

**ESTIMATES OF THE NUMBER OF BARREN-  
GROUND CARIBOU IN THE CAPE BATHURST  
AND BLUENOSE-WEST HERDS AND  
REINDEER/CARIBOU ON THE UPPER  
TUKTOYAKTUK PENINSULA DERIVED  
USING POST CALVING PHOTOGRAPHY,  
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## ABSTRACT

In 2005, Cape Bathurst, Bluenose-East and Bluenose-West caribou herd population estimates indicated all three herds were declining. In 2006, standard methods were used to conduct photo-census surveys on the three herds to confirm population estimates obtained in 2005 and determine if herds had continued to decline. Surveys were also undertaken to estimate the number of reindeer and caribou on the upper Tuktoyaktuk Peninsula. Analysis of the results provided a population estimate of 18,050  $\pm$  527 non-calf caribou (CV = 1%) for the Bluenose-West herd. This population estimate was significantly lower than that for 2005 indicating that this herd has continued to decline. A population estimate of 1,821  $\pm$  149 non-calf caribou (CV = 4%) was generated for the Cape Bathurst herd. This population estimate is significantly lower than that for 2005 indicating that this herd has also continued to decline. The population estimate for reindeer/caribou in the upper Tuktoyaktuk Peninsula was 3,078 non-calf reindeer/caribou. Previous estimates for this area were obtained with different methods so it is not appropriate to compare them with this estimate. Conditions were favourable for the successful completion of the photocensus surveys and researchers believe the population estimates generated are precise and accurate, indicating that herd declines are real and that these herds continued to decline between 2005 and 2006.



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## INTRODUCTION

In 1994, as part of the Bluenose barren-ground caribou herd management planning and environmental impact assessment process, distribution data obtained during population and telemetry surveys done between 1966 and 1993 were analyzed using a computer geographic information system (GIS) to define the seasonal ranges of the Bluenose barren-ground caribou herd (Nagy et al. 1999). That analysis indicated there were three calving and two rutting areas within the range of the 'Bluenose caribou herd'. Caribou management has been based on the herd concept, where herds are identified based on their use of traditional calving grounds (Thomas 1969, Gunn and Miller 1986). Applying this approach, Nagy et al. (1999) hypothesized that there were two, and possibly three, herds within the range of the 'Bluenose' caribou herd.

Satellite tracking and genetic studies similar to those done to define polar bear populations (Paetkau et al. 1995, Bethke et al. 1996) were initiated in March 1996 to identify the number of caribou herds within the 'Bluenose' range (Nagy et al. 1999, Zittlau et al. 2003). Tissue samples were also collected from the well defined Porcupine (*R. t. granti*) and Bathurst herds (*R. t. groenlandicus*) to the west and east of the Bluenose range, respectively, to obtain DNA for genetic comparisons. The results of these studies strongly support the hypothesis that there are three herds of barren-ground caribou within the range previously ascribed to the 'Bluenose caribou herd' (Nagy et al. 1999, Zittlau et al. 2003). These data also showed that the herds use different seasonal ranges (especially calving) (Nagy et al. 2005) and are genetically different (Nagy et al. 1999, Zittlau et al. 2003). For convenience we have referred to these herds as the Cape Bathurst, Bluenose-West, and Bluenose-East herds.

The first photo-census surveys of the 'Bluenose' herd were completed in 1986 and 1987 (McLean and Russell 1992). Nagy (in prep. a) reviewed and mapped McLean and Russell's (1992) capture locations and movement data in order to assign the groups photographed in 1986 and 1987 to Cape Bathurst, Bluenose-West, or Bluenose-East herds and to derive the parameters required to generate population estimates using a modified Lincoln-Petersen estimator (Russell et al. 1996). Nagy (in prep. a) was not able to derive the parameter required to derive a modified Lincoln-Petersen estimate for the 1986 survey as the data were not fully documented, however, there were 83,460 and 13,476 non-calf caribou counted in the groups photographed within the post-calving ranges of the Bluenose-West and Cape Bathurst herds, respectively (McLean and Russell 1992). Based on Nagy's (in prep. a) re-analysis of the 1987 data, the Bluenose-West and Cape Bathurst herds were estimated at  $98,874 \pm 3,145$  and  $14,529 \pm 2,542$  non-calf caribou, respectively, in the 1987. A similar re-analysis of the 1992 photo-census data resulted in estimates of  $64,705 \pm 9,057$  and  $17,521 \pm 5,352$  non-calf caribou in the Bluenose-West and Cape Bathurst herds, respectively (Nagy in prep. a).

Prior to the 1986, 1987, and 1992 photo-census surveys, the majority of the caribou that were radio-collared were captured in the western and central portions of the range of the 'Bluenose' herd (now defined as ranges of the Cape Bathurst and Bluenose-West caribou herds)(Nagy in prep. a). As a result, there were an insufficient number of radio collars deployed in the eastern portion of the 'Bluenose' range (now defined as range of Bluenose-East herd) to derive reliable estimates of the number caribou in this area (Nagy et al. 1999, Nagy in prep. a).

The first photo-census surveys designed to estimate the size of the Cape Bathurst, Bluenose-West, and Bluenose-East herds were undertaken during summer 2000 (Nagy in prep. a, Patterson et al. 2004). The results of these surveys suggested that the Cape Bathurst herd had declined from  $17,521 \pm 5,352$  non-calf caribou in 1992 to  $10,013 \pm 1,132$  non-calf caribou in 2000, however, (Nagy in prep. a) surveys also indicated that portions of the herd were poorly aggregated and as a result population size was underestimated. By 2005 this herd had declined to  $2,435 \pm 257$  non-calf caribou (Nagy and Johnson in prep. v). The size of Bluenose-West herd was estimated at  $64,705 \pm 9,057$  non-calf caribou in 1992 and  $74,273 \pm 10,591$  non-calf caribou in 2000; these estimates are not significantly different (Nagy in prep. a). By 2005 this herd had declined to  $20,801 \pm 2,040$  non-calf caribou (Nagy and Johnson in prep. v). The Bluenose-East herd was estimated at  $103,974 \pm 22,101$  non-calf caribou in 2000 (Patterson et al. 2004), but by 2005 this herd had declined to  $66,584 \pm 4,388$  caribou (Nagy et al. in prep. r).

In 2006, the Department of Environment and Natural Resources, Government of the Northwest Territories (GNWT) in cooperation with the Government of Nunavut, conducted photo-census surveys of the Cape Bathurst, Bluenose-West, and Bluenose-East herds to verify the population estimates obtained in 2005 and to determine if these herds had continued to decline. In addition, surveys were undertaken to derive estimates of the number of reindeer and caribou on the upper Tuktoyaktuk Peninsula. This report presents the results of photo-census surveys completed for the Cape Bathurst and Bluenose-West barren-ground caribou herds and for reindeer and caribou on the upper Tuktoyaktuk Peninsula.

## **METHODS**

### **Pre-radio Collar Deployment Reconnaissance Survey**

Reconnaissance surveys were flown to document the distribution of caribou on the winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds and over the upper Tuktoyaktuk Peninsula prior to collar deployment. The surveys were flown with fixed-wing aircraft (Helio courier or Cessna 185) at an altitude of 110 m agl and air speed of 160 km per hour. Transect lines were spaced at 20 km interval. Estimates of the number of caribou in each group observed and sightings of other wildlife including wolves, muskoxen, and moose were recorded. A GPS was used to record the longitude and latitude coordinates of each sighting and the tracks flown.

### **VHF and Satellite Radio Collar Deployment**

During March/early April 2005 and 2006 barren-ground caribou were captured with a handheld net gun (Ron's Gun Shop, Prince George, BC) fired from a Bell 206B helicopter and equipped with radio collars (VHF, ARGOS satellite, and GPS satellite). In 2006 we also deployed radio collars on caribou/reindeer on the upper Tuktoyaktuk Peninsula. Capture efforts were conducted over open tundra and lakes during periods when there was (1) sufficient snow to impede the movement of caribou and cushion their fall after netting, (2) good contrasting light conditions, (3) little or no wind, and (4) temperatures were not severe (warmer than  $-30^{\circ}\text{C}$ ). Caribou were radio-collared throughout the areas occupied by the three herds during the late winter 2006 reconnaissance survey.

### **Reconnaissance/Telemetry Surveys**

During March 2005 to July 2006 we maintained a database documenting the status of caribou radio-collared during late winter 2005 and 2006. The frequencies of radio collars for caribou that were harvested, died of natural causes, or that were on fast pulse but the status of the collar or caribou was not verified were censored from the database. We then flew telemetry surveys over the post-calving ranges of the Cape Bathurst and Bluenose-West herds and on the upper Tuktoyaktuk Peninsula during June and July 2006 to locate and verify the status of the remaining radio-collared caribou, to monitor their movements, and to detect aggregations. We also searched for the frequencies of radio collars that had not been located on the post-calving/early summer ranges of the Bluenose-East herd. Similarly, the field crew conducting the photo-census survey of the Bluenose-East herd searched for the frequencies of radio collars that had not been located on the ranges of the Cape Bathurst and Bluenose-West herds or on the upper Tuktoyaktuk Peninsula.

We used a Helio Courier fixed-wing aircraft equipped with two independent tracking systems consisting of an ATS scanner/receiver (Advanced Telemetry

Systems Inc., Isanti, MN) and 2 model RA-2AK dual antennae (Telonics Corp. Ltd., Mesa, AZ). One operator scanned the frequencies of the target herd (Cape Bathurst, Bluenose-West, or upper Tuktoyaktuk Peninsula) and the other scanned the frequencies of the target herd and those of radio-collared caribou from neighbouring herds for which the status had not yet been verified (including Bluenose-East). Transect lines were spaced approximately 20-40 km apart, while flight altitude ranged between 440 and 1320 m agl.

We also monitored the movements of ARGOS and GPS satellite-collared caribou and reindeer. We received ARGOS and GPS satellite location data every two days via email from ENR Yellowknife, Sahtu, or Inuvik. Data obtained for VHF and satellite collars were then mapped using Arcview (Environmental Systems Research Institute) so that tracking and monitoring efforts could be allocated effectively.

We mapped the movements of all radio-collared caribou and reindeer, observed during telemetry tracking flights done during the period 17 June 2006 to 13 July 2006, in relation to where they were captured. The size of ranges used during 1 April 2006 to 15 July 2006 by all satellite collared caribou/reindeer was estimated using the “minimum convex polygon” function in ArcView extension Animal Movement V.2.0 (Environmental Systems Research Institute). We used Mann-Whitney U tests (Gibbons 1985) to determine if the size of ranges used during this period varied significantly among Bluenose-West, Cape Bathurst, and upper Tuktoyaktuk Peninsula cows.

We assessed calving/post-calving range fidelity for cows that were captured and located during the 2005 photo-census and located again during the 2006 photo-census.

### **Aerial Photography and Image Processing**

Once suitably aggregated, groups were photographed from a Helio Courier fixed-wing aircraft with a handheld Nikon D2x digital (12.4 megapixel) camera equipped Nikon AF 35 mm 1:2 D lens. The aircraft flew between 110 and 330 m above and parallel to each group when the photos were taken. The photographer sat in the rear seat of the aircraft behind the pilot and removed the rear window for each photo session. We attempted to photograph each aggregation in a single pass to minimize movement of caribou between frames and to allow for approximately 20% overlap between successive frames. The group number, longitude and latitude co-ordinates, frequency of radio collars present, and frame numbers of photos taken for each group photographed were recorded.

In the lab we selected the best photo or series of photos taken of each group and printed these on 38.6 X 50 cm paper. For groups that were photographed over a series of photos, we identified the unique portions of each photo and marked the

boundaries of these on the paper prints. We used OziExplorer GPS Mapping Software, Version 3.95.4m, D & L Software Pty Ltd. to create a photomap of each digital image. For groups that were photographed over a series of frames, we transferred the boundaries of the unique portions of each image as marked on the paper prints to the corresponding photomaps by creating track lines on the digital image. Once this was completed, the photomaps were visually scanned on a computer screen and a waypoint was created on each caribou. The waypoint count gave the number of caribou present on each photomap. OziExplorer allowed us to easily change the view magnification as required to ensure that all caribou could be accurately identified and counted. We classified caribou as:

- calves,
- cows, yearlings, and young bulls
- mature bulls, and
- unknown

whenever possible. We assigned a unique symbol colour for each class of caribou. In the OziExplorer Mapping Software each colour has a unique number code. Once all caribou were counted, we imported the waypoint files into Microsoft EXCEL and determined the number of caribou counted in each class by doing a frequency count of each colour code. This was particularly useful for large mixed-class groups of caribou.

## Population Size

The photo count data provided an estimate of the minimum number of non-calf caribou in the Cape Bathurst and Bluenose-West barren-ground caribou herds and the number of reindeer/caribou on the upper Tuktoyaktuk Peninsula. However, because not all collared caribou are associated with aggregations and not all aggregations will always contain a collared caribou, total herd size will always be larger than the minimum count obtained during a photo-census (Russell et al. 1996). We estimated the total population size using a modification of the method presented by Russell et al. (1996) that is based on the Lincoln-Petersen Index as applied to radio-telemetry data by White and Garrott (1990). Not all aggregations photographed contained a radio-collared caribou but they were typically found in close proximity to aggregations that contained radio-collared caribou. We assumed that these groups formed a general aggregation of caribou that under more favourable conditions would have formed one group. By this method

$$N = (((M+1)(C+1))/(R+1))-1$$

Where:

- N = estimate of population size during the census
- M = number of radio-collared caribou present in the herd (including all collars known to be active during the survey)
- C = number of caribou in all aggregations observed during the survey
- R = number of radio-collared caribou observed in these aggregations during the survey.

The 95% CI for the estimate can then be calculated as  $N_i = 1.96 \text{ Var}(N)^{0.5}$ , where:

$$\text{Var}(N) = ((M+1)(C+1)(M-R)(C-R))/(R+1)^2(R+2)$$

### Comparison of Population Estimates

We used Lincoln-Petersen estimators to determine if the relative abundance of caribou ( $K$ ) in each herd during 2005 and 2006 was significantly different (Williams et al. 2002). We assumed that capture probabilities were different between 2005 and 2006. We estimated  $K$  and constructed the appropriate 95% confidence intervals as follows (Williams et al. 2002):

$$K = [((n_{b1}+1)(n_{b2}+1)/(m_{b2}+1))-1]/(n_{a1}n_{a2})/m_{a2}$$

with

$$\text{var}(K) = (m_{a2}n_{b1}^3n_{b2}/m_{b2}^3n_{a1}^3n_{a2}^3)[((n_{b2}-m_{b2})(n_{b1}-m_{b2})(m_{a2}n_{a1}n_{a2}))+((n_{a2}-m_{a2})(n_{a1}-m_{a2})(m_{b2}n_{b1}n_{b2}))]$$

where  $n_1$  = number of collared animals available for the photo-census,  $n_2$  = number of caribou associated with radio collared caribou located,  $m_2$  = number of collared caribou located during the photo-census, and the subscripts a and b refer to time period 1 and 2 of the comparisons, respectively.

We calculated the 95% CI of  $K$  as  $1.96 \text{ Var}(K)^{0.5}$  (Williams et al. 2002). If  $K$  was  $< 1$  and the 95% CI did not include 1, the population estimate for time period 2 was significantly lower than that for time period 1. If  $K$  was  $> 1$  and the 95% CI did not include 1, the population estimate for time period 2 was significantly higher than that for time period 1. If the 95% CI around  $K$  included 1, the population estimates for time periods 1 and 2 were not significantly different.

### Composition of the Herds

The majority of photos taken on the post-calving range of the Cape Bathurst herd and on the upper Tuktoyaktuk Peninsula were of sufficient quality that we were able to classify most of the caribou or reindeer and caribou present. We used a chi-square test for independence (Gibbons 1985) to determine if the composition of the caribou photographed varied significantly among photo sessions.

### Estimates of the Number of Reindeer on Upper Tuktoyaktuk Peninsula

The majority of photos taken on the upper Tuktoyaktuk Peninsula were of sufficient quality that we were able to classify calves as reindeer or caribou based on colour. Reindeer calves, based on photos available on the internet, appear to range in colour from jet black to dark chocolate brown to a medium yellow brown colour with a black cast. Their legs are generally dark or yellow brown in colour. There is a light colour phase but this phase is not as common (about 10% of the calves) (Nasogaluak 2006 pers. comm.). We looked at the



calves present in the photos taken of the Cape Bathurst and Bluenose-West herds. The majority of these calves ranged in colour from being almost completely white to a light to medium rufous brown colour with white legs and facial markings. Darker calves are observed but this colour phase is not common (estimate: <5 percent of calves).

We counted the number of light to medium rufous brown coloured calves on the photos taken of groups photographed on the upper Tuktoyaktuk Peninsula on 13 July 2006 and assumed these were caribou calves. The number of caribou cows present was estimated as:

- (number of calves counted in photos) / (number of calves per 100 cows observed on the upper Tuktoyaktuk Peninsula in late June adjusted for calf mortality) \* 100

### **Weather Conditions at Paulatuk**

Records of air temperature (Celsius), wind speed (knots), and wind direction (true north) were obtained from the CARS weather station at Paulatuk for the period mid June to mid July 2006.



## RESULTS

### Pre-radio Collar Deployment Reconnaissance Survey

The distribution of transect lines flown and sightings of caribou on the winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds and on the upper Tuktoyaktuk Peninsula are shown on Figure 1.

