SEASONAL RANGES OF THE CAPE BATHURST, BLUENOSE-WEST, AND BLUENOSE-EAST BARREN-GROUND CARIBOU HERDS

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ABSTRACT

Satellite tracking data obtained for Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou during March 1996 to May 2004 were analyzed to define the seasonal and cumulative ranges of each of these herds. Location data were grouped into the following 8 seasons: calving/post calving (1-25 June), early summer (26 June-15 July), mid summer (16 July-7 August), late summer (8 August-7 October), fall/rut (8-31 October), fall/post rut (1-30 November), winter (1 December-31 March), and spring, spring migration, and pre-calving (1 April-31 May). Seasons used were similar to those defined for the Porcupine caribou herd. Maps showing the geographic extent of the seasonal and cumulative ranges used by each herd are provided.

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INTRODUCTION

In 1950, Banfield (1954) described two herds of barren-ground caribou (*Rangifer tarandus groenlandicus*) in the area north of Great Bear Lake in the Northwest Territories (NT) and Nunavut (NU). Based on various historic accounts, reconnaissance aerial surveys, and where these caribou wintered, he named these herds the Great Bear Lake and Colville Lake herds (Banfield 1954). Thomas (1969) introduced the name Bluenose herd for caribou that wintered northwest of Great Bear Lake; these animals included Banfield's Great Bear Lake and Colville Lake herds. Based on aerial surveys in March and April 1967, Thomas (1969) assumed that these caribou migrated toward the Arctic coast and Bluenose Lake. The area around Bluenose Lake was recognized as the calving area of the Bluenose herd (Thomas 1969), although a small portion of the herd was later thought to calve on the Cape Bathurst Peninsula (Hawley *et al*. 1979). The latter calving area was reported to have been permanently abandoned by 1979 (Brackett *et al*. 1979, Gunn & Miller 1986). Thomas (1969) also found caribou wintering northeast of Great Bear Lake (i.e. Caribou Point and Dease Arm), an area that Banfield (1950, 1954) had associated with his Great Bear Lake herd. However, based on aerial surveys in April and May 1967, Thomas (1969) described these caribou as migrating toward Bathurst Inlet, and he designated them as being part of the Bathurst herd.

By the mid 1980s the range of the 'Bluenose caribou herd' was considered to include the area south of the Arctic coast from the Mackenzie Delta east to Kugluktuk, and north of Great Bear Lake in the Northwest Territories (NT) and Nunavut (NU). Caribou within this area were managed as a single unit. The range of the 'Bluenose caribou herd' includes portions of the Inuvialuit, Gwich'in, Sahtu, and Nunavut land claim areas, 14 user communities on the mainland (12 communities) and on the Arctic islands (2 communities), and four regions of the Governments of the NWT and Nunavut. Currently, wildlife co-management boards established under land claim agreements have primary responsibility for managing caribou within this area. From 1994 to 1999, these groups worked together to develop a comprehensive co-management plan for the 'Bluenose caribou herd' (Nagy et al. 1999).

In 1994, as part of this planning 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 caribou herd'. Analysis indicated there were three calving and two rutting areas within this area. Caribou management has been based on the herd concept, where herds are identified based on their use of traditional calving grounds (Thomas 1969, Gunn & Miller 1986). Applying this approach we hypothesized that there were two, and possibly three, herds within the range of 'Bluenose caribou'.

In March 1996, satellite tracking and genetic studies similar to those done to define polar bear populations (Paetkau *et al*. 1995, Bethke *et al*. 1996) were initiated to identify the number of caribou herds within the 'Bluenose' range (Figure 1). Samples were also collected for genetic comparisons from the two well defined herds to the west and east of the Bluenose range, the Porcupine (*R. t. granti*) and Bathurst herds (*R. t. groenlandicus*), respectively, and the reindeer herd on the Tuktoyaktuk Peninsula. 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*. in prep). These data show that the herds use different seasonal ranges (especially calving) and are genetically different (Nagy *et al.* in prep.). For convenience we have referred to these herds as the Cape Bathurst, Bluenose-West, and Bluenose-East herds.

Barren-ground caribou use different geographic areas to meet their seasonal requirements. These are referred to as 'seasonal ranges'. Given current and proposed levels of development activities within the ranges of these herds, knowledge of the geographic boundaries and relative importance of seasonal ranges to Cape Bathurst, Bluenose-West, and Bluenose-East caribou herds is important for management purposes. The movement data obtained for adult female caribou tracked with satellite collars during the period March 1996 to May 2004 were analyzed to define these seasonal ranges. The geographic distributions of these ranges are presented.

METHODS

The movements of 60 adult female caribou of the Cape Bathurst (n = 18), Bluenose-West (n = 26), and Bluenose-East (n = 16) barren-ground caribou herds were tracked with satellite collars during March 1996 to May 2004. Satellite collars (Telonics Inc., Mesa, Arizona, USA) were deployed on adult female caribou of these herds (Table 1).

Table 1. Distribution of 60 collars deployed on adult female caribou of the Cape Bathurst, Bluenose-West, and Bluenose-East herds between 1996 and 2003

Herd	Dates of collar deployment	Number deployed (n)
Cape Bathurst	16-30 March 1996	4
	13-16 April 1999	2
	31 March-16 April 1999	2
	31 March-2 April 2002	10
Bluenose-West	21-30 March 1996	6
	28 March 1997	2

	13-28 April 1999	12
	28 March-1 April 2002	6
Bluenose-East	23 March 1996	5
	19 March 1997	3
	7 May 1999	5
	23 March 2003	3

The data obtained for these animals were grouped into 8 seasons (Table 2). Seasons were defined in a manner similar to those defined for the Porcupine caribou herd (Porcupine Caribou Technical Committee 1993).

Table 2. Date range of each of the eight defined seasons

Season	Date range
Calving/post calving	1 - 25 June
Early summer	26 June -15 July
Mid summer	16 July - 7 August
Late summer	8 August - 7 October
Full/rut	8 - 31 October
Fall/post rut	1 - 30 November
Winter	1 December - 31 March
Spring, spring migration, and pre-calving	1 April - 31 May

Satellite collared caribou were assigned to herds based on calving ground use and subsequent movements. Herd assignments were verified using cluster analyses in SPSS (Nagy *et al*. in prep). Some caribou were harvested or died after being collared but before we obtained sufficient data to assign them to a herd. In addition, the satellite collars on some caribou failed before we obtained sufficient data to assign them to a herd. Data for these animals were excluded from the final analyses.

