	
3/14/2023 11:12:38 AM	65.29648	-113.575026	15	BNE2	13	6	3	0	3	22	Bat cow collar 22119 not seen small group
3/14/2023 11:25:18 AM	65.33723	-113.579398	17	BNE2	1	2	0	0	0	3	
3/14/2023 11:25:56 AM	65.61154	-113.63178	18	BNE2	4	2	10	2	12	18	
3/14/2023 11:26:27 AM	65.61527	-113.628559	19	BNE2	3	1	3	0	3	7	
3/14/2023 11:28:02 AM	65.61651	-113.619791	20	BNE2	7	3	0	0	0	10	
3/14/2023 11:37:32 AM	65.60606	-113.646594	21	BNE2	19	6	7	0	7	32	
3/14/2023 11:38:04 AM	65.76433	-113.618923	23	BNE2	2	2	0	0	0	4	
3/14/2023 11:39:04 AM	65.7622	-113.61416	24	BNE2	5	3	1	0	1	9	BNE cow 21728 not seen 50 or less
3/14/2023 11:42:40 AM	65.76212	-113.611009	25	BNE2	2	1	0	0	0	3	
3/14/2023 11:51:46 AM	65.71379	-113.726081	26	BNE2	13	8	1	4	5	26	little sign small grp

Date Time	Lat deg	Long deg	Wpt	Sector	Cows	Calves	Young Bulls	Prime Bulls	Bulls Total	All Total	Notes
3/14/2023 12:04:22 PM	65.73797	-114.144145	27	BNE2	25	12	2	0	2	39	
3/14/2023 12:06:26 PM	66.01576	-114.325368	28	BNE2	18	6	1	0	1	25	
3/14/2023 12:13:01 PM	66.03173	-114.328876	29	BNE2	5	3	0	0	0	8	
3/14/2023 12:29:50 PM	65.97763	-114.067302	30	BNE2	20	11	1	0	1	32	
3/14/2023 12:30:53 PM	65.78357	-113.230365	31	BNE2	22	11	4	0	4	37	
3/14/2023 12:32:26 PM	65.78797	-113.229401	32	BNE2	18	9	3	0	3	30	
3/14/2023 12:33:47 PM	65.78787	-113.20597	33	BNE2	17	7	2	0	2	26	1000 or so east of BNE 21728 could be BNE
3/14/2023 12:35:46 PM	65.79002	-113.180579	34	BNE2	23	6	4	0	4	33	NA
3/14/2023 2:01:43 PM	65.7793	-114.789057	36	BNE2	6	6	5	0	5	17	NA
3/14/2023 2:01:53 PM	65.77407	-114.919729	37	BNE2	0	0	3	0	3	3	NA
3/14/2023 2:07:18 PM	65.7743	-114.918969	38	BNE2	17	6	8	0	8	31	NA
3/14/2023 2:08:02 PM	65.77747	-115.034345	39	BNE2	13	4	3	0	3	20	BNE 20230 in area small groups less than 20
3/14/2023 2:09:56 PM	65.77544	-115.026005	40	BNE2	5	1	0	0	0	6	
3/14/2023 2:11:05 PM	65.77943	-115.051409	41	BNE2	7	5	0	0	0	12	
3/14/2023 2:11:38 PM	65.77967	-115.068921	42	BNE2	3	2	2	0	2	7	
3/14/2023 2:20:13 PM	65.77488	-115.067269	43	BNE2	1	2	0	0	0	3	
3/15/2023 11:18:07 AM	64.87512	-115.698835	127	BNE3	2	1	4	2	6	9	
3/15/2023 11:21:08 AM	64.87717	-115.7777	128	BNE3	1	0	3	1	4	5	
3/15/2023 11:24:04 AM	64.8908	-115.830646	129	BNE3	3	1	0	0	0	4	near 21719 collar cow w calf
3/15/2023 11:26:11 AM	64.89576	-115.837246	130	BNE3	4	1	0	0	0	5	
3/15/2023 11:26:48 AM	64.89523	-115.842475	131	BNE3	2	1	0	0	0	3	
3/15/2023 11:28:06 AM	64.89246	-115.83959	132	BNE3	0	0	1	1	2	2	
3/15/2023 11:33:28 AM	64.9284	-115.680272	133	BNE3	17	9	4	2	6	32	
3/15/2023 11:35:43 AM	64.93447	-115.635615	134	BNE3	2	0	5	0	5	7	
3/15/2023 11:36:56 AM	64.94077	-115.639161	135	BNE3	9	0	2	1	3	12	
3/15/2023 11:37:29 AM	64.94586	-115.632788	136	BNE3	7	4	1	0	1	12	
3/15/2023 11:38:17 AM	64.94743	-115.644087	137	BNE3	0	0	6	0	6	6	
3/15/2023 11:39:27 AM	64.94906	-115.652779	138	BNE3	3	3	4	0	4	10	
3/15/2023 11:41:59 AM	64.95027	-115.624678	139	BNE3	6	5	4	0	4	15	
3/15/2023 11:45:31 AM	64.9724	-115.524669	140	BNE3	12	5	2	0	2	19	
3/15/2023 11:47:21 AM	64.98078	-115.575372	141	BNE3	0	0	1	5	6	6	22155
3/15/2023 11:49:26 AM	64.98329	-115.620827	142	BNE3	9	2	3	0	3	14	
3/15/2023 11:50:06 AM	64.97931	-115.627776	143	BNE3	4	0	4	0	4	8	
3/15/2023 1:14:05 PM	65.08398	-115.813733	145	BNE3	22	4	1	0	1	27	
3/15/2023 1:15:34 PM	65.07669	-115.799731	146	BNE3	15	4	3	0	3	22	
3/15/2023 1:15:55 PM	65.08413	-115.789429	147	BNE3	1	0	2	0	2	3	