### VHF and Satellite Radio Collar Deployment

During March/early April 2005 and 2006 we captured and equipped 162 and 80 barren-ground caribou with radio collars (VHF) and satellite collars (ARGOS and GPS satellite), respectively, on the winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds (Table 1) (Figure 2). In 2006 we also deployed 26 radio collars on caribou/reindeer on the upper Tuktoyaktuk Peninsula (Table 1) (Figure 2).

### Verification of Status of Radio-Collared Caribou

We flew telemetry surveys daily between 17 June and 14 July 2006, weather permitting, and verified the status of caribou that were radio-collared in 2005 and 2006. In late June/early July 2006 there were 66 functional radio collars (including VHF and ARGOS and GPS satellite collars) on Bluenose-West caribou (45 deployed in 2005 and 21 in 2006); 33 on Cape Bathurst caribou (16 deployed in 2005, 16 in 2006, and 1 in 2002), and 27 on caribou/reindeer on the upper Tuktoyaktuk Peninsula (deployed in 2005 and 2006) (Table 2). We were not able to verify the status of 5 radio collars deployed on the winter range of the Bluenose-West herd (3 deployed in 2005 and 2 in 2006), 2 radio collars deployed on the winter range of the Cape Bathurst herd in 2006, and one radio collar deployed on the upper Tuktoyaktuk Peninsula in 2006 (Table 2). Given the extensive area that was flown during reconnaissance/telemetry surveys (Figure 3 and 4) and that we ran two tracking systems and continually scanned for these radio collars, we believe that these collars failed prior to the photo-census.

### Distribution of Radio-Collared Caribou Relative to Capture Sites

Figures 5 and 6 show the movements of the radio-collared cow and bull caribou, respectively, that we tracked during 17 June to 14 July 2006 relative to where they were captured. Caribou found on the Cape Bathurst calving/post-calving range were captured in the area south and east of Tuktoyaktuk and south to Caribou Lakes. Caribou found on the Bluenose-West calving/post calving range were captured in the Colville Lake/Rendezvous Lake/Crossley Lakes area. One cow captured east of Tuktoyaktuk was located on the Bluenose-West calving/post-calving range. The majority of caribou found on the Bluenose-East calving/post-calving range were captured in the area south and east of Great Bear Lake and northeast to Kugluktuk, NT. One bull captured in the Colville

Lake area in 2005 was located on the Bluenose-East calving/post-calving range in 2005 and 2006. Similarly, one cow and one bull captured in the Colville Lake area in 2005 and 2006, respectively, were located on the Bluenose-East calving/post-calving range in 2005 and 2006, respectively. These three caribou were assigned to the Bluenose-East herd. The reindeer and caribou found on the upper Tuktoyaktuk Peninsula calving/post-calving range were captured north and east of Tuktoyaktuk to the upper fingers on Husky Lakes. One cow captured in the Tuktoyaktuk area was located on the Cape Bathurst calving/post-calving range in 2005 and on the upper Tuktoyaktuk Peninsula in 2006. In general, caribou captured on the winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East herds were found on the calving/post-calving ranges defined for these herds (Nagy et al. 2005). Reindeer/caribou captured on the Tuktoyaktuk Peninsula north and east of Tuktoyaktuk were found at the northern tip of the peninsula during the calving/post-calving period.

### **Distribution of Satellite-Collared Cows by Herd**

Figure 7 shows the movements of the satellite collared (GPS and ARGOS) Cape Bathurst and Bluenose-West barren-ground caribou cows and the reindeer and barren-ground caribou cows on the upper Tuktoyaktuk Peninsula documented during the period 1 April to 15 July 2006. The movements of the radio-collared reindeer and barren-ground caribou cows on the upper Tuktoyaktuk Peninsula appeared to be highly restricted when compared with those of radio-collared Cape Bathurst and Bluenose-West cows. The median range size for Bluenose-West cows for the period 1 April to 15 July 2006 was 17,348 km<sup>2</sup> (range 7,908-52610 km<sup>2</sup>, n=16), while that for Cape Bathurst and upper Tuktoyaktuk Peninsula cows was 10,461 km<sup>2</sup> (range 1,069-15,070 km<sup>2</sup>, n=12) and 1716 km<sup>2</sup> (range 412-3,360 km<sup>2</sup>, n=8), respectively. Bluenose-West cows had significantly larger ranges than those of Cape Bathurst and upper Tuktoyaktuk Peninsula cows (MW P < 0.05) during this period. Similarly, Cape Bathurst cows had significantly larger ranges than those upper Tuktoyaktuk Peninsula cows (MW P < 0.05). This suggests that the pattern of range use for reindeer and caribou on the upper Tuktoyaktuk Peninsula during late winter to mid-summer was significantly different than that for the Cape Bathurst and Bluenose-West herds.

### **Post-calving Photo-census 2006**

#### *i. Bluenose-West Herd*

The Bluenose-West herd was photographed on 4 and 7/8 July 2006.

The majority of the satellite collared cows of the Bluenose-West herd migrated out of the calving/post-calving ranges in Tuktoyaktuk National Park during the period 30 June and 4 July 2006 (Figure 8). By the evening of 4 July 2006 at least 45 collared caribou were heard in the Biname Lake area south and west of

Paulatuk (Figure 9). That evening we photographed 10 groups of caribou, 8 of which included collared caribou (Table 3). A total of 31 of the 66 available collared caribou were photographed. We counted 10,902 non-calf caribou on the photos taken. We did not count calves as most of the photos were taken at relatively high altitudes and as a result the calves were very small and difficult to count or not visible. The largest group included 5,388 non-calf caribou and 12 collared caribou. The population estimate generated for this photo session was  $22,827 \pm 5,621$  non-calf caribou (CV = 13%) (Table 4).

The caribou in this herd were sufficiently aggregated for photography again on 7 and 8 July 2006. The tracks flown and distribution of groups photographed are shown in Figure 10. The movements of the satellite-collared caribou on 7 and 8 July 2006 relative to the sites where we photographed groups of caribou are shown on Figure 11. We photographed 65 groups, 40 of which included radio-collared caribou (Table 5). A total of 65 of the 66 available radio-collared caribou were photographed. We counted 17,781 non-calf and 5,247 calf caribou on the photos taken. Calves represented 23% of the total number of caribou counted. The largest groups include 3,028 non-calf and 947 calf caribou and 10 radio-collared caribou. The population estimate generated for this photo session was  $18,050 \pm 527$  non-calf caribou (CV = 1%)(Table 4).

The population estimate based on the groups and radio-collared caribou photographed on 7&8 July 2006 was significantly lower than that for 4 July 2006 ( $K = 0.78$ ; upper and lower 95% CI are 0.58 and 0.98, respectively). However, the 10 groups that we photographed on 4 July 2006 included < 50% of available radio collars, and as a result, we believe herd size was over estimated. We believe that best estimate was obtained on 7&8 July 2006 because we photographed 65 groups of caribou that included 65 of the 66 collars available on these days. This population estimate was significantly lower than that for 2005 ( $K = 0.87$  range 0.77 and 0.96) indicating that this herd has continued to decline (Table 6).

## ii. *Cape Bathurst Herd*

The Cape Bathurst herd was photographed on 6, 9 and 13 July 2006. On 6 July 2006 we photographed 12 groups, 10 of these included radio-collared caribou (Table 7). The tracks flown and distribution of groups photographed are shown in Figure 12. A total of 27 of the 33 available radio-collared caribou were photographed. We counted 1,508 non-calf and 371 calf caribou on the photos. The largest group included 364 non-calf and 131 calf caribou and 9 radio-collared caribou. The population estimate generated for this photo session was  $1,831 \pm 278$  non-calf caribou (CV = 8%) (Table 4).

On 9 July 2006 we photographed 23 groups, 17 of these included radio-collared caribou (Table 8). The groups were more widely dispersed than they were on 6

July 2006. The tracks flown and distribution of groups photographed are shown in Figure 13. A total of 30 of the 33 available radio-collared caribou were photographed. We counted 1,514 non-calf and 284 calf caribou on the photos. The largest group included 264 non-calf caribou and 1 radio-collared caribou. There were no calves in this group. The population estimate generated for this photo session was 1,661  $\pm$ 169 non-calf caribou (CV = 5%) (Table 4).

On 13 July 2006 we photographed 11 groups, 6 groups included radio-collared caribou (Table 9). The tracks flown and distribution of groups photographed are shown in Figure 14. A total of 31 of the 33 available radio-collared caribou were photographed. We counted 1,714 non-calf and 298 calf caribou on the photos. The largest group included 1,367 (80%) of the 1,714 non-calf and 266 (89%) of the 298 calf caribou counted on the photos. This group included 19 radio-collared caribou. The population estimate generated for this photo session was 1,821  $\pm$ 149 non-calf caribou (CV = 4%) (Table 4).

The population estimates generated for the three photo sessions were not significantly different (Table 4). The K-value for the comparison of estimates obtained for 6 and 9 July 2006 was 0.90 (upper and lower 95% CI are 0.73 and 1.07, respectively), while K-values for the comparison of estimates obtained on 6 and 13 July 2006 was 0.99 (upper and lower 95% CI are 0.81 and 1.17, respectively) and on 9 and 13 July 2006 was 0.94 (upper and lower 95% CI are 0.94 and 1.24, respectively). We believe that the best estimate for the Cape Bathurst herd was obtained on 13 July 2006 because weather conditions were most favourable for aggregation on this day. This population estimate was significantly lower than that for 2005 (K = 0.75; upper and lower 95% CI are 0.64 and 0.85, respectively) indicating that this herd has continued to decline (Table 6).

### *iii. Upper Tuktoyaktuk Peninsula*

The reindeer/caribou on the upper Tuktoyaktuk Peninsula were photographed on 9 and 13 July 2005.

On 9 July 2006 we photographed 22 groups, 15 groups included radio-collared reindeer/caribou (Table 10). The tracks flown and distribution of groups photographed are shown in Figure 15. A total of 27 of the 27 available radio-collared reindeer/caribou were photographed. We counted 2,866 non-calf and 1,077 calf reindeer/caribou on the photos. The largest group included 951 non-calf and 307 calf reindeer/caribou. This group included 5 radio-collared reindeer/caribou. Because we photographed all of the collars available the population estimate equals the number of caribou counted on the photos or 2,866 non-calf reindeer/caribou (Table 4).

On 13 July 2006 we photographed 14 groups, 8 groups included radio-collared reindeer/caribou (Table 11). The tracks flown and distribution of groups photographed are shown in Figure 16. A total of 27 of the 27 available radio-collared reindeer/caribou were photographed. We counted 3,078 non-calf and 979 calf reindeer/caribou on the photos. The largest group included 1,627 non-calf and 438 calf reindeer/caribou. This group included 10 radio-collared reindeer/caribou. Because we photographed all of the collars available the population estimate equals the number of caribou counted on the photos or 3,078 non-calf reindeer/caribou (Table 4).

We believe that the best estimate of the number of reindeer/caribou in this area was obtained on 13 July 2006 because weather conditions were most favourable for aggregation. The upper Tuktoyaktuk Peninsula was not surveyed in previous years so we do not have historical estimates of the number of reindeer/caribou in this area (Table 6).

### **Age and Sex Composition of Herds Photographed**

The age and sex composition of the caribou photographed on the Cape Bathurst post-calving range on 6, 9, and 13 July 2006 and that of reindeer and caribou photographed on 9 and 13 July 2006 on the upper Tuktoyaktuk Peninsula is shown in Figures 17 and 18. The age and sex composition of the caribou photographed on the Cape Bathurst post-calving range varied significantly when data for 6, 9, and 13 July 2006 were compared ( $Q = 121.986$ ,  $df = 6$ ,  $P < 0.001$ ). Fewer bulls and more cows/yearlings/young bulls and more calves were in the groups photographed on 6 July 2006 than expected. We believe that this disparity was due to the fact that we were not able to photograph caribou on the Nicholson Peninsula on 6 July 2006 due to poor weather conditions. However, when the data for 9 and 13 July 2006 were compared, the age and sex composition of caribou in groups photographed was not significantly different ( $Q = 2.673$ ,  $df = 3$ ,  $P > 0.05$ ). This indicates that the relative numbers cows/yearlings/young bulls, calves, and bulls on the Cape Bathurst post-calving range had not changed between 9 and 13 July 2006.

The relative composition of the caribou and reindeer photographed on the upper Tuktoyaktuk Peninsula was significantly different on 9 and 13 July 2006 ( $Q = 49.752$ ,  $df = 3$ ,  $P < 0.001$ ). The groups photographed on 13 July 2006 had a larger than expected number of cows/yearlings/young bulls and bulls and fewer calves than expected. The reindeer/caribou were more dispersed on 9 July 2006 and as a result we may have missed some small groups of adults. Some of the difference in numbers of calves observed may be due to mortality.

### **Estimates of the Number of Reindeer on the Upper Tuktoyaktuk Peninsula**

We counted 256 light colour calves on the photos taken on the upper Tuktoyaktuk Peninsula on 13 July 2006. On 17 June 2006 there were 55 calves

per 100 cows on the upper Tuktoyaktuk Peninsula. We adjusted this value to 50 calves per 100 cows to account for some calf mortality between 17 June and 13 July 2006. Using these values we estimate that there are approximately 512 caribou cows or  $((256/50)(100))$  on the upper Tuktoyaktuk Peninsula. We assumed that there were some bull caribou in this area as well. As a result, we estimate that there are approximately 600 non-calf caribou on the upper Tuktoyaktuk Peninsula, or approximately 20 % of the non-calf animals counted ( $600/3078 = 0.195$ ).

### **Weather Conditions at Paulatuk**

Air temperatures, wind speeds, and wind directions documented at the CARS weather station at Paulatuk, NT, during 15 June to 14 July 2006 are given in Table 12. Paulatuk is situated on the coast and as a result its weather is strongly influenced by the marine environment, particularly the presences of ice flows or ice pack. Temperatures in Paulatuk can be in the +2 to +3 range but may be significantly higher inland from the coast. However, if winds are calm or relatively calm in Paulatuk, weather conditions inland are usually favourable for the aggregation of caribou.

We photographed the Bluenose-West herd on 4 July 2006. The weather in Paulatuk was cool and relatively calm (temperatures were in the +3 to +4 °C range and wind speed ranged from 3 to 5 knots) (Table 12). The majority of the Bluenose-West herd was approximately 40 km inland from the coast, south and west of Paulatuk, (we heard 45 of the radio collars in this area) and all groups observed were sufficiently aggregated for photography.

We photographed the Cape Bathurst herd on 6 July 2006, the Bluenose-West herd on 7&8 July 2006, the Cape Bathurst herd on 9 July 2006, and the reindeer/caribou on the upper Tuktoyaktuk Peninsula on 9 July 2006. Again the weather in Paulatuk was cool and relatively calm (temperatures were generally in the +1 to +3 °C range and wind speed generally ranged from 2 to 5 knots). All groups observed in these herds during this period were sufficiently aggregated for photography.

We photographed the Cape Bathurst herd and the reindeer/caribou on the upper Tuktoyaktuk Peninsula on 13 July 2006. The weather in Paulatuk was hot and relatively calm (temperatures were in the +14 to +18 °C range and wind speed ranged from 2 to 8 knots). All groups observed were sufficiently aggregated for photography.



## DISCUSSION

We believe that conditions were favourable for the successful completion of photo-census surveys of the Cape Bathurst and Bluenose-West barren-ground caribou herds and of the reindeer and caribou on the upper Tuktoyaktuk Peninsula during early July 2006. Russell et al. (1996) discussed 4 assumptions on which an accurate estimate of population size using post-calving photography and the Lincoln-Petersen estimator is dependent. The degree to which each of these assumptions was met during our photo-census is discussed below:

**Assumption 1:** The population is closed.

Satellite tracking and genetic data indicate that the Cape Bathurst, Bluenose-West, and Bluenose-East herds are distinct from each other and adjacent herds (Porcupine and Bathurst herds) (Nagy et al. 2005, Nagy et al. 1999, Zittlau et al. 2003). Range overlap occurs in some seasons, particularly during the winter (Nagy et al. 2005) and some overlap occurs between the Bluenose-West and Bluenose-East herds during the post-calving period in some years (Patterson et al. 2004). We found some evidence of mixing of herds on winter ranges, including:

- one radio-collared bull that was found on the Bluenose-East post-calving range in 2005 and 2006, was captured on the Bluenose-West winter range in 2005,
- one radio-collared bull and cow that were located on the Bluenose-East post-calving range in 2005 were captured on the Bluenose-West winter range in 2005; neither were located during 2006, and
- one radio-collared bull that was found on the upper Tuktoyaktuk Peninsula post-calving range in 2006 was captured on the Cape Bathurst winter range in 2005.

In 2006 we found remarkable fidelity to post-calving ranges, including:

- of 45 radio-collared caribou that were captured in 2005 and were located in 2005 and 2006, all were located on the Bluenose-West post-calving range in both years,
- of 30 radio-collared caribou that were captured in 2005 and were located in 2005 and 2006, all were located on the Bluenose-East post-calving range in both years,
- 17 of 18 radio-collared caribou that were captured in 2005, and were located in 2005 and 2006, were located on the Cape Bathurst post-calving range in both years, and
- one cow that was captured in 2005 was found on the Cape Bathurst post-calving range in 2005 and on the upper Tuktoyaktuk Peninsula in 2006.