The duty cycle for deployed collars varied among years. As a result, the number of locations obtained each season varied among caribou tracked. To reduce the potential bias resulting from different sample sizes, the location data for each caribou were selected every 4 - 5 days during the calving/post calving, early summer, mid summer, late summer, and rut/fall periods; and every 10 days during the post rut, winter, and spring migration periods.

Locations for individual caribou were included in the analyses if $\geq$ ⅔ of the possible locations for a season were obtained and these locations were distributed throughout the season.

We estimated the extent of the seasonal ranges by pooling the location data obtained for each herd for each season among years. The boundaries of the seasonal ranges were estimated by analyzing location data using the fixed kernel home range option with the least squares cross validation smoothing factor of the Animal Movement Program extension (Hooge *et al*. 1999) of ArcView GIS 3.2a (ESRI 2000). The 50, 60, 70, 80, 90, and 95 percent utilization distributions for each season were generated and mapped for each herd. We used the 95 percent utilization distribution for the pooled data to define the boundaries of each seasonal range and to calculate the area (km^2) of each seasonal range. The utilization distribution describes the relative frequency distribution for the location data, and calculates boundaries based on the complete distribution of locations (Millsspaugh and Marzluff 2001). Because unusual movements of animals or outlier locations can dramatically affect the estimates of boundaries and the size of "normal" seasonal ranges, we excluded animals from the analyses that made long-range movements out of the "normal" seasonal distribution of locations for each herd. The movements of caribou were overlaid on each seasonal range to provide information on the direction of movement or migration.

The boundaries of the ranges of each herd were estimated by analyzing the location data obtained for each herd, each season and each year, using the fixed kernel home range option with the least squares cross validation smoothing factor of the Animal Movement Program extension (Hooge *et al*. 1999) of ArcView GIS 3.2a (ESRI 2000). We then overlaid all of the resulting 95 percent seasonal utilization distributions for each herd to estimate the boundary of its range. We determined the frequency of use of areas within the range of each herd by determining the frequency of overlap of the 95 percent seasonal utilization distributions. The maximum number of utilization distributions was 64 (8 seasons for 8 years). We then classified and mapped the frequency of use of areas within the range of each herd as: high use, or areas where $\geq$ 8 seasonal ranges overlapped; moderate use, or areas where 4 to 7 seasonal ranges overlapped; or low use, or areas where 1 to 3 seasonal ranges overlapped.

Caribou use ranged between 1 season for 8 years and 8 seasons for 1 year in areas mapped as high frequency of use. Use ranged between 1 season for 4 to 7 years and 4 to 7 seasons for 1 year in areas mapped as moderate frequency of use. Similarly, use ranged between 1 season for 1 to 3 years and 1 to 3 seasons during 1 year in areas mapped as low frequency of use.

There was overlap among some of the seasonal ranges of the three herds. We overlaid all of the 95 percent seasonal utilization distributions obtained for these three herds to estimate the cumulative range used. We then determined the frequency of overlap of 95 percent seasonal utilization distributions in areas within the cumulative range of the herds. We classified and mapped the frequency of use of areas within the cumulative range of the three herds as follows: high use, or areas where $\geq$ 8 seasonal ranges overlapped; moderate

use, or areas where 4 to 7 seasonal ranges overlapped; or low use, or areas where 1 to 3 seasonal ranges overlapped.

RESULTS

The number of individual caribou for which location data were obtained by season between March 1996 and May 2004 varied from 13 to 16 for the Bluenose-East herd, 18 to 24 for the Bluenose-West herd, and 14 to 16 for the Cape Bathurst herd (Table 3). The number of caribou seasons of location obtained by year, during March 1996 to May 2004 for the Cape Bathurst, Bluenose-West, and Bluenose-East herds are given in Tables 4, 5, and 6. The number of locations used to generate each seasonal range is given in Table 7. The sizes of the seasonal ranges (km^2) for each herd are given in Table 8. Areas of the 50 to 95 percent utilization distributions by season are given for each herd (Tables 9, 10, and 11).

The seasonal ranges and movements of caribou within those ranges are given in Figures 1 through 16. Unusual movements were documented for some caribou. In 1999 and 2000 one Bluenose-East caribou was within the range of the Bathurst caribou herd during the 1999 fall/rut to 2000 calving period (Figure 17). Similarly two Cape Bathurst caribou were within the range of the Bluenose-West herd during the 2003 fall/rut to 2004 spring migration period (Figure 18). The data for these animals were excluded from analyses for these periods.

The frequencies of use of areas within the ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East herds are shown in Figures 19, 20, and 21. The frequencies of use of areas within the cumulative range of the Cape Bathurst, Bluenose-West, and Bluenose-East herds (data pooled among herds) is shown in Figure 22.

DISCUSSION

Adult female caribou of the Cape Bathurst, Bluenose-West and Bluenose-East herds were tracked using satellite collars during March 1996 to May 2004. The primary objective of this paper was to present results of analyses completed to define the seasonal ranges of these herds. Maps showing the seasonal ranges of these herds are presented (Figures 1 to 22). The following paragraphs describe some of the limitations of the data used to generate these maps.

The distribution maps presented in this document were generated using satellite location data obtained for adult female caribou. Information was not available on the distribution of adult males in these herds and, as a result, the full extent of

some seasonal ranges of these herds may be underestimated. Satellite tracking work should be undertaken to document the distribution of males in these herds.

With the exception of a few years, the number of satellite-collared animals tracked each year in each herd was relatively small. As a result, the seasonal ranges presented here may be under estimated. Additionally, we were not able to determine how the seasonal ranges for these herds varied among years. The seasonal ranges presented in this document incorporate variation in ranges used by satellite-collared adult female caribou among years in each herd. A minimum of 20 satellite collars should be maintained each year on adult female caribou in all herds so that annual variations in seasonal range use can be assessed.