Mixing of caribou herds on seasonal ranges may be more prevalent among herds whose seasonal ranges are in close proximity, and especially during periods of population highs. Our data indicates that the cows and bulls of the Cape Bathurst, Bluenose-West, and Bluenose-East herds were distributed within their respective post-calving ranges and as a result the assumption of closure was met during the survey.

**Assumption 2:** All highly aggregated groups contain at least one radio-collared caribou and thus can be located.

We had a high ratio of collars per caribou in each herd/area including:

- 1 per 273 caribou in the Bluenose-West herd,
- 1 per 55 caribou in the Cape Bathurst herd, and
- 1 per 67 for reindeer/caribou on the upper Tuktoyaktuk Peninsula.

As a result we believe that we located all significant aggregations of caribou or reindeer on these post-calving ranges. Aggregations were clustered non-randomly across the landscape. Not all aggregations photographed contained a radio-collared caribou but they were typically found in close proximity to aggregations that contained radio-collared caribou. We assumed that these groups were part of a general aggregation that under more favourable conditions would have formed one group. As a result, these caribou were considered to be part of nearby groups that contained radio-collared animals and were included in the analyses. Although we did not strictly meet the conditions for this assumption, we believe that this violation had little influence on our population estimates.

**Assumption 3:** Radio-collared animals are randomly distributed throughout the herd.

We designed and conducted a survey in late February/early March 2005 to define the distribution of caribou on the winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East caribou herds prior to collar deployment in March 2005. Similarly, in consultation with the user communities we designed and conducted a survey in late February/early March 2006 to define the distribution of these herds prior to collar deployment in March 2006. We captured and radio-collared caribou randomly across the areas occupied by these herds during late winter each year. Radio-collared caribou found within the largest groups photographed on the post-calving ranges of the Bluenose-West herd on 7 July 2006 and the Cape Bathurst herd on 13 July 2006, and on the upper Tuktoyaktuk Peninsula on 13 July 2006 were captured over a wide geographic area suggesting that the radio-collared caribou were randomly distributed within these herds (Figure 19).

**Assumption 4:** No significant movement of individual caribou among photographed groups used in the estimate occurred during the photo-census.

We photographed the Cape Bathurst herd on 3 separate occasions. The herd was photographed in 4-5 hours during each occasion. The reindeer and caribou on the upper Tuktoyaktuk Peninsula were photographed on 2 separate occasions. These animals were photographed in 4-5 hours during each session. We did not detect any movement of collared animals among groups during any of the photo sessions. The best estimate for the Bluenose-West herd was obtained during a photo session that spanned 2 consecutive days, however, 84 % radio-collared caribou (56 of 65 collars photographed) and 93% of the caribou counted (16558 of 17781 caribou counted) were photographed on the first day. These caribou were found within the central and western portion of the post-calving range of the herd. We then photographed the remaining caribou on the eastern portion of post-calving range of the herd on the second day. We did not detect any movement of radio-collared animals among groups photographed on day 1 and 2. We believe that this assumption was fully met.

In summary, radio-collars were distributed randomly among caribou in these herds during late winter 2005 and 2006, and the status of the majority of these was verified prior to and during the photo-census. The largest majority of caribou or reindeer were found in each area because there was a high ratio of radio-collars deployed per caribou in each herd. Weather conditions during the days when we photographed the herds were favourable for aggregation. We met the basic assumptions on which an accurate estimate of population size using post-calving photography and the Lincoln-Petersen estimator is dependent. As a result, we believe that the population estimates generated for caribou on the post-calving ranges of the Cape Bathurst and Bluenose-West barren-ground caribou herds and for reindeer/caribou on the upper Tuktoyaktuk Peninsula are precise and accurate.

### **Management Implications**

Comparisons of population estimates derived in 2000 and 2005 for the Cape Bathurst and Bluenose-West herds indicated significant declines in these herds (Nagy in prep. a). The results of the photo-census survey completed during 2006 indicate that these declines were real, and that these herds continued to decline between 2005 and 2006. The small number of calves observed in the Cape Bathurst herd in early July 2006 indicates that few yearlings will be recruited to this herd in spring 2007. This suggests that a further decline of the Cape Bathurst herd can be anticipated. The Bluenose-West herd appears to be in better shape, but recruitment to this herd needs to be maximized during the next few years to facilitate its recovery. We believe that a large portion of the animals (approximately 80%) on the upper Tuktoyaktuk Peninsula are reindeer but recognize that additional assessment of this is needed.



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**Table 1.** Number of radio-collars deployed on caribou in the winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East herds and on reindeer/caribou on the upper Tuktoyaktuk Peninsula during 2005 and 2006.

| Herd Winter Range | Year                        | Sex      | Collar Manufacturer |          |     |     | Total |    |
|-------------------|-----------------------------|----------|---------------------|----------|-----|-----|-------|----|
|                   |                             |          | Habit               | Telonics |     |     |       |    |
|                   |                             |          | VHF                 | ARGOS    | GPS | VHF |       |    |
| Bluenose-East     | 2005                        | female   |                     | 12       |     | 26  | 38    |    |
|                   |                             | male     |                     |          |     | 10  | 10    |    |
|                   |                             | subtotal |                     | 12       |     | 36  | 48    |    |
|                   | 2006                        | female   |                     |          | 8   | 5   | 13    |    |
|                   |                             | male     |                     |          | 1   | 12  | 13    |    |
|                   |                             | subtotal |                     |          | 9   | 17  | 26    |    |
|                   | Total                       |          |                     | 12       | 9   | 53  | 74    |    |
|                   | Bluenose-West               | 2005     | female              |          | 10  |     | 44    | 54 |
|                   |                             |          | male                |          |     |     | 16    | 16 |
|                   |                             |          | subtotal            |          | 10  |     | 60    | 70 |
| 2006              |                             | female   |                     |          | 10  | 6   | 16    |    |
|                   |                             | male     |                     |          |     | 14  | 14    |    |
|                   |                             | subtotal |                     |          | 10  | 20  | 30    |    |
| Total             |                             |          |                     | 10       | 10  | 80  | 100   |    |
| Cape Bathurst     |                             | 2005     | female              |          | 11  |     | 23    | 34 |
|                   |                             |          | male                |          |     |     | 10    | 10 |
|                   |                             |          | subtotal            |          | 11  |     | 33    | 44 |
|                   | 2006                        | female   |                     |          | 8   | 3   | 11    |    |
|                   |                             | male     |                     |          |     | 13  | 13    |    |
|                   |                             | subtotal |                     |          | 8   | 16  | 24    |    |
|                   | Total                       |          |                     | 11       | 8   | 49  | 68    |    |
|                   | Upper Tuktoyaktuk Peninsula | 2006     | female              | 2        | 3   | 7   | 7     | 19 |
|                   |                             |          | male                | 3        |     |     | 4     | 7  |
|                   |                             | Total    |                     | 5        | 3   | 7   | 11    | 26 |
| Total             |                             |          | 5                   | 36       | 34  | 193 | 268   |    |

**Table 2.** Number of active radio-collars in the Cape Bathurst and Bluenose-West barren-ground caribou herds and on the upper Tuktoyaktuk Peninsula during late June/early July 2006.

| Herd                        | Year of Capture | No. of radio-collared caribou not located |      |       | No. of radio-collared caribou located |      |       |
|-----------------------------|-----------------|---|------|-------|---------------------------------------|------|-------|
|                             |                 | Female                                    | Male | Total | Female                                | Male | Total |
| Bluenose-West               | 2005            | 1   | 2    | 3     | 38                                    | 7    | 45    |
|                             | 2006            |   | 2    | 2     | 13                                    | 8    | 21    |
|                             | subtotal        | 1   | 4    | 5     | 51                                    | 15   | 66    |
| Cape Bathurst               | 2002            |   |      |       | 1                                     |      | 1     |
|                             | 2005            |   |      |       | 12                                    | 4    | 16    |
|                             | 2006            |   | 2    | 2     | 10                                    | 6    | 16    |
|                             | subtotal        |   | 2    | 2     | 23                                    | 10   | 33    |
| Upper Tuktoyaktuk Peninsula | 2005            |   |      |       | 1                                     | 1    | 2     |
|                             | 2006            | 1   |      | 1     | 18                                    | 7    | 25    |
|                             | subtotal        | 1   |      | 1     | 19                                    | 8    | 27    |



**Table 3.** Non-calf caribou counted on photographs taken of the Bluenose-West barren-ground caribou herd on 4 July 2006. We did not count calves as they were difficult to discern on some of the photos.

| Date     | Group | No. of radio collars | Number counted |
|----------|-------|----------------------|----------------|
|          |       |                      | non-calf       |
| 4-Jul-06 | 1     | 1                    | 135            |
| 4-Jul-06 | 2     | 1                    | 74             |
| 4-Jul-06 | 3     | 0                    | 80             |
| 4-Jul-06 | 4     | 1                    | 7              |
| 4-Jul-06 | 5     | 2                    | 1196           |
| 4-Jul-06 | 6     | 0                    | 13             |
| 4-Jul-06 | 7     | 9                    | 3358           |
| 4-Jul-06 | 8     | 1                    | 7              |
| 4-Jul-06 | 9     | 12                   | 5388           |
| 4-Jul-06 | 10    | 4                    | 644            |
| Total    |       | 31                   | 10902          |

**Table 4.** Non-calf population estimates for the Cape Bathurst and Bluenose-West barren-ground caribou herds and for reindeer/caribou on the upper Tuktoyaktuk Peninsula in 2006.

| Herd<br>and<br>Date         | Year | M  | C     | R  | N                | Number<br>Counted<br>on<br>Photos | Coefficient<br>of<br>Variation<br>(%) |
|-----------------------------|------|----|-------|----|------------------|-----------------------------------|---------------------------------------|
| Bluenose-West               |      |    |       |    |                  |                                   |                                       |
| 4 July                      | 2006 | 66 | 10902 | 31 | $22827 \pm 5621$ | 10902                             | 13                                    |
| 7&8 July                    | 2006 | 66 | 17781 | 65 | $18050 \pm 527$  | 17781                             | 1                                     |
| Cape Bathurst               |      |    |       |    |                  |                                   |                                       |
| 6 July                      | 2006 | 33 | 1508  | 27 | $1831 \pm 278$   | 1508                              | 8                                     |
| 9 July                      | 2006 | 33 | 1514  | 30 | $1661 \pm 169$   | 1514                              | 5                                     |
| 13 July                     | 2006 | 33 | 1714  | 31 | $1821 \pm 149$   | 1714                              | 4                                     |
| Upper Tuktoyaktuk Peninsula |      |    |       |    |                  |                                   |                                       |
| 9 July                      | 2006 | 27 | 2866  | 27 | 2866             | 2866                              |                                       |
| 13 July                     | 2006 | 27 | 3078  | 27 | 3078             | 3078                              |                                       |

The estimate of population size for each census was calculated as

$N = (((M+1)(C+1))/(R+1)) - 1$ ; where:

N = estimate of population size during the census

M = number of radio-collared caribou present in the herd (including all collars known to be active during the survey)

C = number of caribou observed in aggregations containing at least one radio-collared caribou during the survey

R = number of radio-collared caribou observed in these aggregations during the survey.

The 95% CI for the estimate was calculated as  $N_i = 1.96 \text{ Var}(N)^{0.5}$ , where:

$\text{Var}(N) = ((M+1)(C+1)(M-R)(C-R))/(R+1)^2(R+2)$

**Table 5.** Calf and non-calf caribou counted on photographs taken of the Bluenose-West barren-ground caribou herd on 7 and 8 July 2006.

| Date     | Group | No. of radio collars | No. counted |      | Percent Calf |
|----------|-------|----------------------|-------------|------|--------------|
|          |       |                      | Non-calf    | Calf |              |
| 7-Jul-06 | 1     | 3                    | 486         | 42   | 8.0          |
| 7-Jul-06 | 2     | 1                    | 844         | 50   | 5.6          |
| 7-Jul-06 | 3     | 1                    | 86          | 1    | 1.1          |
| 7-Jul-06 | 4     | 0                    | 3           |      |              |
| 7-Jul-06 | 5     | 1                    | 8           |      |              |
| 7-Jul-06 | 6     | 7                    | 1511        | 377  | 20.0         |
| 7-Jul-06 | 7     | 1                    | 689         | 115  | 14.3         |
| 7-Jul-06 | 8     | 1                    | 1223        | 170  | 12.2         |
| 7-Jul-06 | 9     | 0                    | 199         | 3    | 1.5          |
| 7-Jul-06 | 10    | 0                    | 12          |      |              |
| 7-Jul-06 | 11    | 6                    | 1271        | 525  | 29.2         |
| 7-Jul-06 | 12    | 0                    | 189         | 40   | 17.5         |
| 7-Jul-06 | 13    | 10                   | 3028        | 947  | 23.8         |
| 7-Jul-06 | 14    | 2                    | 173         | 88   | 33.7         |
| 7-Jul-06 | 15    | 1                    | 136         |      |              |
| 7-Jul-06 | 16    | 1                    | 97          | 1    | 1.0          |
| 7-Jul-06 | 17    | 1                    | 3           | 1    | 25.0         |
| 7-Jul-06 | 18    | 1                    | 377         | 51   | 11.9         |
| 7-Jul-06 | 19    | 2                    | 384         | 4    | 1.0          |
| 7-Jul-06 | 20    | 1                    | 229         |      |              |
| 7-Jul-06 | 21    | 1                    | 2           |      |              |
| 7-Jul-06 | 22    | 0                    | 4           |      |              |
| 7-Jul-06 | 23    | 1                    | 511         | 261  | 33.8         |
| 7-Jul-06 | 24    | 1                    | 3           | 1    | 25.0         |
| 7-Jul-06 | 25    | 1                    | 310         | 144  | 31.7         |
| 7-Jul-06 | 26    | 0                    | 3           | 2    | 40.0         |
| 7-Jul-06 | 27    | 0                    | 27          | 15   | 35.7         |
| 7-Jul-06 | 28    | 2                    | 283         | 119  | 29.6         |
| 7-Jul-06 | 29    | 0                    | 137         | 56   | 29.0         |
| 7-Jul-06 | 30    | 2                    | 757         | 230  | 23.3         |
| 7-Jul-06 | 31    | 0                    | 208         | 56   | 21.2         |
| 7-Jul-06 | 32    | 1                    | 418         | 130  | 23.7         |
| 7-Jul-06 | 33    | 1                    | 284         | 121  | 29.9         |

Table 5. (continued).

| Date     | Group | No. of radio collars | No. counted |      | Percent |
|----------|-------|----------------------|-------------|------|---------|
|          |       |                      | Non-Calf    | Calf | Calf    |
| 7-Jul-06 | 34    | 0                    | 111         | 44   | 28.4    |
| 7-Jul-06 | 35    | 1                    | 75          | 28   | 27.2    |
| 7-Jul-06 | 36    | 1                    | 105         | 32   | 23.4    |
| 7-Jul-06 | 37    | 0                    | 81          | 33   | 28.9    |
| 7-Jul-06 | 38    | 1                    | 1365        | 580  | 29.8    |
| 7-Jul-06 | 39    | 1                    | 616         | 219  | 26.2    |
| 7-Jul-06 | 40    | 1                    | 114         | 69   | 37.7    |
| 7-Jul-06 | 41    | 0                    | 32          | 10   | 23.8    |
| 7-Jul-06 | 42    | 0                    | 4           |      |         |
| 7-Jul-06 | 43    | 1                    | 6           | 2    | 25.0    |
| 7-Jul-06 | 44    | 0                    | 1           |      |         |
| 7-Jul-06 | 45    | 0                    | 153         | 94   | 38.1    |
| 8-Jul-06 | 46    | 0                    | 2           |      |         |
| 8-Jul-06 | 47    | 1                    | 35          | 21   | 37.5    |
| 8-Jul-06 | 48    | 1                    | 2           |      |         |
| 8-Jul-06 | 49    | 1                    | 22          | 13   | 37.1    |
| 8-Jul-06 | 50    | 1                    | 337         | 192  | 36.3    |
| 8-Jul-06 | 51    | 0                    | 9           | 6    | 40.0    |
| 8-Jul-06 | 52    | 1                    | 7           | 3    | 30.0    |
| 8-Jul-06 | 53    | 0                    | 23          | 10   | 30.3    |
| 8-Jul-06 | 54    | 0                    | 23          | 15   | 39.5    |
| 8-Jul-06 | 55    | 1                    | 24          | 17   | 41.5    |
| 8-Jul-06 | 56    | 0                    | 8           | 6    | 42.9    |
| 8-Jul-06 | 57    | 0                    | 9           | 5    | 35.7    |
| 8-Jul-06 | 58    | 1                    | 354         | 166  | 31.9    |
| 8-Jul-06 | 59    | 0                    | 1           |      |         |
| 8-Jul-06 | 60    | 0                    | 2           | 2    | 50.0    |
| 8-Jul-06 | 61    | 1                    | 127         | 58   | 31.4    |
| 8-Jul-06 | 62    | 0                    | 3           |      |         |
| 8-Jul-06 | 63    | 0                    | 5           |      |         |
| 8-Jul-06 | 64    | 1                    | 76          | 32   | 29.6    |
| 8-Jul-06 | 65    | 0                    | 154         | 40   | 20.6    |
| Total    |       | 65                   | 17781       | 5247 | 22.8    |

**Table 6.** Non-calf population estimates for Cape Bathurst and Bluenose-West barren-ground caribou herds in 1986, 1987, 1992, 2000, 2005, and 2006 and reindeer/caribou on the upper Tuktoyaktuk Peninsula in 2006.

| Herd                        | Year              | M  | C     | R  | N             | Number Counted on Photos | Coefficient of Variation (%) |
|-----------------------------|-------------------|----|-------|----|---------------|--------------------------|------------------------------|
| Bluenose-West               |                   |    |       |    |               |                          |                              |
|                             | 1986 <sup>1</sup> | ?  | 83460 | 33 | 83460         | 83460                    |                              |
|                             | 1987 <sup>1</sup> | 43 | 96626 | 42 | 98874 ± 3145  | 101067                   | 2                            |
|                             | 1992 <sup>2</sup> | 31 | 48528 | 23 | 64705 ± 9057  | 72049                    | 10                           |
|                             | 2000 <sup>3</sup> | 50 | 48058 | 32 | 74273 ± 10591 | 52508                    | 10                           |
|                             | 2005 <sup>4</sup> | 63 | 17875 | 54 | 20801 ± 2040  | 17875                    | 5                            |
|                             | 2006 <sup>5</sup> | 66 | 17781 | 65 | 18050 ± 527   | 17781                    | 1                            |
| Cape Bathurst               |                   |    |       |    |               |                          |                              |
|                             | 1986 <sup>1</sup> | ?  | 13476 | 3  | 13476         | 13476                    |                              |
|                             | 1987 <sup>1</sup> | 7  | 12712 | 6  | 14529 ± 2542  | 14173                    | 12                           |
|                             | 1992 <sup>2</sup> | 6  | 12514 | 4  | 17521 ± 5352  | 15670                    | 22                           |
|                             | 2000 <sup>3</sup> | 17 | 8899  | 15 | 10013 ± 1132  | 9857                     | 8                            |
|                             | 2005 <sup>4</sup> | 32 | 2213  | 29 | 2435 ± 257    | 2213                     | 5                            |
|                             | 2006 <sup>5</sup> | 33 | 1714  | 31 | 1821 ± 149    | 1714                     | 4                            |
| Upper Tuktoyaktuk Peninsula |                   |    |       |    |               |                          |                              |
|                             | 2006 <sup>5</sup> | 27 | 3078  | 27 | 3078          | 3078                     |                              |

The estimate of population size for each census was calculated as

$N = (((M+1)(C+1))/(R+1)) - 1$ ; where:

N = estimate of population size during the census

M = number of radio-collared caribou present in the herd (including all collars known to be active during the survey)

C = number of caribou observed in aggregations containing at least one radio-collared caribou during the survey

R = number of radio-collared caribou observed in these aggregations during the survey.

The 95% CI for the estimate was calculated as  $N_i = 1.96 \text{ Var}(N)^{0.5}$ , where:

$\text{Var}(N) = ((M+1)(C+1)(M-R)(C-R))/(R+1)^2(R+2)$

<sup>1</sup>Parameters used to derive population estimates for 1987 were obtained from field and published data (McLean and Russell (1992). There was not sufficient information documented to derive population estimates for 1986; the estimates provided here are the number of caribou counted on photos taken (McLean and Russell 1992).

<sup>2</sup>Parameters used to derive population estimates were obtained from field and unpublished data (Nagy in prep. a).

<sup>3</sup>Parameters used to derive population estimates were obtained from field and unpublished data (Nagy in prep. a)

<sup>4</sup>Parameters used to derive population estimates were obtained from field and unpublished data (Nagy and Johnson in prep. v)

<sup>5</sup> Parameters used to derive population estimates are presented in this paper.

**Table 7.** Calf and non-calf caribou counted on photographs taken of the Cape Bathurst barren-ground caribou herd on 6 July 2006.

| Date     | Group | No. of radio collars | No. counted |      | Percent Calf |
|----------|-------|----------------------|-------------|------|--------------|
|          |       |                      | Non-Calf    | Calf |              |
| 6-Jul-06 | 1     | 1                    | 6           |      |              |
| 6-Jul-06 | 2     | 9                    | 364         | 131  | 26.5         |
| 6-Jul-06 | 3     | 1                    | 1           |      |              |
| 6-Jul-06 | 4     | 1                    | 7           |      |              |
| 6-Jul-06 | 5     | 1                    | 161         | 77   | 32.4         |
| 6-Jul-06 | 6     | 4                    | 197         | 56   | 22.1         |
| 6-Jul-06 | 7     | 0                    | 2           |      |              |
| 6-Jul-06 | 8     | 7                    | 350         | 106  | 23.2         |
| 6-Jul-06 | 9     | 1                    | 2           |      |              |
| 6-Jul-06 | 10    | 0                    | 16          |      |              |
| 6-Jul-06 | 11    | 1                    | 146         | 1    | 0.7          |
| 6-Jul-06 | 12    | 1                    | 256         |      |              |
| Total    |       | 27                   | 1508        | 371  | 19.7         |

**Table 8.** Calf and non-calf caribou counted on photographs taken of the Cape Bathurst barren-ground caribou herd on 9 July 2006.

| Date     | Group | No. of radio collars | No. counted |      | Percent Calf |
|----------|-------|----------------------|-------------|------|--------------|
|          |       |                      | Non-Calf    | Calf |              |
| 9-Jul-06 | 1     | 6                    | 166         | 44   | 21.0         |
| 9-Jul-06 | 2     | 3                    | 58          | 13   | 18.3         |
| 9-Jul-06 | 3     | 1                    | 192         | 68   | 26.2         |
| 9-Jul-06 | 4     | 2                    | 106         | 29   | 21.5         |
| 9-Jul-06 | 5     | 0                    | 14          | 2    | 12.5         |
| 9-Jul-06 | 6     | 4                    | 70          | 22   | 23.9         |
| 9-Jul-06 | 7     | 3                    | 128         | 40   | 23.8         |
| 9-Jul-06 | 8     | 3                    | 224         | 56   | 20.0         |
| 9-Jul-06 | 9     | 1                    | 6           |      |              |
| 9-Jul-06 | 10    | 1                    | 34          |      |              |
| 9-Jul-06 | 11    | 0                    | 1           |      |              |
| 9-Jul-06 | 12    | 0                    | 15          | 2    | 11.8         |
| 9-Jul-06 | 13    | 0                    | 48          |      |              |
| 9-Jul-06 | 14    | 1                    | 1           |      |              |
| 9-Jul-06 | 15    | 1                    | 67          |      |              |
| 9-Jul-06 | 16    | 1                    | 264         |      |              |
| 9-Jul-06 | 17    | 0                    | 2           |      |              |
| 9-Jul-06 | 18    | 1                    | 53          |      |              |
| 9-Jul-06 | 19    | 0                    | 35          | 8    | 18.6         |
| 9-Jul-06 | 20    | 0                    | 9           |      |              |
| 9-Jul-06 | 21    | 1                    | 18          |      |              |
| 9-Jul-06 | 22    | 1                    | 2           |      |              |
| 9-Jul-06 | 23    | 0                    | 1           |      |              |
| Total    |       | 30                   | 1514        | 284  | 15.8         |

**Table 9.** Calf and non-calf caribou counted on photographs taken of the Cape Bathurst barren-ground caribou herd on 13 July 2006.

| Date      | Group | No. of radio collars | No. counted |      | Percent Calf |
|-----------|-------|----------------------|-------------|------|--------------|
|           |       |                      | Non-Calf    | Calf |              |
| 13-Jul-06 | 1     | 1                    | 1           |      |              |
| 13-Jul-06 | 2     | 2                    | 106         | 7    | 6.2          |
| 13-Jul-06 | 3     | 7                    | 225         | 25   | 10.0         |
| 13-Jul-06 | 4     | 19                   | 1367        | 266  | 16.3         |
| 13-Jul-06 | 5     | 1                    | 1           |      |              |
| 13-Jul-06 | 6     | 0                    | 1           |      |              |
| 13-Jul-06 | 7     | 1                    | 3           |      |              |
| 13-Jul-06 | 8     | 0                    | 5           |      |              |
| 13-Jul-06 | 9     | 0                    | 2           |      |              |
| 13-Jul-06 | 10    | 0                    | 2           |      |              |
| 13-Jul-06 | 11    | 0                    | 1           |      |              |
| Total     |       | 31                   | 1714        | 298  | 14.8         |



**Table 10.** Calf and non-calf reindeer/caribou counted on photographs taken on the upper Tuktoyaktuk Peninsula on 9 July 2006.

| Date     | Group | No. of radio collars | No. counted |      | Percent Calf |
|----------|-------|----------------------|-------------|------|--------------|
|          |       |                      | Non-Calf    | Calf |              |
| 9-Jul-06 | 1     | 1                    | 8           |      |              |
| 9-Jul-06 | 2     | 1                    | 18          |      |              |
| 9-Jul-06 | 3     | 1                    | 8           | 1    | 11.1         |
| 9-Jul-06 | 4     | 3                    | 112         | 52   | 31.7         |
| 9-Jul-06 | 5     | 0                    | 7           | 3    | 30.0         |
| 9-Jul-06 | 6     | 1                    | 16          | 7    | 30.4         |
| 9-Jul-06 | 7     | 0                    | 16          | 2    | 11.1         |
| 9-Jul-06 | 8     | 0                    | 38          | 20   | 34.5         |
| 9-Jul-06 | 9     | 0                    | 5           |      |              |
| 9-Jul-06 | 10    | 2                    | 293         | 136  | 31.7         |
| 9-Jul-06 | 11    | 0                    | 35          | 15   | 30.0         |
| 9-Jul-06 | 12    | 5                    | 951         | 307  | 24.4         |
| 9-Jul-06 | 13    | 2                    | 364         | 155  | 29.9         |
| 9-Jul-06 | 14    | 3                    | 167         | 74   | 30.7         |
| 9-Jul-06 | 15    | 3                    | 230         | 73   | 24.1         |
| 9-Jul-06 | 16    | 0                    | 84          | 28   | 25.0         |
| 9-Jul-06 | 17    | 1                    | 352         | 170  | 32.6         |
| 9-Jul-06 | 18    | 1                    | 82          |      |              |
| 9-Jul-06 | 19    | 1                    | 1           |      |              |
| 9-Jul-06 | 20    | 1                    | 1           |      |              |
| 9-Jul-06 | 21    | 0                    | 4           |      |              |
| 9-Jul-06 | 22    | 1                    | 74          | 34   | 31.5         |
| Total    |       | 27                   | 2866        | 1077 | 27.3         |

**Table 11.** Calf and non-calf reindeer/caribou counted on photographs taken on the upper Tuktoyaktuk Peninsula on 13 July 2006.

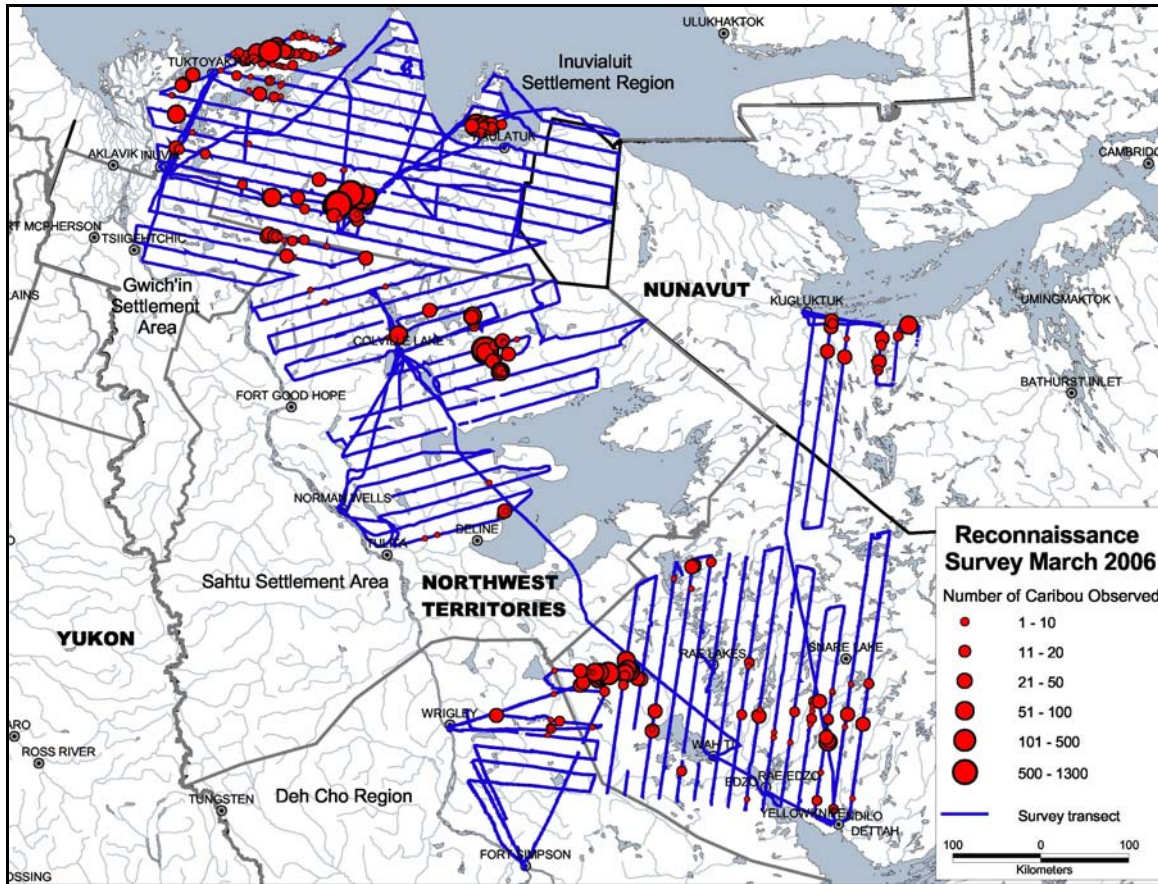
| Date      | Group | No. of radio collars | No. counted |      | Percent Calf |
|-----------|-------|----------------------|-------------|------|--------------|
|           |       |                      | Non-Calf    | Calf |              |
| 13-Jul-06 | 1     | 1                    | 1           |      |              |
| 13-Jul-06 | 2     | 10                   | 1627        | 438  | 21.2         |
| 13-Jul-06 | 3     | 2                    | 135         | 3    | 2.2          |
| 13-Jul-06 | 4     | 1                    | 228         | 81   | 26.2         |
| 13-Jul-06 | 5     | 0                    | 147         | 66   | 31.0         |
| 13-Jul-06 | 6     | 4                    | 317         | 158  | 33.3         |
| 13-Jul-06 | 7     | 7                    | 335         | 141  | 29.6         |
| 13-Jul-06 | 8     | 0                    | 9           |      |              |
| 13-Jul-06 | 9     | 0                    | 13          |      |              |
| 13-Jul-06 | 10    | 0                    | 1           | 1    | 50.0         |
| 13-Jul-06 | 11    | 0                    | 13          | 8    | 38.1         |
| 13-Jul-06 | 12    | 0                    | 1           | 1    | 50.0         |
| 13-Jul-06 | 13    | 1                    | 250         | 82   | 24.7         |
| 13-Jul-06 | 14    | 1                    | 1           |      |              |
| Total     |       | 27                   | 3078        | 979  | 24.1         |

**Table 12.** Air temperatures, wind speed, and wind direction documented at the CARS weather station at Paulatuk, NT, 15 June 2006 to 14 July 2006.