We documented what we believed were 'unusual' movements of caribou in the Bluenose-East and Cape Bathurst herds. Because the number of satellite-collared animals tracked each year in each herd was relatively small, we do not know the extent or frequency with which these types of movements occur. The 'unusual' movements of the Cape Bathurst animals occurred after freezing rains fell along northern coastal areas within the range of this, and the Bluenose-West, herd during fall 2003. These conditions may have precipitated the movement of caribou out of the normal northern portion of their fall and winter ranges. The Department of Resources, Wildlife, and Economic Development completed a range wide caribou survey during late March/early April 2004 (D'Hont *et al*. in prep). Very few caribou were observed within the northern portion of the normal winter range of the Bluenose-West or Cape Bathurst herds. The absence of caribou in the areas where people from Paulatuk harvest caribou was notable during winter 2003-2004. Insights into the frequency and magnitude of these types of movements may be obtained by monitoring the movements of a larger number of satellite-collared caribou in each herd and monitoring climatic and snow conditions on the fall/early winter ranges of these herds. The frequency of these types of 'unusual' movements may increase if current trends in climate change persist.

The relative importance of each seasonal range to Cape Bathurst, Bluenose-West, and Bluenose-East caribou herds has not been investigated specifically, however, relevant research has been completed to define the importance of seasonal ranges of similar caribou in the Porcupine caribou herd (Porcupine Caribou Technical Committee 1993). Additional work is required to make assessments for the seasonal ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East herds. This work is particularly important given existing and proposed levels of oil and gas development activities on their winter ranges. Development activities, in combination with wild fires, may have significant impacts on the availability and use of herd ranges.

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Table 3. Number of individual caribou for which location data were obtained during March 1996 to May 2004 and used to define the seasonal ranges of each herd.

	Herd		
Season	**Bluenose-East**	**Bluenose-West**	**Cape Bathurst**
Calving/Post Calving	16	24	15
Early Summer	15	24	15
Mid Summer	16	23	15
Late Summer	14	21	15
Fall/Rut	13	19	16
Fall/Post Rut	14	20	15
Winter	13	18	14
Spring and Spring Migration	16	24	16

Table 4. Number of caribou seasons of location data obtained by caribou year during March 1996 to May 2004 and used to define the seasonal ranges of the Cape Bathurst barren-ground caribou herd.

	Number Caribou Seasons of Location Data by Caribou Year (1 June – 31 May)									
Season	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**Total**
Calving/Post Calving	-	4	4	3	5	3	1	9	9	38
Early Summer	-	4	4	3	4	3	1	10	9	38
Mid Summer	-	4	3	3	4	1	1	10	9	35
Late Summer	-	4	3	3	3	1	1	10	6	31
Fall/Rut	-	4	3	3	4	1	1	10	6	32
Fall/Post Rut	-	4	3	3	2	1	-	10	6	29
Winter	-	4	3	3	2	1	1	9	3	26
Spring and Spring Migration	4	4	3	5	2	1	10	9	2	40

Table 5. Number of caribou seasons of location data obtained by caribou year during March 1996 to May 2004 and used to define the seasonal ranges of the Bluenose-West barren-ground caribou herd.

	Number of Caribou Seasons of Location Data by Caribou Year (1 June – 31 May)									
Season	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**Total**
Calving/Post Calving	-	4	5	5	12	9	3	8	4	50
Early Summer	-	5	5	5	13	8	3	9	4	52
Mid Summer	-	5	5	5	14	7	4	9	4	53
Late Summer	-	4	5	3	12	6	3	9	4	46
Fall/Rut	-	4	5	3	10	4	3	9	3	41
Fall/Post Rut	-	3	5	3	12	6	3	8	4	44
Winter	-	3	5	3	12	5	2	5	2	37
Spring and Spring Migration	5	5	5	14	10	5	9	5	2	60

Table 6. Number of caribou seasons of location data obtained by caribou year during March 1996 to May 2004 and used to define the seasonal ranges of the Bluenose-East barren-ground caribou herd.

	Number of Caribou Seasons of Location Data by Caribou Year (1 June – 31 May)									
Season	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**Total**
Calving/Post Calving	-	4	5	10	9	5	1	-	3	37
Early Summer	-	4	5	6	8	5	1	-	3	32
Mid Summer	-	4	5	8	8	4	1	-	3	33
Late Summer	-	4	5	7	7	3	1	-	3	30
Fall/Rut	-	3	5	8	6	2	1	-	3	28
Fall/Post Rut	-	3	5	9	6	2	1	-	3	29
Winter	-	2	5	9	6	2	-	-	3	27
Spring and Spring Migration	5	5	5	9	5	2	-	3	3	37

Table 7. Number of locations used to generate seasonal ranges for the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

	Number of locations by Herd		
Season	**Bluenose-East**	**Bluenose-West**	**Cape Bathurst**
Calving/Post Calving	200	276	217
Early Summer	148	223	184
Mid Summer	162	259	165
Late Summer	372	520	352
Fall/Rut	138	198	149
Fall/Post Rut	86	127	84
Winter	324	442	311
Spring and Spring Migration	252	351	238

Table 8. The size of seasonal ranges used by the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

	Size of Seasonal Range (km^2) by Herd		
Season	**Cape Bathurst**	**Bluenose-West**	**Bluenose-East**
Calving/Post Calving	3,894	15,350	14,119
Early Summer	2,285	18,668	21,639
Mid Summer	11,627	44,112	51,877
Late Summer	7,965	43,167	31,677
Fall/Rut	12,557	111,481	81,461
Fall/Post Rut	7,820	99,524	113,174
Winter	7,339	78,151	83,479
Spring and Spring Migration	18,986	95,364	27,312

Table 9. Areas (km^2) of the 50 to 95 percent utilization distributions by season for the Bluenose-East herd.