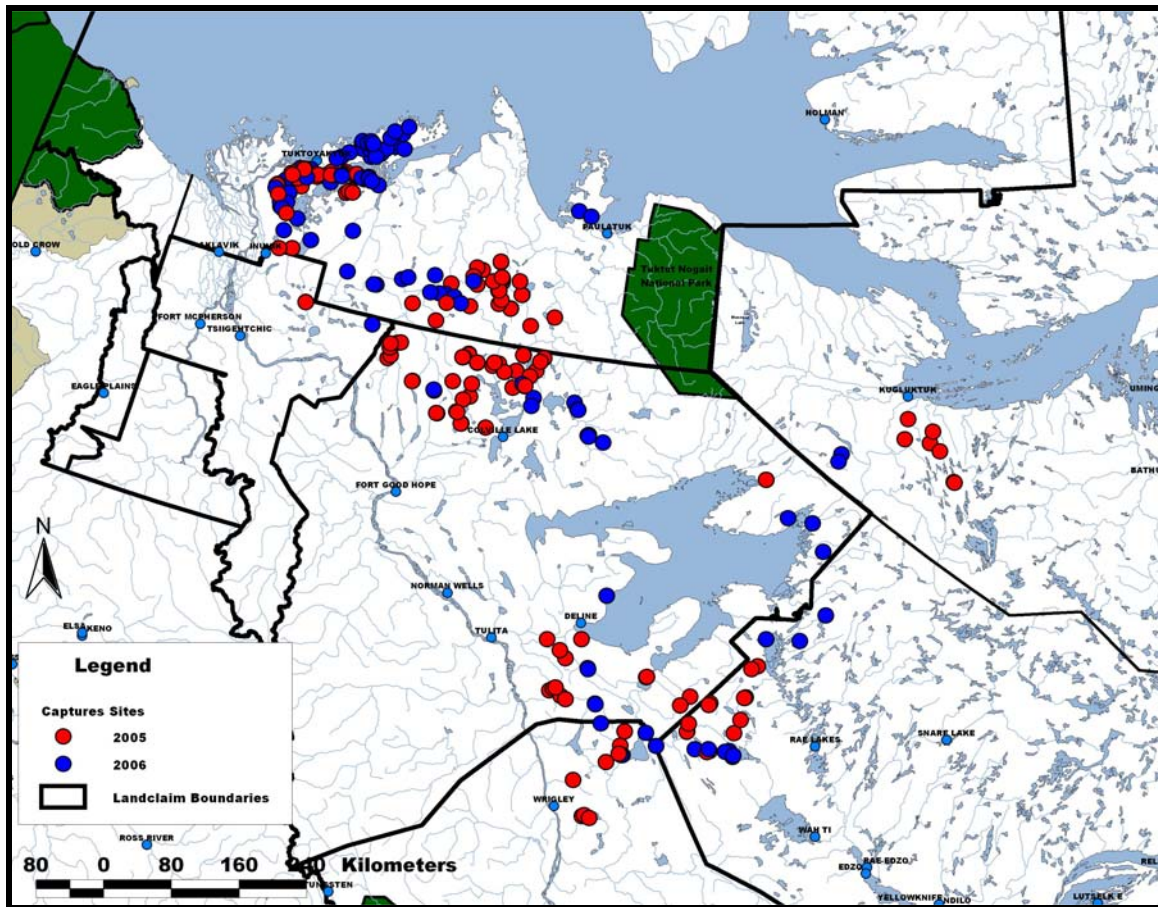
| Date      | Temperature<br>(Celsius) |      |      | Wind Speed<br>(Knots) |      |      | Wind Direction<br>(True) |      |      |
|-----------|--------------------------|------|------|-----------------------|------|------|--------------------------|------|------|
|           | Time UTC                 |      |      | Time UTC              |      |      | Time UTC                 |      |      |
|           | 1500                     | 1800 | 2100 | 1500                  | 1800 | 2100 | 1500                     | 1800 | 2100 |
| 15-Jun-06 | 1.3                      | 2.0  | 2.9  | 5                     | 3    | 4    | 29                       | 32   | 30   |
| 16-Jun-06 | 2.7                      | 2.9  | 1.5  | 3                     | 3    | 4    | 33                       | 30   | 34   |
| 17-Jun-06 | 2.4                      | 2.3  | 0.7  | 3                     | 3    | 3    | 31                       | 33   | 6    |
| 18-Jun-06 | 3.4                      | 2.1  |      | 4                     | 5    |      | 28                       | 28   |      |
| 19-Jun-06 | 12.0                     | 7.3  | 5.0  | 3                     | 10   | 5    | 33                       | 5    | 5    |
| 20-Jun-06 | 1.0                      | 2.1  | 3.1  | 5                     | 5    | 5    | 27                       | 32   | 32   |
| 21-Jun-06 | 3.8                      | 4.0  | 14.0 | 15                    | 10   | 10   | 18                       | 23   | 36   |
| 22-Jun-06 | 10.2                     | 7.0  | 5.9  | 5                     | 5    | 5    | 6                        | 3    | 35   |
| 23-Jun-06 | 3.8                      | 2.7  | 3.1  | 5                     | 5    | 5    | 27                       | 27   | 27   |
| 24-Jun-06 | 5.7                      | 5.2  | 5.2  | 10                    | 10   | 5    | 32                       | 32   | 32   |
| 25-Jun-06 | 6.1                      | 4.7  |      | 5                     | 5    |      | 36                       | 4    |      |
| 26-Jun-06 | 9.6                      | 8.1  | 5.7  | 0                     | 3    | 5    |                          | 33   | 30   |
| 27-Jun-06 | 6.3                      | 6.1  | 6.3  | 0                     | 3    | 5    |                          | 27   | 27   |
| 28-Jun-06 | 6.2                      | 4.1  | 4.4  | 15                    | 15   | 15   | 18                       | 23   | 18   |
| 29-Jun-06 | 15.2                     | 13.1 | 11.7 | 15                    | 10   | 10   | 23                       | 23   | 27   |
| 30-Jun-06 | 6.2                      | 4.7  | 3.6  | 10                    | 10   | 5    | 27                       | 32   | 32   |
| 01-Jul-06 | 11.3                     | 10.4 | 12.6 | 10                    | 5    | 7    | 20                       | 27   | 29   |
| 02-Jul-06 | 10.5                     | 8.6  |      | 20                    | 15   |      | 21                       | 24   |      |
| 03-Jul-06 | 5.7                      | 3.7  | 6.0  | 20                    | 15   | 10   | 32                       | 27   | 29   |
| 04-Jul-06 | 4.7                      | 3.7  | 3.2  | 3                     | 5    | 5    | 28                       | 31   | 32   |
| 05-Jul-06 | 7.0                      | 4.0  | 2.8  | 10                    | 10   | 10   | 27                       | 32   | 32   |
| 06-Jul-06 | 3.1                      | 2.0  | 1.3  | 10                    | 5    | 5    | 32                       | 32   | 32   |
| 07-Jul-06 | 2.1                      | 1.7  | 0.6  | 2                     | 5    | 10   | 36                       | 36   | 6    |
| 08-Jul-06 | 6.0                      | 2.8  | 1.0  | 5                     | 3    | 5    | 36                       | 36   | 3    |
| 09-Jul-06 | 3.1                      | 2.8  |      | 0                     | 3    |      |                          | 33   |      |
| 10-Jul-06 | 4.7                      | 3.8  | 2.1  | 5                     | 3    | 6    | 34                       | 33   | 6    |
| 11-Jul-06 | 7.8                      | 5.1  | 3.6  | 3                     | 3    | 5    | 34                       | 4    | 6    |
| 12-Jul-06 | 18.3                     | 20.9 | 16.9 | 9                     | 4    | 17   | 17                       | 18   | 5    |
| 13-Jul-06 | 14.4                     | 18.4 | 18.3 | 2                     | 6    | 8    | 6                        | 5    | 4    |
| 14-Jul-06 | 9.8                      | 11.4 | 14.3 | 5                     | 5    | 2    | 28                       | 31   | 33   |



**Figure 1.** Transect lines flown during late February and March 2006 to document the distribution of caribou on the winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds and of reindeer/caribou on the upper Tuktoyaktuk Peninsula.

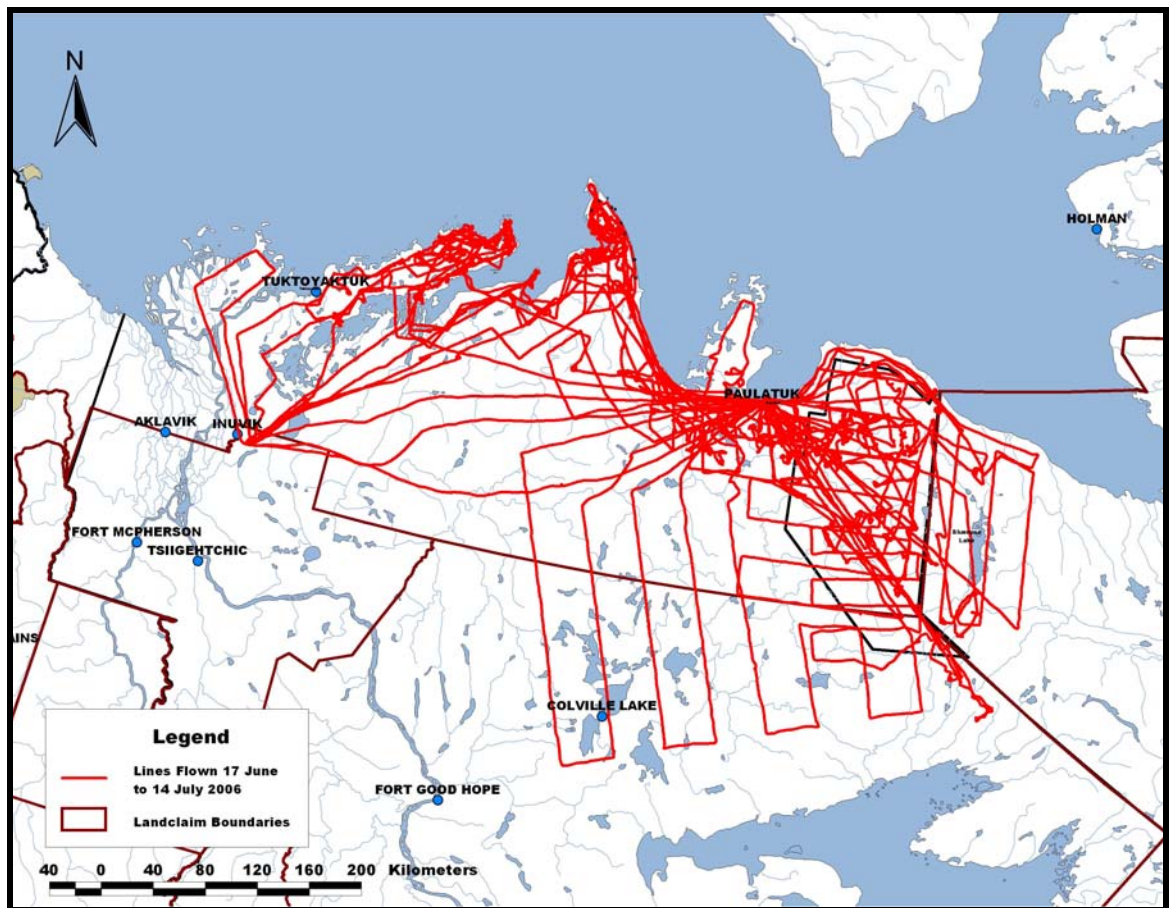


**Figure 2.** Distribution of capture sites, 2005 and 2006.

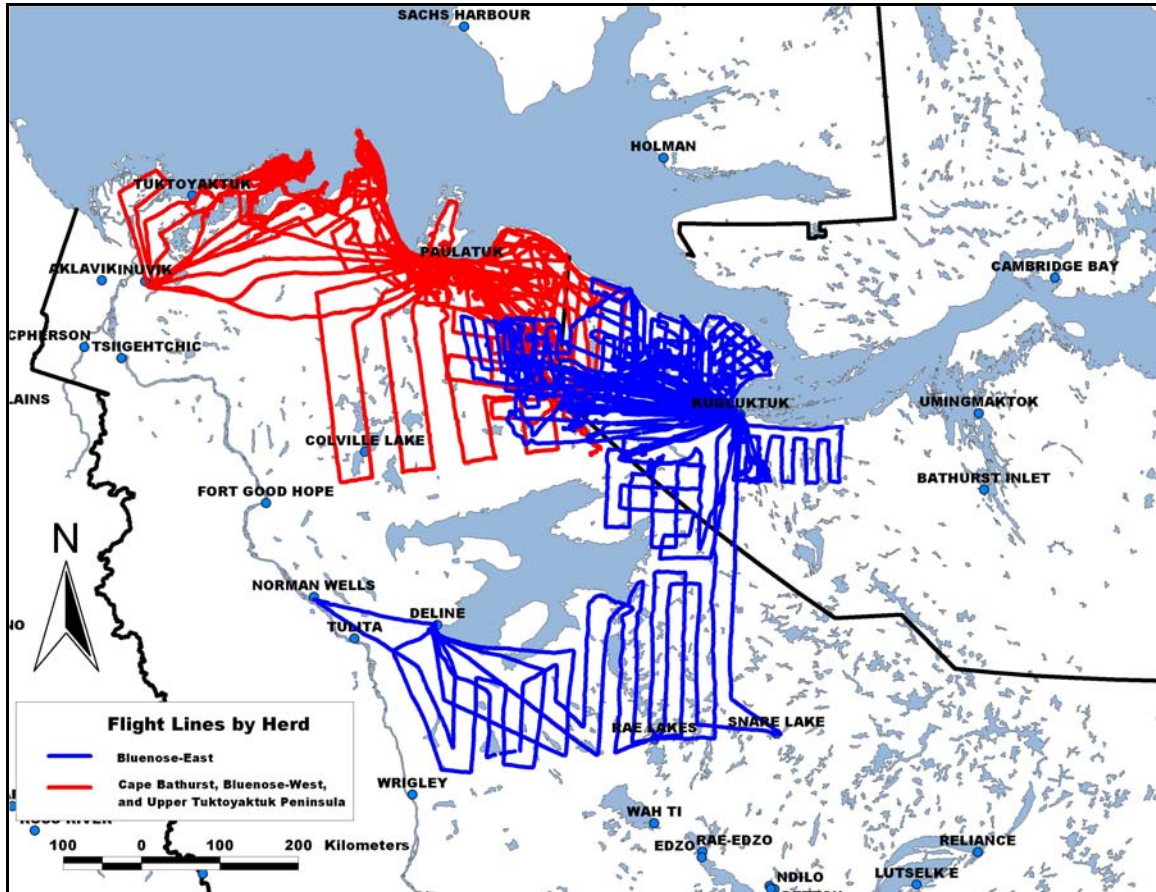




**Figure 3.** Lines flown during reconnaissance flights conducted between 17 June to 14 July 2006.

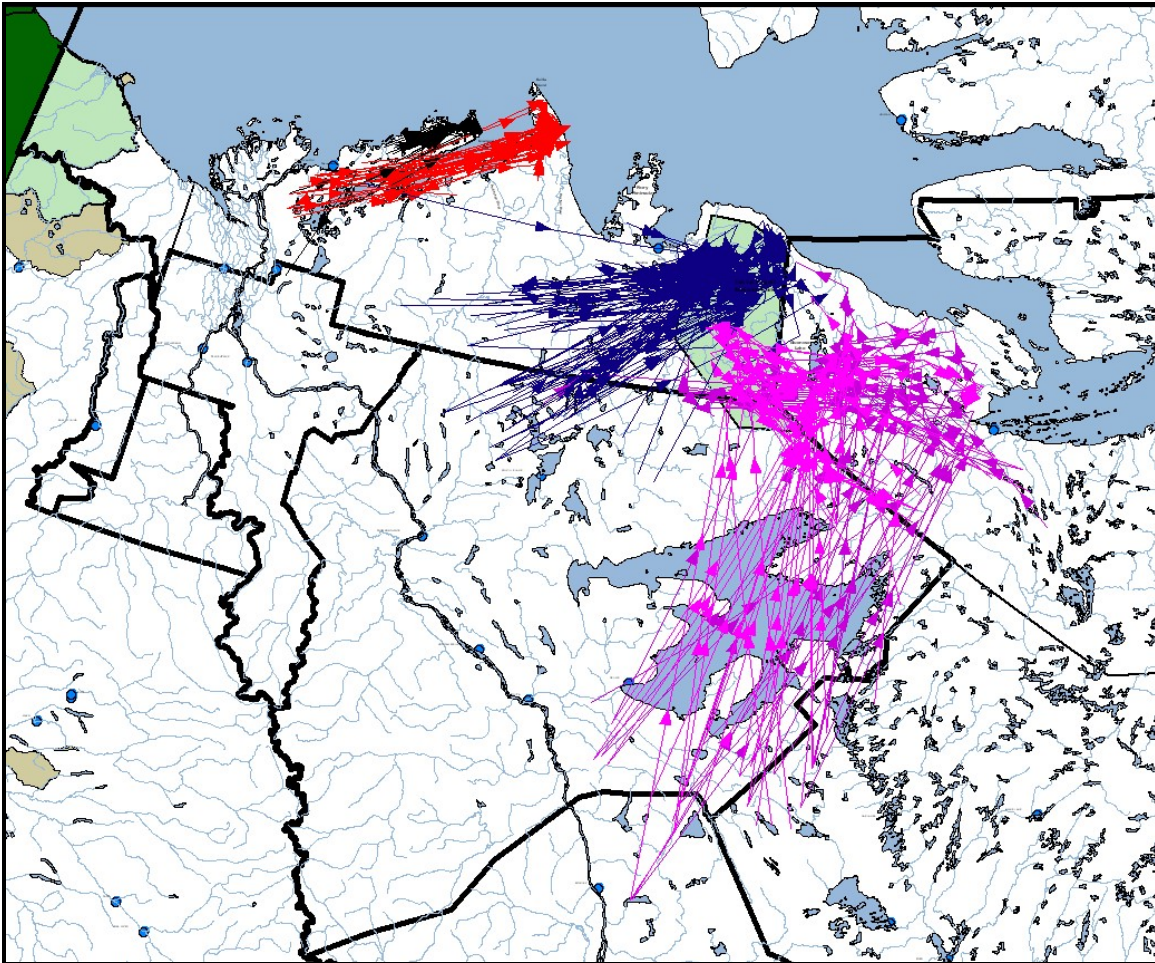


**Figure 4.** Distribution of reconnaissance flights flown to locate and monitor the movements of radio-collared caribou in the Cape Bathurst, Bluenose-West, and Bluenose-East herds and reindeer/caribou on the upper Tuktoyaktuk Peninsula during June and July 2006.

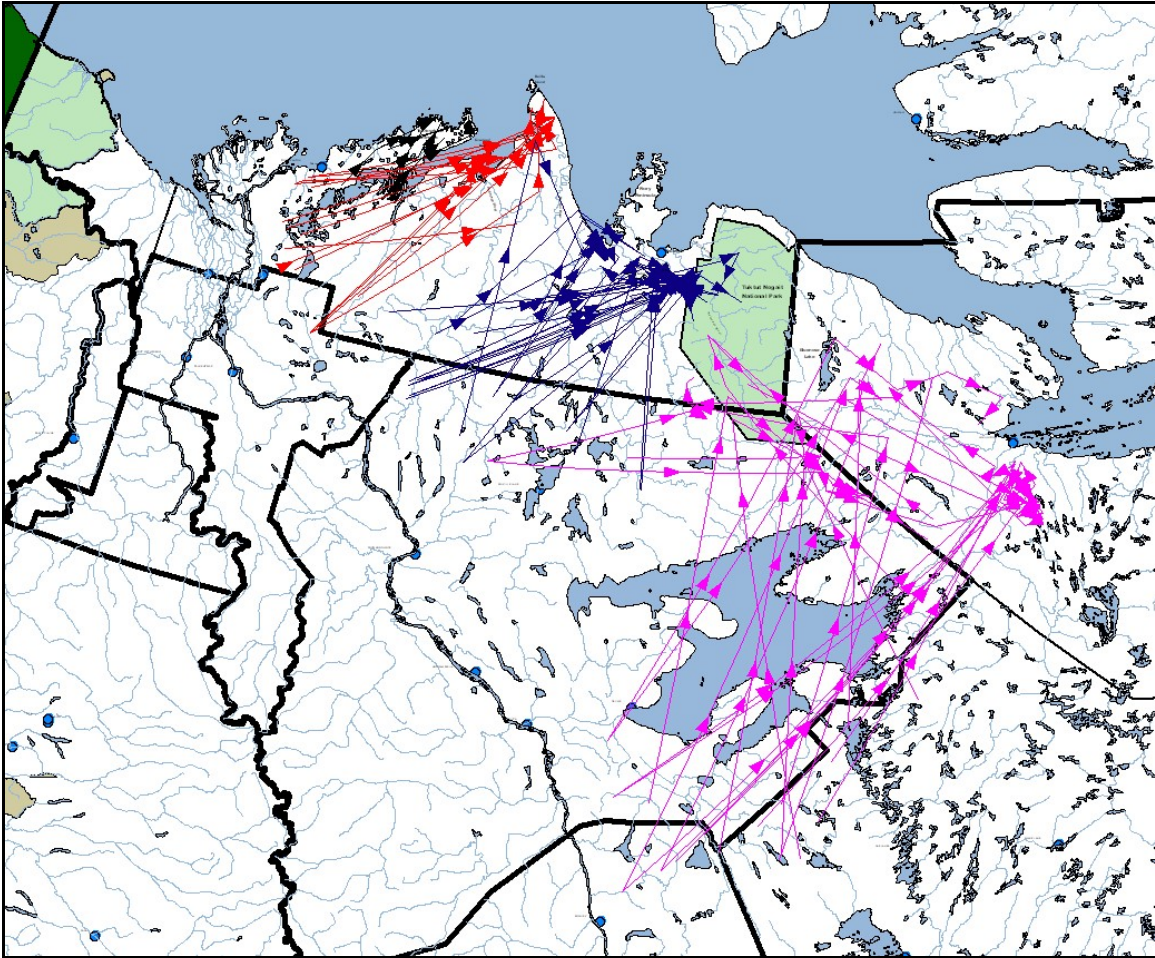




**Figure 5.** Distribution of radio-collared cows relative to where they were captured.

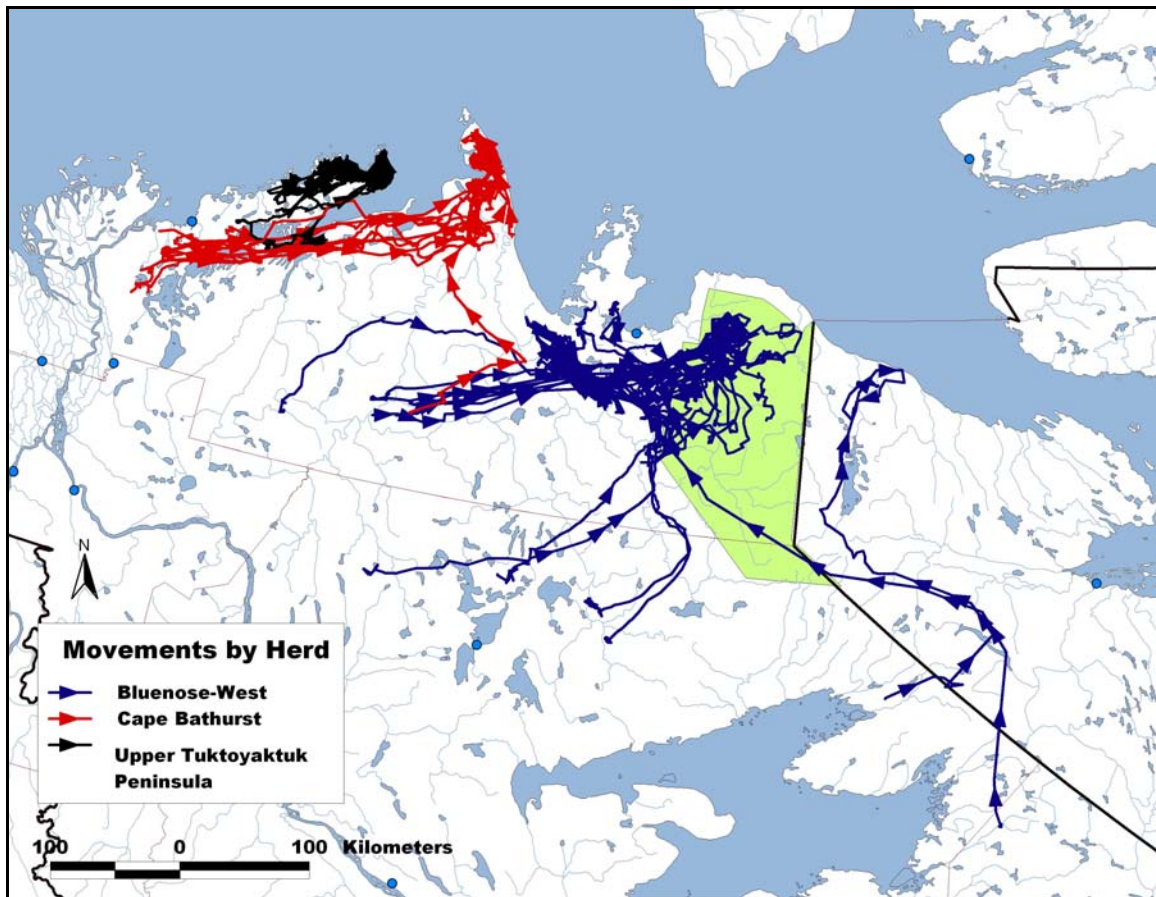


**Figure 6.** Distribution of radio-collared bulls relative to where they were captured.

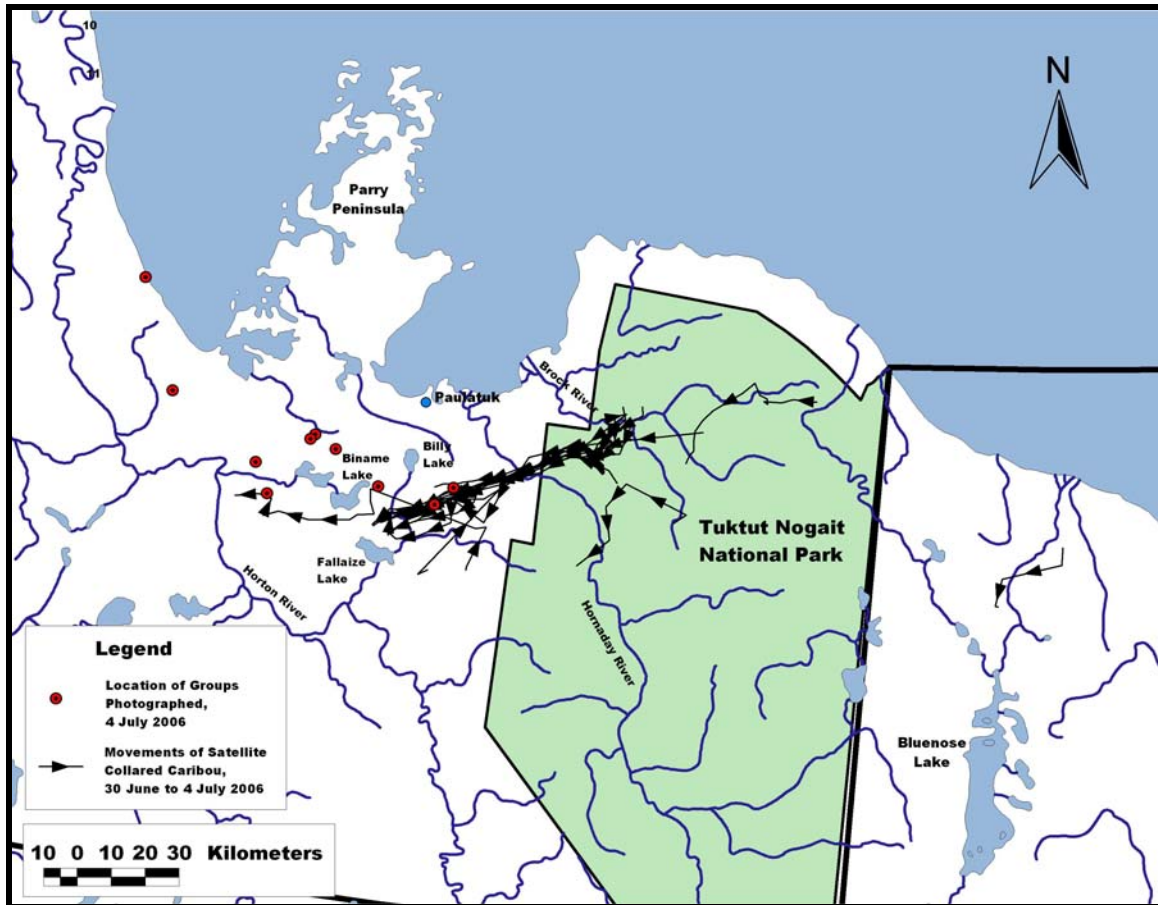




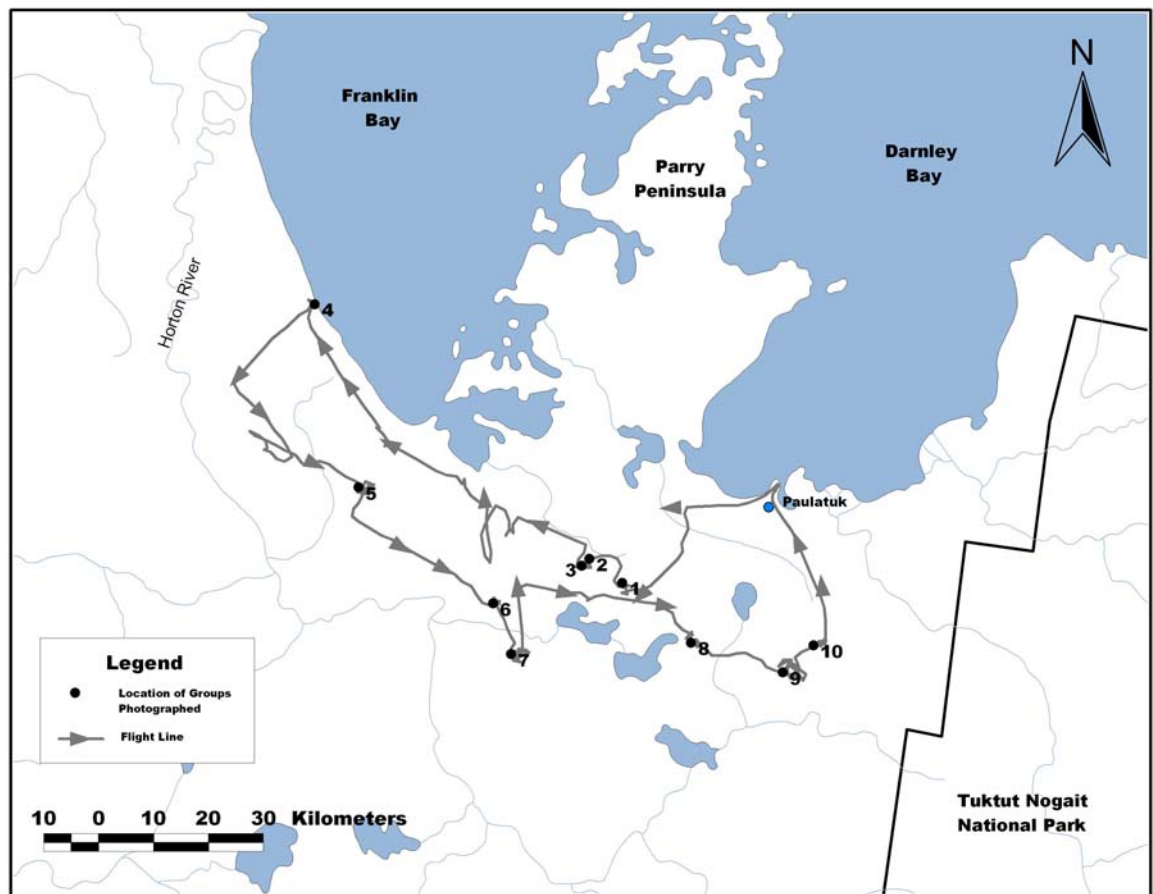
**Figure 7.** Distribution of satellite-collared caribou (ARGOS and GPS), 1 March 2006 to 15 July 2006.



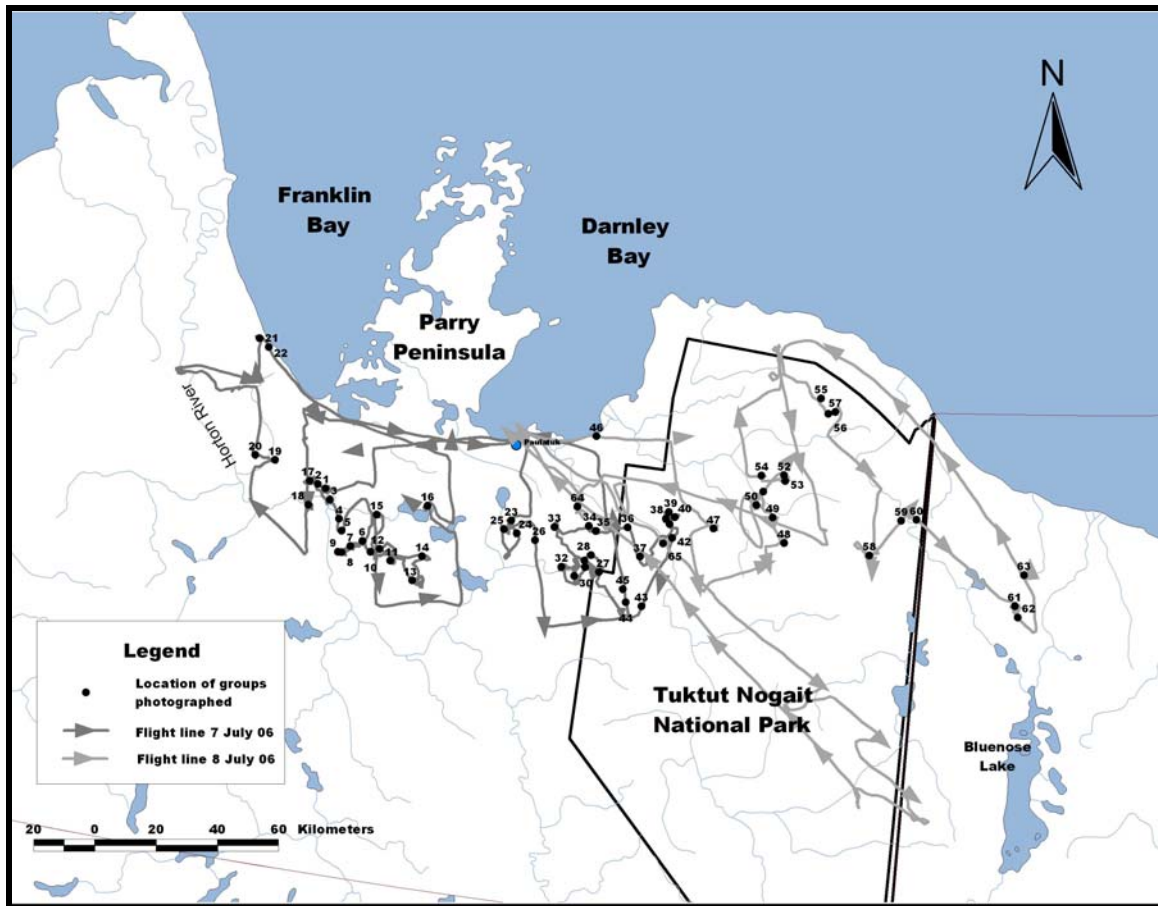
**Figure 8.** Movements of radio-collared Bluenose-West barren-ground caribou during the period 30 June to 4 July 06 and distribution of groups photographed on 4 July 2006.