	Area (km^2) by Percent Utilization Distribution					
Season	**95**	**90**	**80**	**70**	**60**	**50**
Calving/Post Calving	14,119	9,678	5,298	3,511	2,528	1,811
Early Summer	21,639	15,950	9,343	5,325	3,361	2,370
Mid Summer	51,877	39,465	21,800	11,807	6,501	4,385
Late Summer	31,677	22,861	10,849	5,743	2,978	1,802
Fall/Rut	81,461	62,221	37,463	24,232	17,066	11,437
Fall/Post Rut	113,174	87,693	61,146	45,800	34,338	23,949
Winter	83,479	49,190	23,450	15,197	10,726	7,610
Spring and Spring Migration	27,312	13,427	8,474	6,346	4,895	3,769

Table 10. Areas (km^2) of the 50 to 95 percent utilization distributions by season for the Bluenose-West herd.

	Area (km^2) by Percent Utilization Distribution					
Season	**95**	**90**	**80**	**70**	**60**	**50**
Calving/Post Calving	15,350	9,480	4,518	2,917	1,960	1,303
Early Summer	18,668	13,542	8,290	4,709	2,808	1,633
Mid Summer	44,112	35,601	25,119	15,816	9,193	4,847
Late Summer	43,167	31,747	18,753	10,383	7,059	5,061
Fall/Rut	111,481	87,446	58,550	38,465	21,757	12,945
Fall/Post Rut	99,524	79,876	52,756	33,063	19,968	10,866
Winter	78,151	61,827	37,486	23,250	16,453	11,459
Spring and Spring Migration	95,364	69,276	35,098	20,391	12,858	7,730

Table 11. Areas (km^2) of the 50 to 95 percent utilization distributions by season for the Cape Bathurst herd.

	Area (km^2) by Percent Utilization Distribution					
Season	**95**	**90**	**80**	**70**	**60**	**50**
Calving/Post Calving	3,894	2,779	1,937	1,428	1,067	709
Early Summer	2,285	1,959	1,484	1,210	1,012	836
Mid Summer	11,627	9,869	6,620	4,156	2,679	1,866
Late Summer	7,965	6,490	4,472	2,996	2,119	1,562
Fall/Rut	12,557	10,557	6,866	4,821	2,673	1,601
Fall/Post Rut	7,820	6,585	4,552	3,156	2,208	1,445
Winter	7,339	5,544	2,924	1,547	813	506
Spring and Spring Migration	18,986	15,590	9,758	6,792	4,746	3,275

Figure 1. Calving/post calving ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

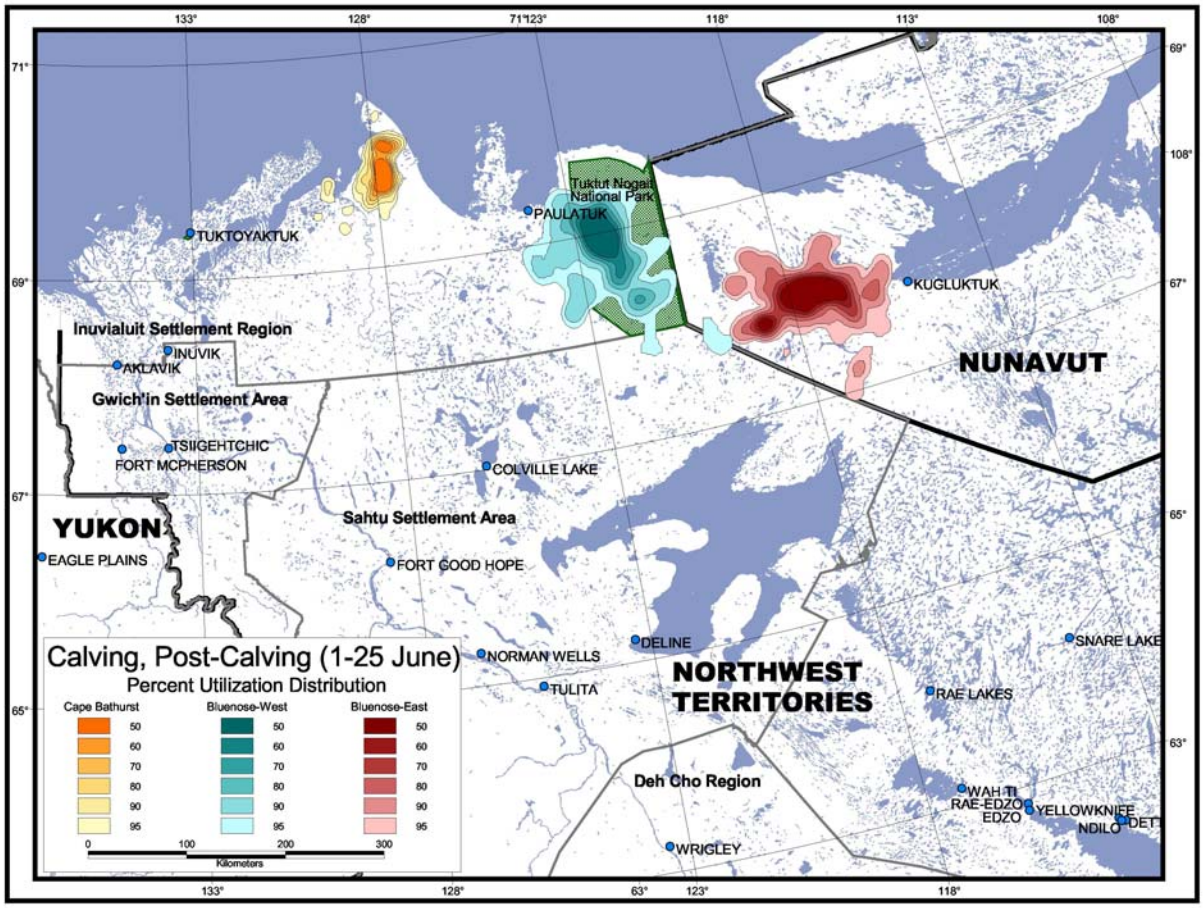

Figure 2. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the calving/post calving season.

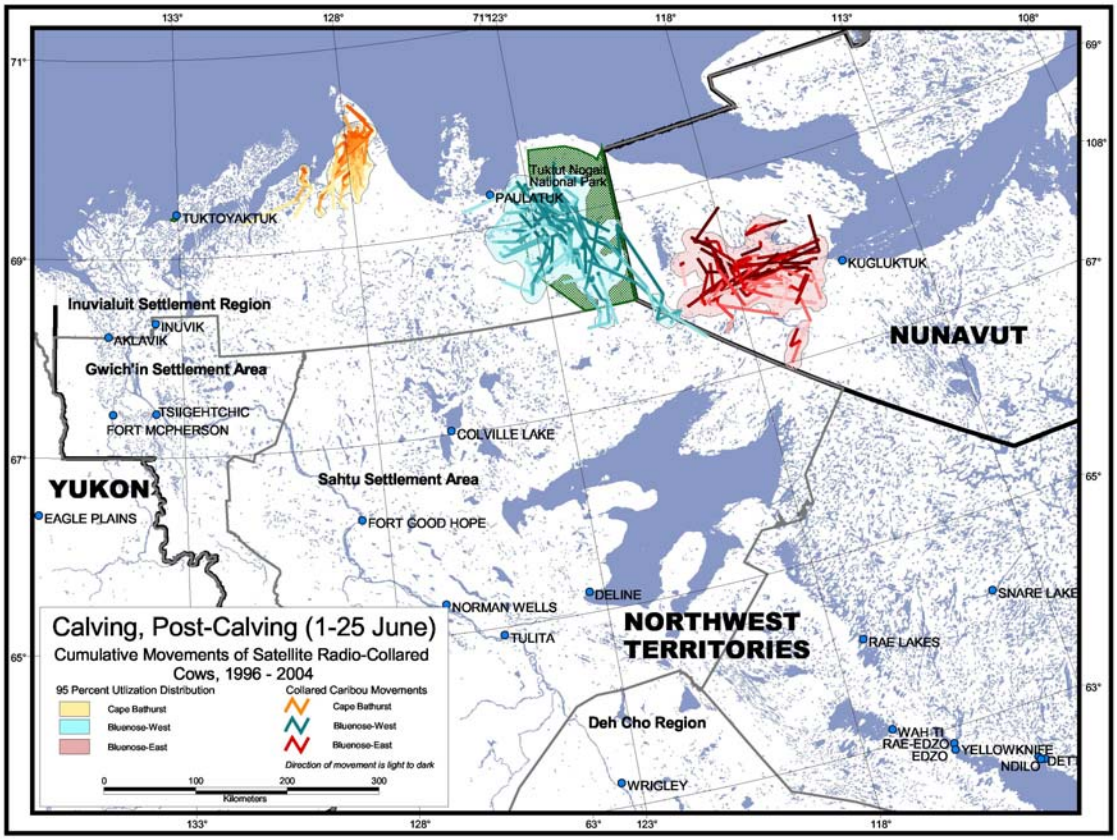

Figure 3. Early summer ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

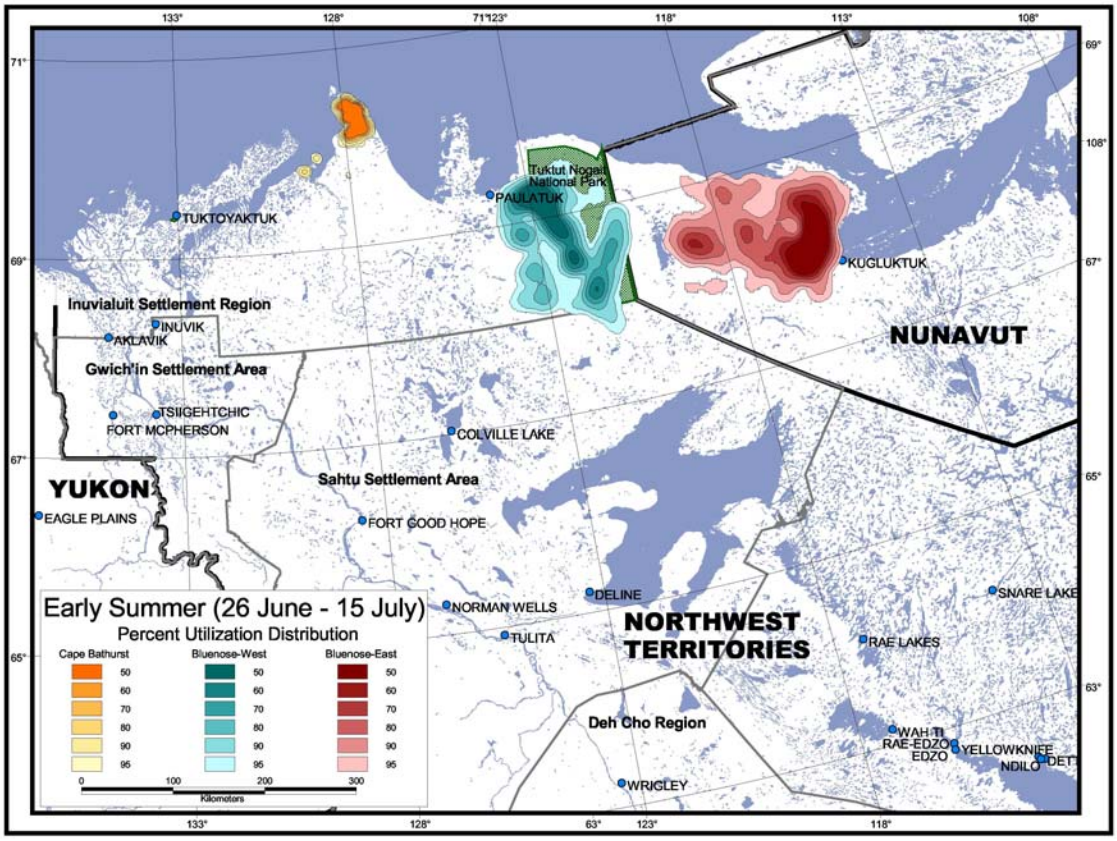

Figure 4. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the early summer season.