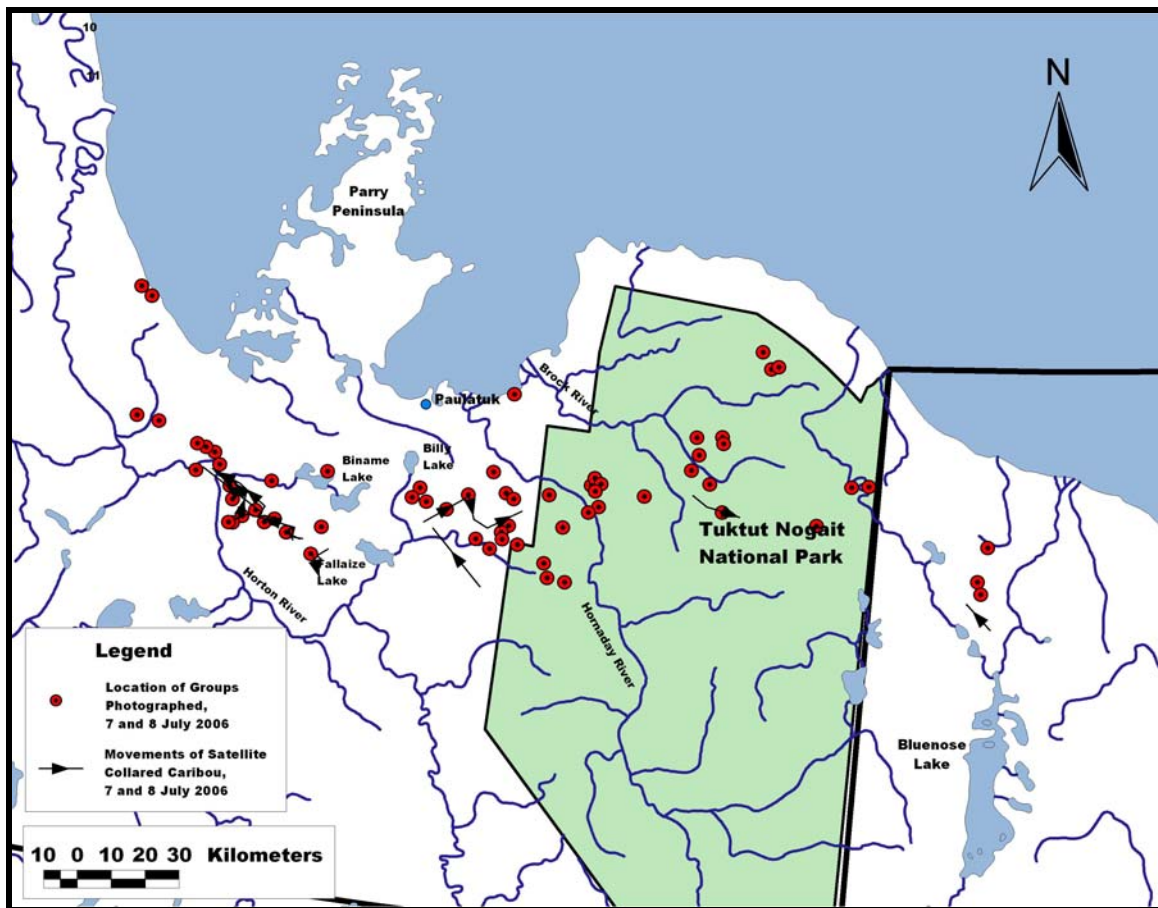
**Figure 9.** Track flown and distribution of groups of Bluenose-West barren-ground caribou photographed on 4 July 2006.



**Figure 10.** Tracks flown and distribution of groups of Bluenose-West barren-ground caribou photographed on 7 and 8 July 2006.

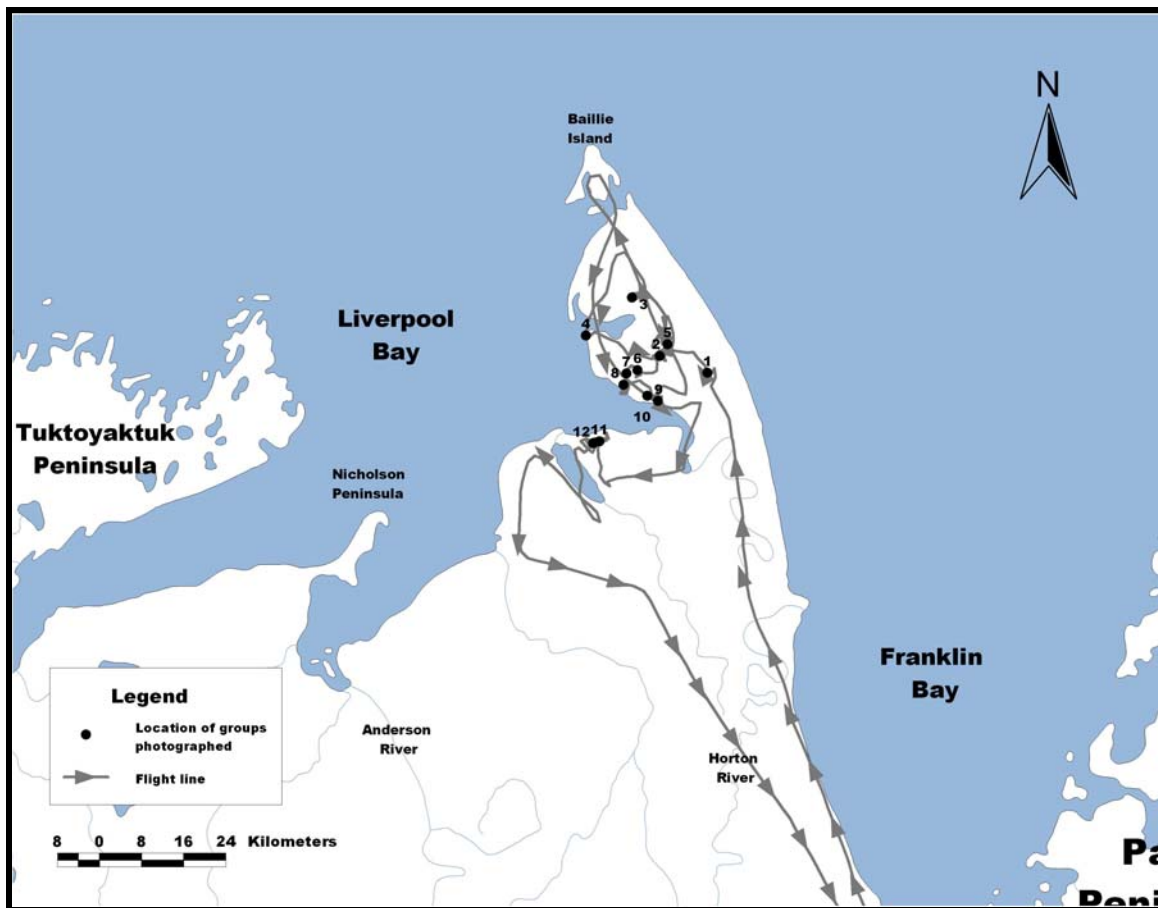


**Figure 11.** Movements of radio-collared Bluenose-West barren-ground caribou and distribution of groups photographed on 7 and 8 July 2006.



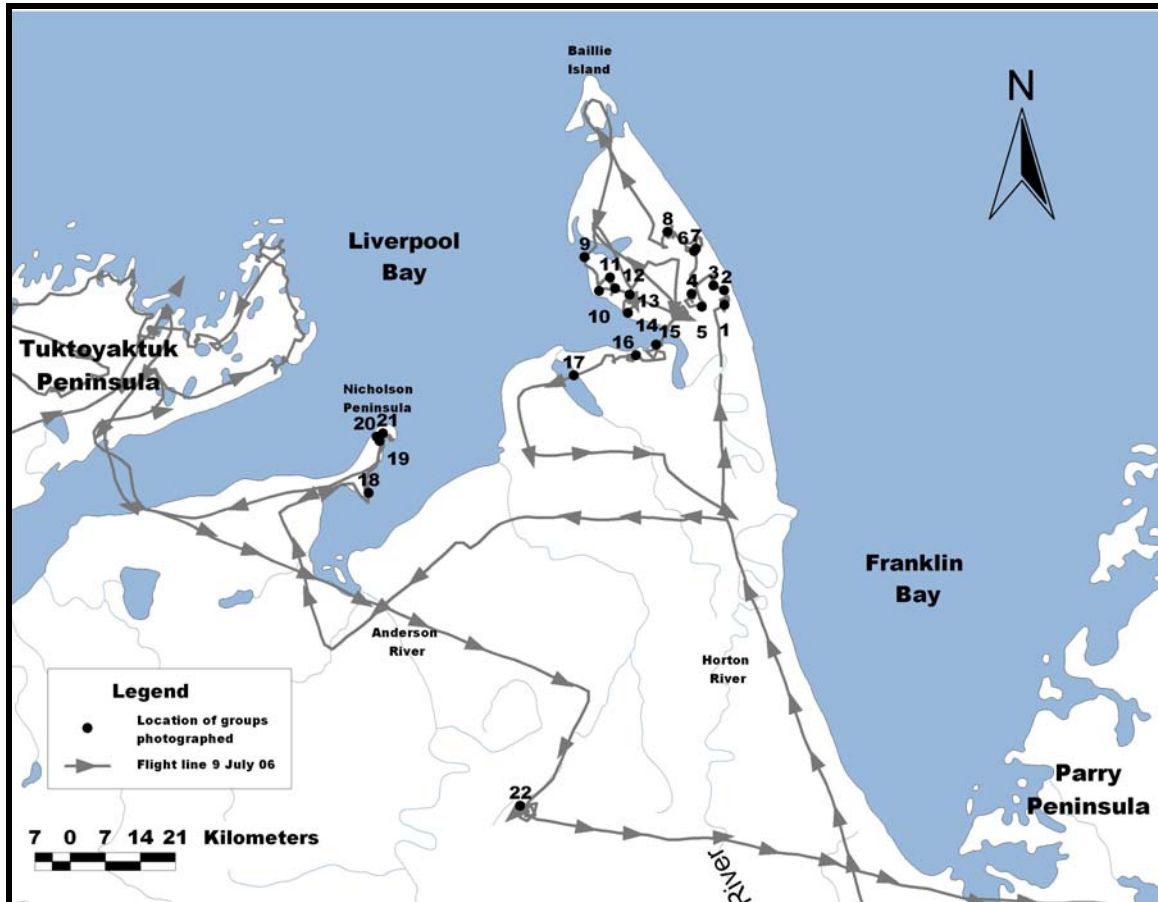


**Figure 12.** Tracks flown and distribution of Cape Bathurst barren-ground caribou groups photographed on 6 July 2006.

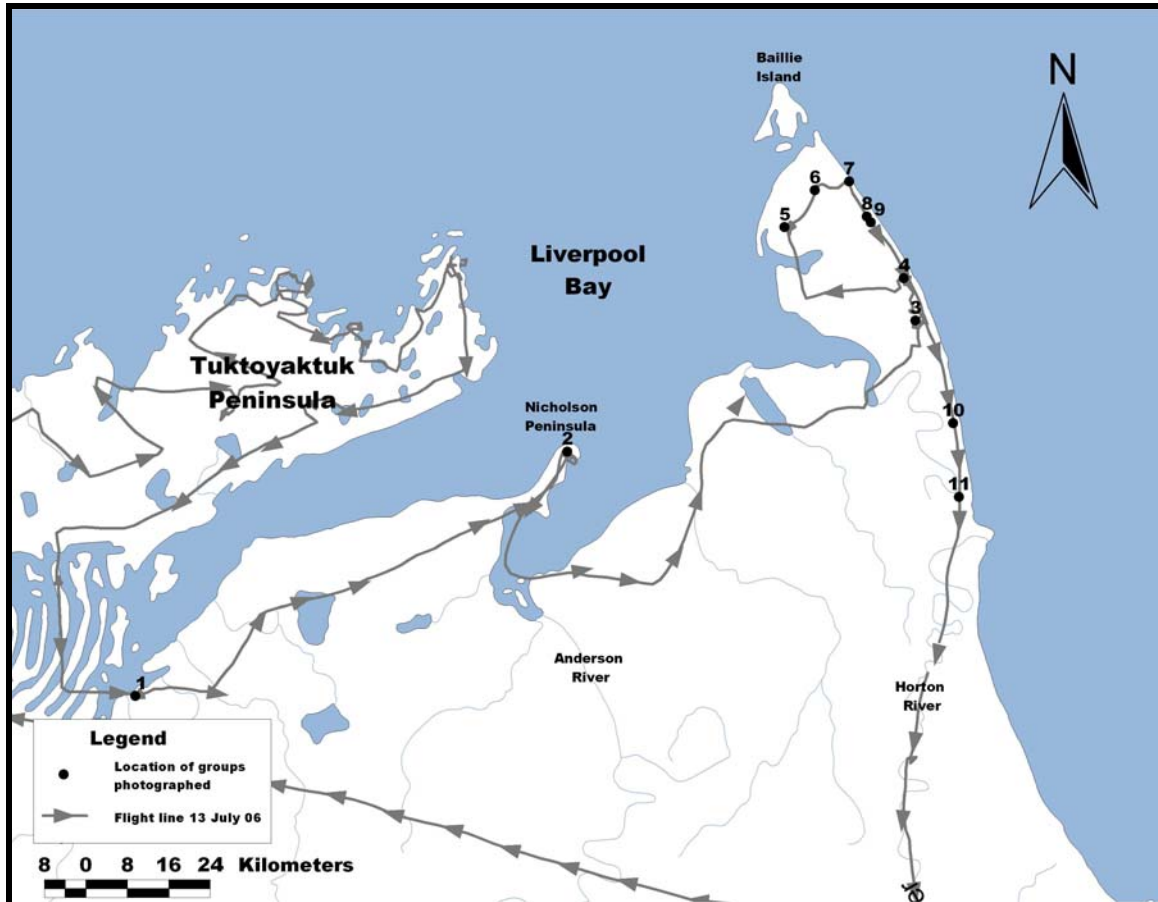




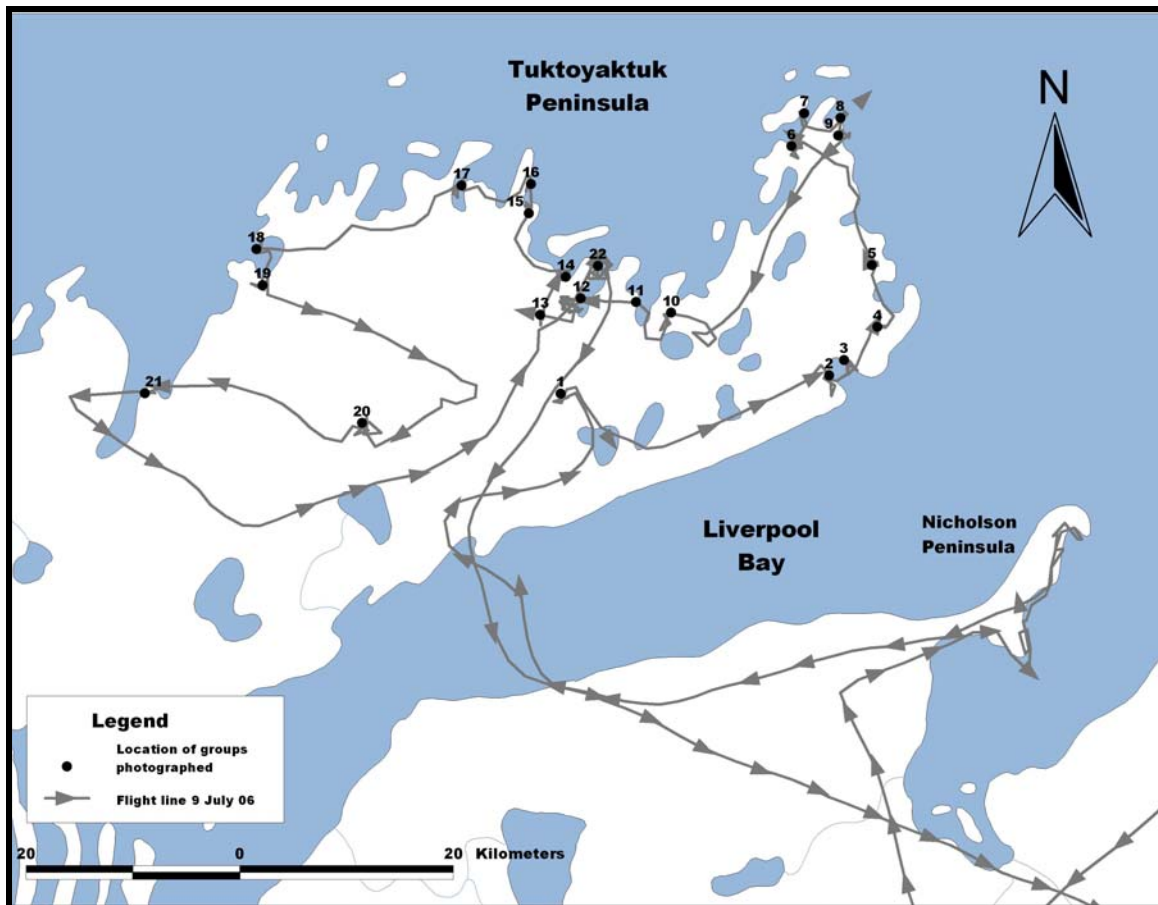
**Figure 13.** Tracks flown and distribution of Cape Bathurst barren-ground caribou groups photographed on 9 July 2006.