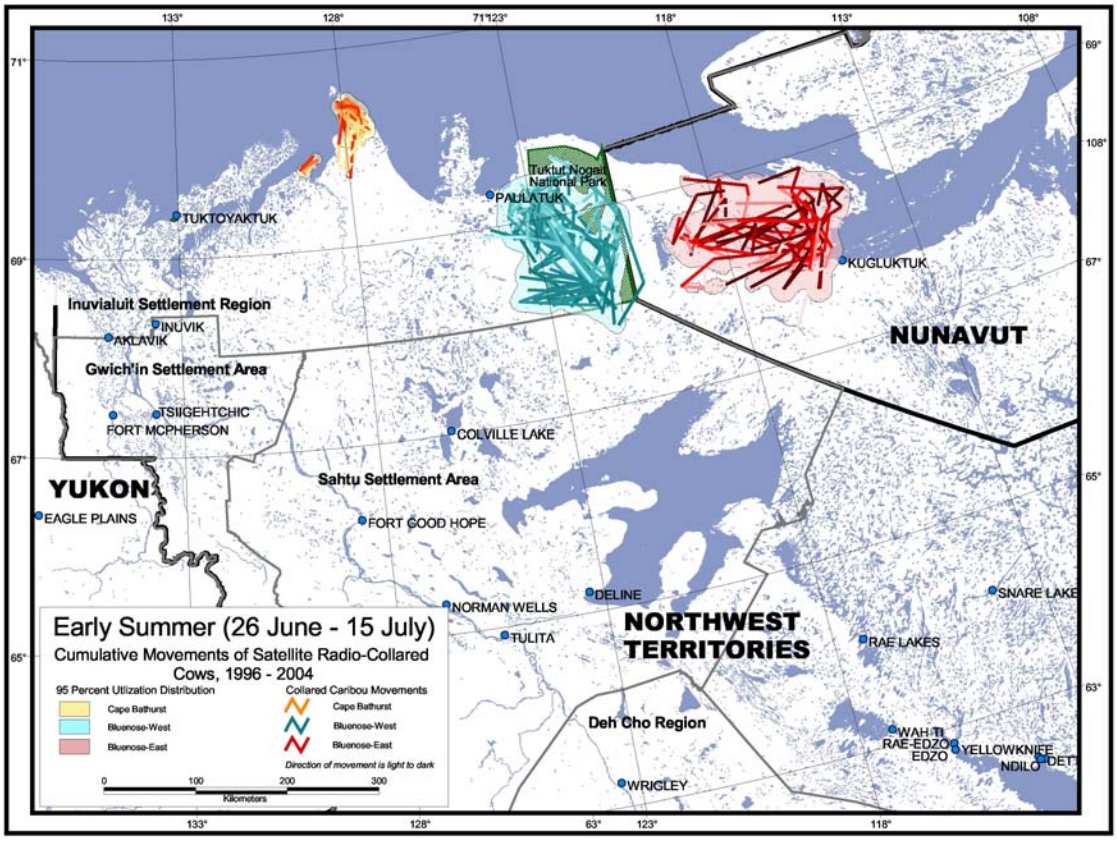

Figure 5. Mid summer ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

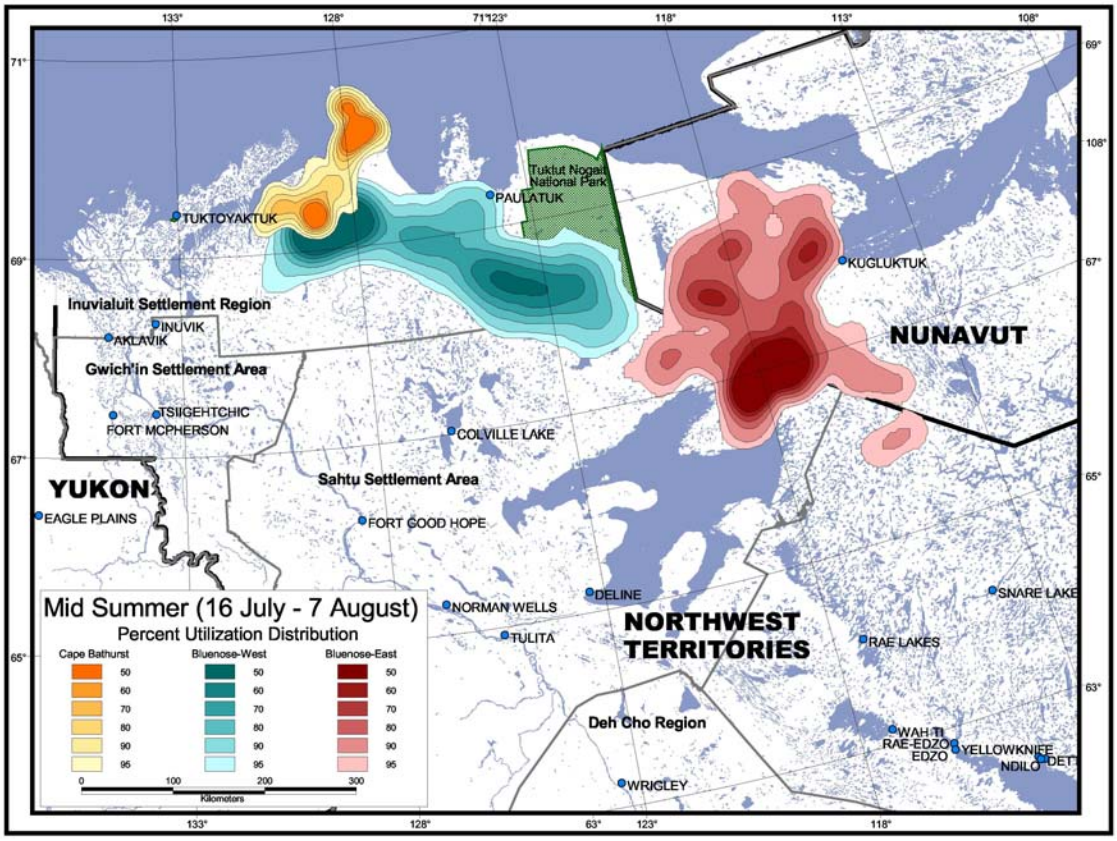

Figure 6. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the mid summer season.