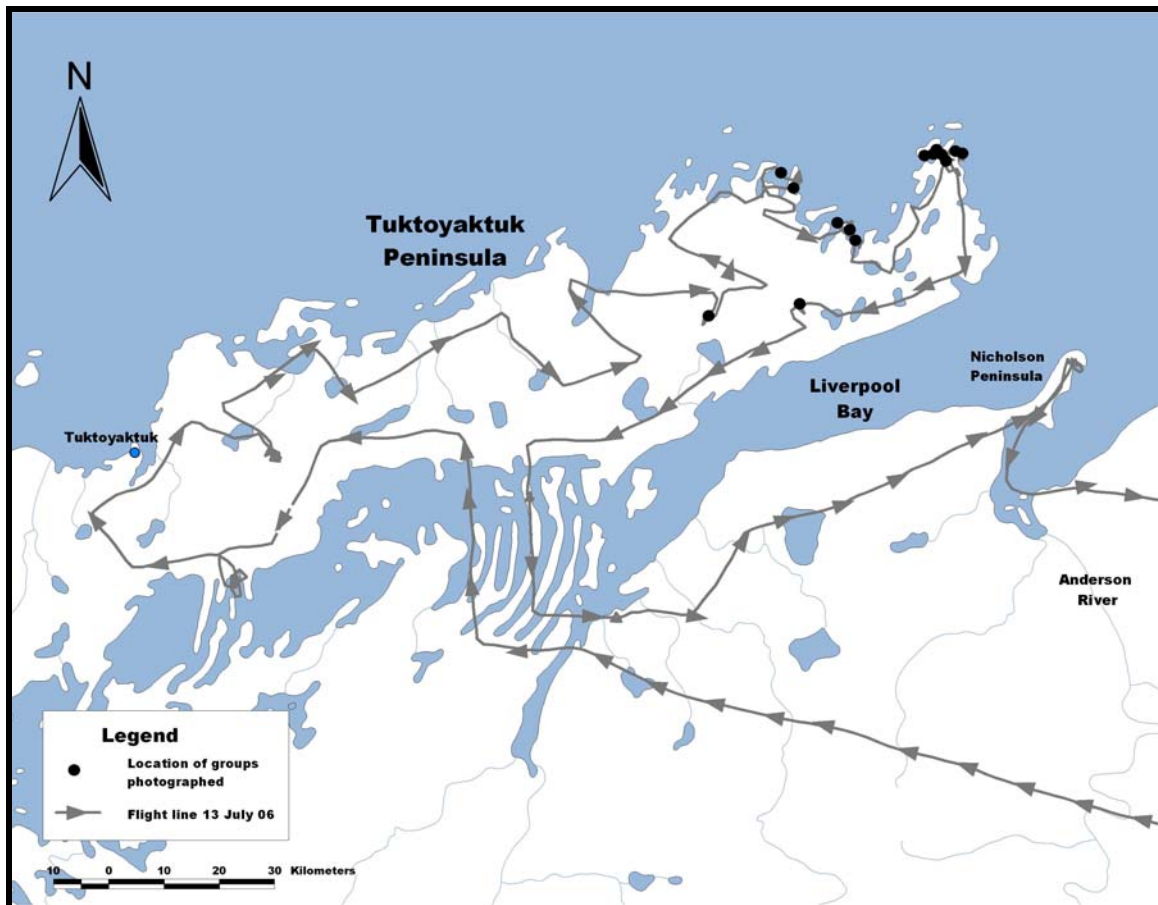
**Figure 14.** Tracks flown and distribution of Cape Bathurst barren-ground caribou groups photographed on 13 July 2006.



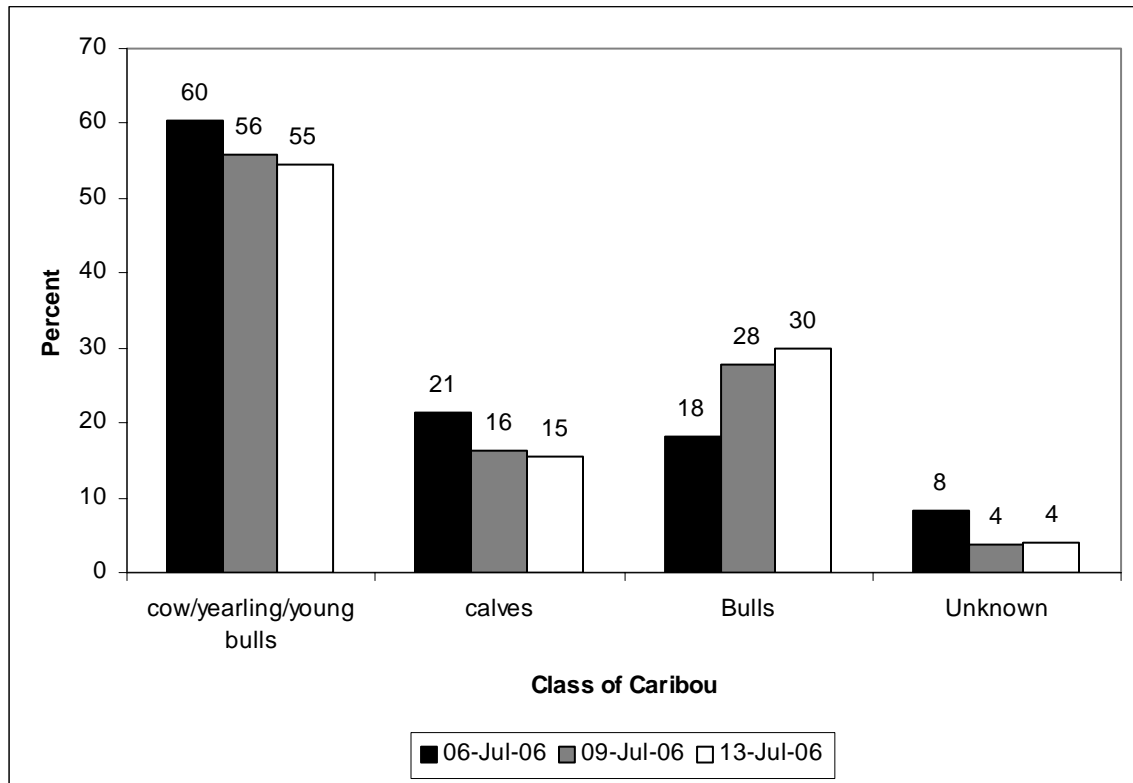
**Figure 15.** Distribution of reindeer and barren-ground caribou groups photographed on 9 July 2006.



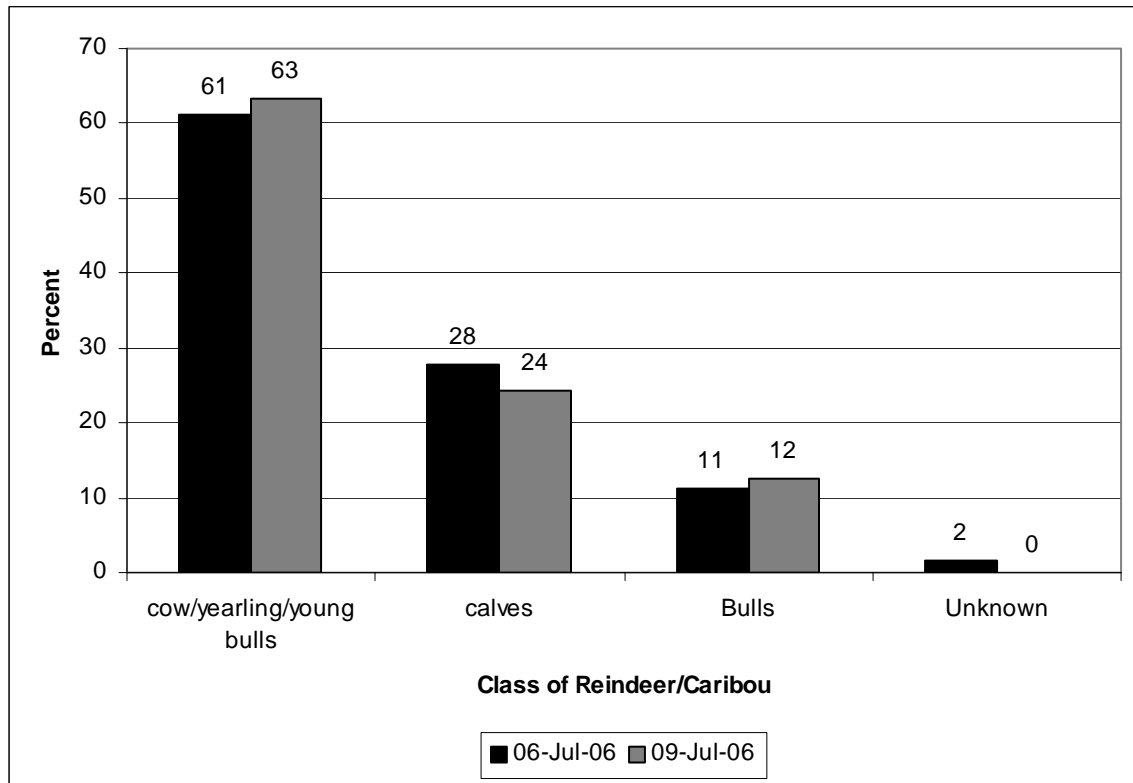
**Figure 16.** Distribution of reindeer and barren-ground caribou groups photographed on 13 July 2006.



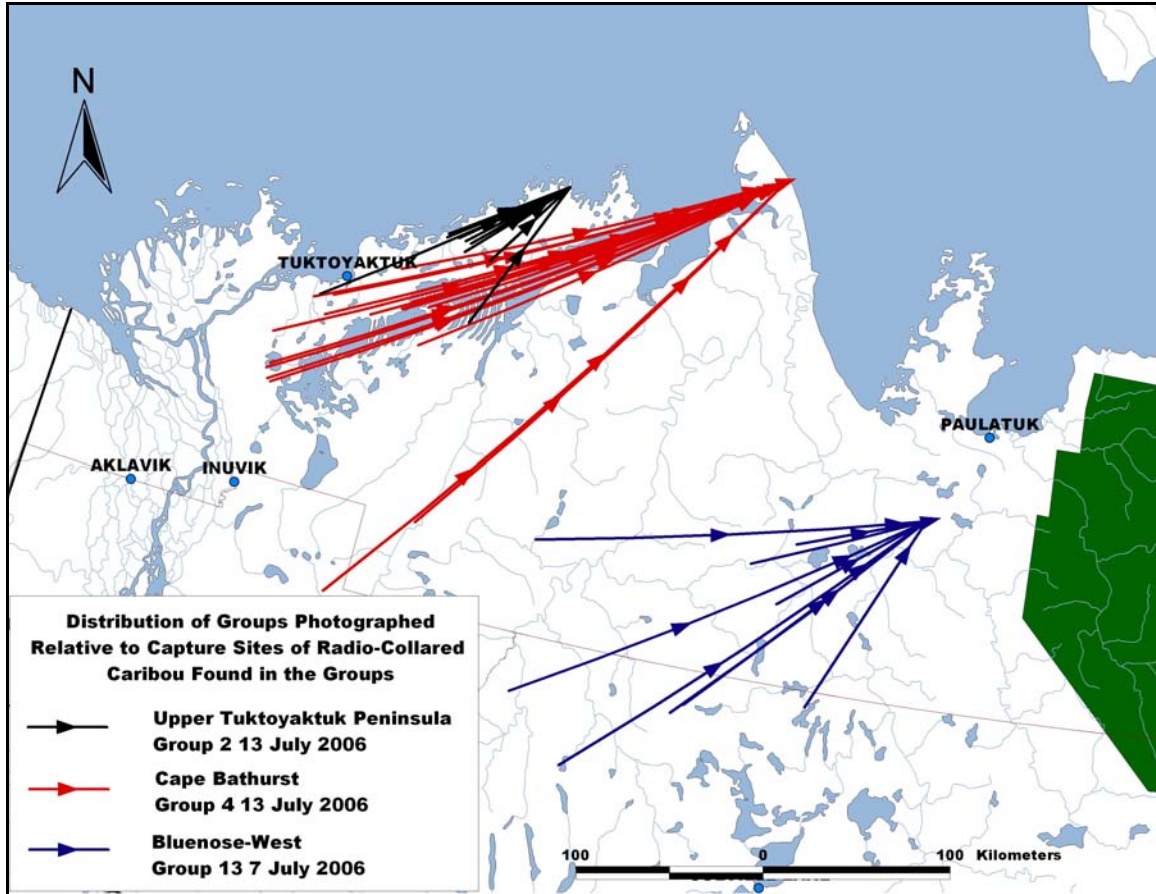
**Figure 17.** Composition of the Cape Bathurst barren-ground caribou herd when photographed on 6, 9, and 13 July 2006.



**Figure 18.** Composition of the reindeer and caribou on the upper Tuktoyaktuk Peninsula when photographed on 9 and 13 July 2006.



**Figure 19.** Distribution of the largest groups photographed in the Bluenose-West herd on 7 July 2006, in the Cape Bathurst herd on 13 July 2006, and on the upper Tuktoyaktuk Peninsula on 13 July 2006 relative to the capture sites of the radio-collared caribou found in those groups.







## LITERATURE CITED

- Bethke, R., Taylor, M., Amstrup, S., and Messier, F. Population delineation of polar bears using satellite collar data. *Ecological Applications* 6, 311-317. 1996.
- Environmental Systems Research Institute. ArcView GIS:Release 3.2 [software]. Redlands, California: Environmental Systems Research Institute, 1992-1999 .
- Gibbons, J. D. Nonparametric methods for quantitative analysis. American Sciences Press, Inc. 481 pp. 1985.
- Gunn, A. and Miller, F. L. Traditional behaviour and fidelity to caribou calving grounds by barren-ground caribou. *Rangifer Special Issue 1* , 151-158. 1986.
- McLean, B.D. and Russell, H.J. 1992. Photocensus of the Bluenose caribou herd in July 1986 and 1987. Department of Renewable Resources, Government of the Northwest Territories, Inuvik, NWT File Report No. 108: 32 pp.
- Nagy, J.A. in prep. a. Populations estimates for the Cape Bathurst and Bluenose-West barren-ground caribou herds derived using post calving photography, July 2000. ENR Manuscript Report.
- Nagy, J.A., Branigan, M., Veitch, A., Popko, R., and Nishi, J. 1999. Co-management plan for the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds and work plans for years 1999/2000 to 2003/2004. Department of Resources, Wildlife, and Economic Development, Government of the Northwest Territories, Inuvik, Northwest Territories Draft: 41 pp.
- Nagy, J. A. and Johnson, D. Estimates of the number of barren-ground caribou in the Cape Bathurst and Bluenose-West herds using post-calving photography, July 2005. Department of Environment and Natural Resources Manuscript Report . in prep. v.
- Nagy, J. A., Tracz, B., and Gunn, A. Estimate of the number of barren-ground caribou in the Bluenose-East barren-ground caribou herd, July 2005. Department of Environment and Natural Resources Manuscript Report . in prep. r.

- Nagy, J. A., Veitch, A. M., Zittlau, K., Larter, N. C., Cooley, D., Patterson, B. R., and Strobeck, C. Defining herds within the range of "Bluenose" barren-ground caribou in Canada's Northwest Territories and Nunavut. Poster presented at the 10th Arctic Ungulate Conference, Tromso, Norway . 9-12 August 1999.
- Nagy, J. A., Wright, W. H., Slack, T. M., and Veitch, A. M. Seasonal ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds. Department of Environment and Natural Resources, Government of the Northwest Territories, Inuvik and Norman Wells, NT. Manuscript Report No. 167. 44. 2005.
- Nasogaluak, D. Tuktoyaktuk Hunters and Trappers Meeting, 12 September 2006. 2006 pers. comm.
- Paetkau, D., Calvert, W., Stirling, I., and Strobeck, C. Microsatellite analysis of population structure in Canadian polar bears. *Molecular Ecology* 4, 347-354. 1995.
- Patterson, B.R., Olsen, B.T., and Joly, D.O. 2004. Population estimate for the Bluenose-East caribou herd using post-calving photography. *Arctic* 57: 47-58.
- Russell, H. J., Couturier, S., Sopuck, L. G., and Ovaska, K. Post-calving photo-census of the Rivere George caribou herd in July 1993. *Rangifer Special Issue* [9], 319-330. 1996.
- Thomas, D.C. 1969. Population estimates and distribution of barren-ground caribou in the Mackenzie District, N.W.T., Saskatchewan, and Alberta-- March to May, 1967. Canadian Wildlife Service, Ottawa Report Series-- No. 9: 44 pp.
- White, G. C. and Garrott, R. A. Analysis of wildlife radio-tracking data. San Diego: Academy Press . 1990.
- Williams, B. K., Nichols, J. D., and Conroy, M. J. Analysis and management of animal populations. Academic Press, San Diego, California , 817 pp. 2002.
- Zittlau, K., Nagy, J.A., Larter, N.C., and Strobeck, C. 2003. Genetic relatedness of caribou herds in Northwest Territories, western Nunavut and the Yukon Territory. Abstract, *Rangifer Special Issue* No. 14: 328.