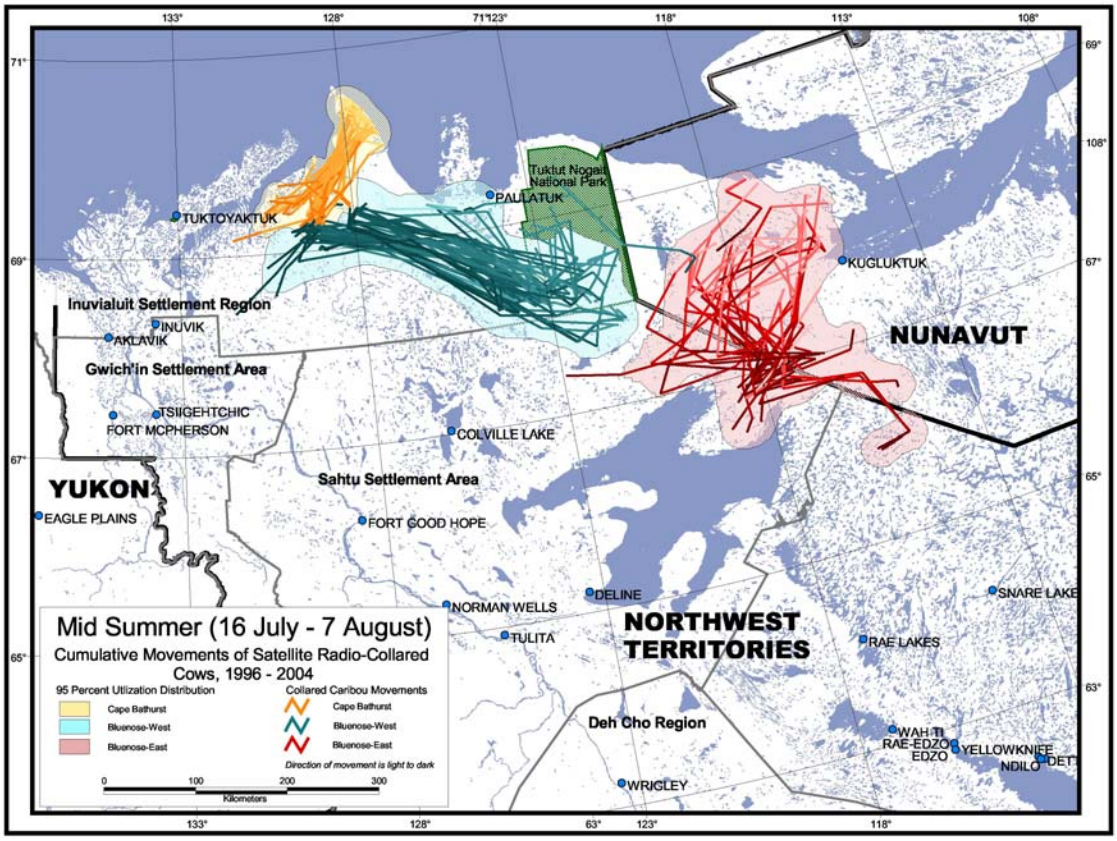

Figure 7. Late summer ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

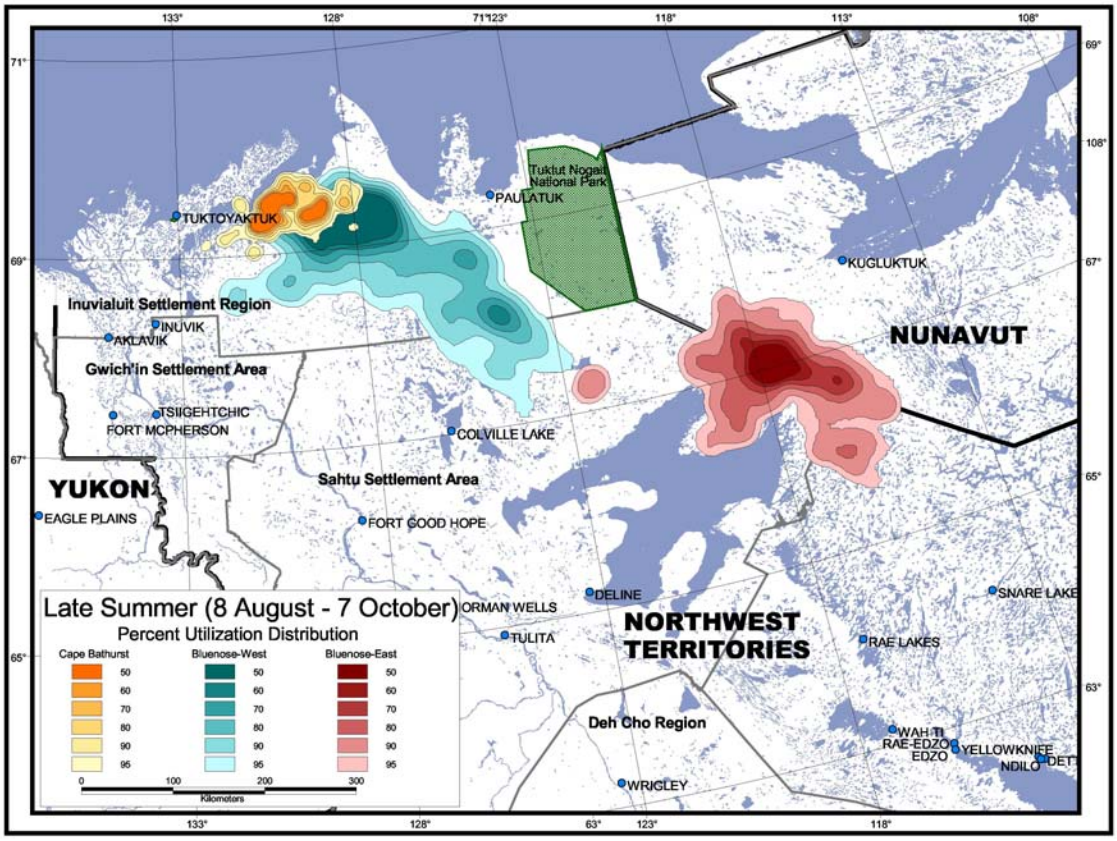

Figure 8. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the late summer season.

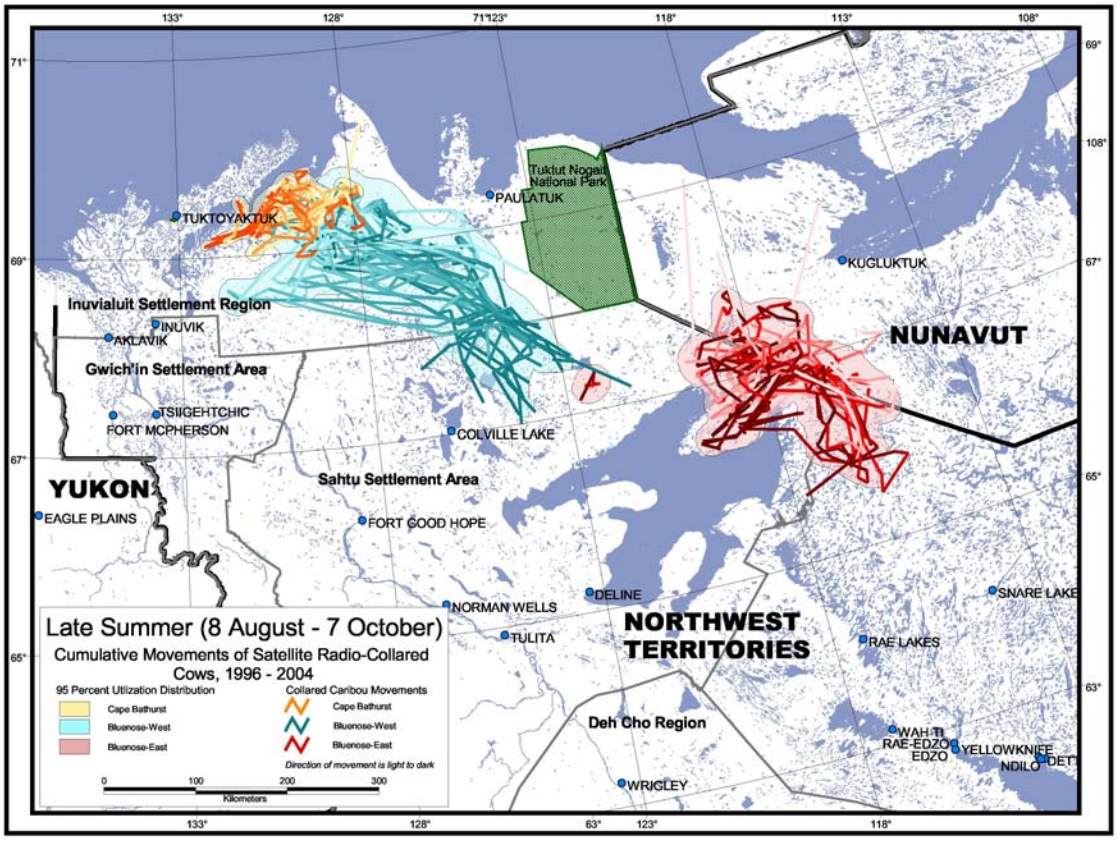

Figure 9. Fall/rutting ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

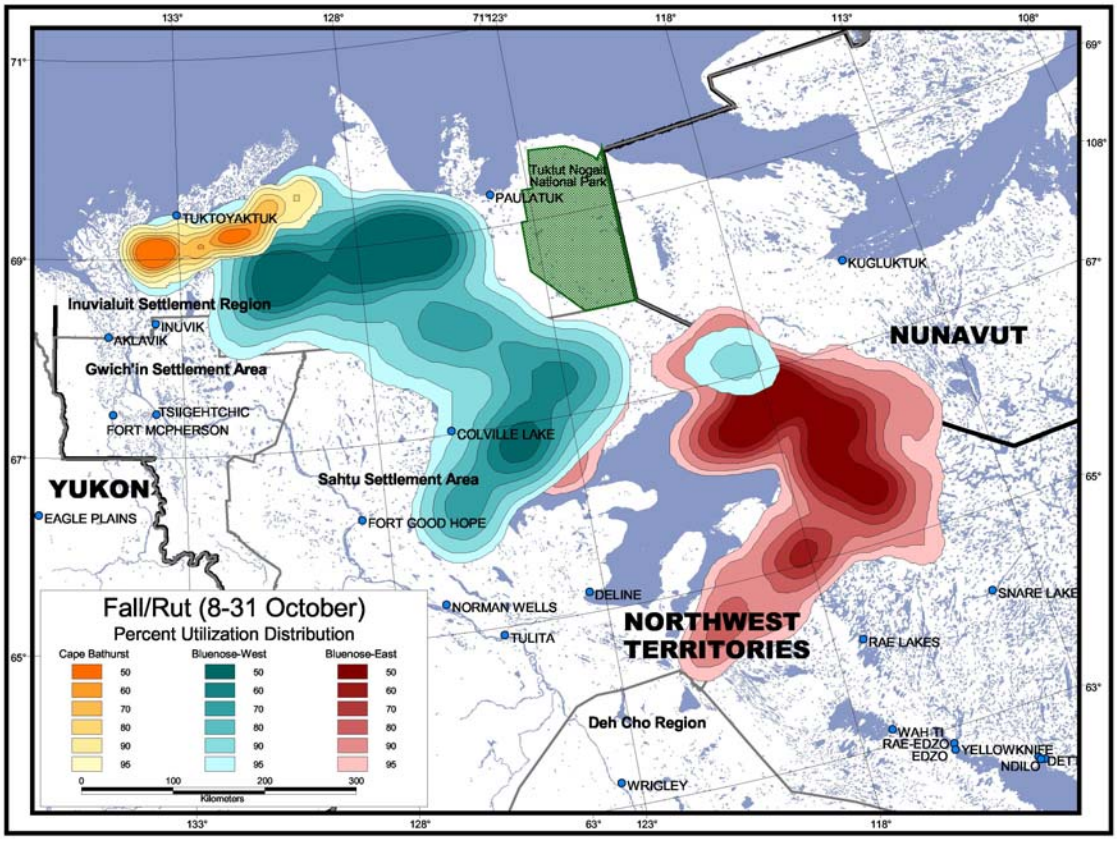

Figure 10. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the fall/rutting season.

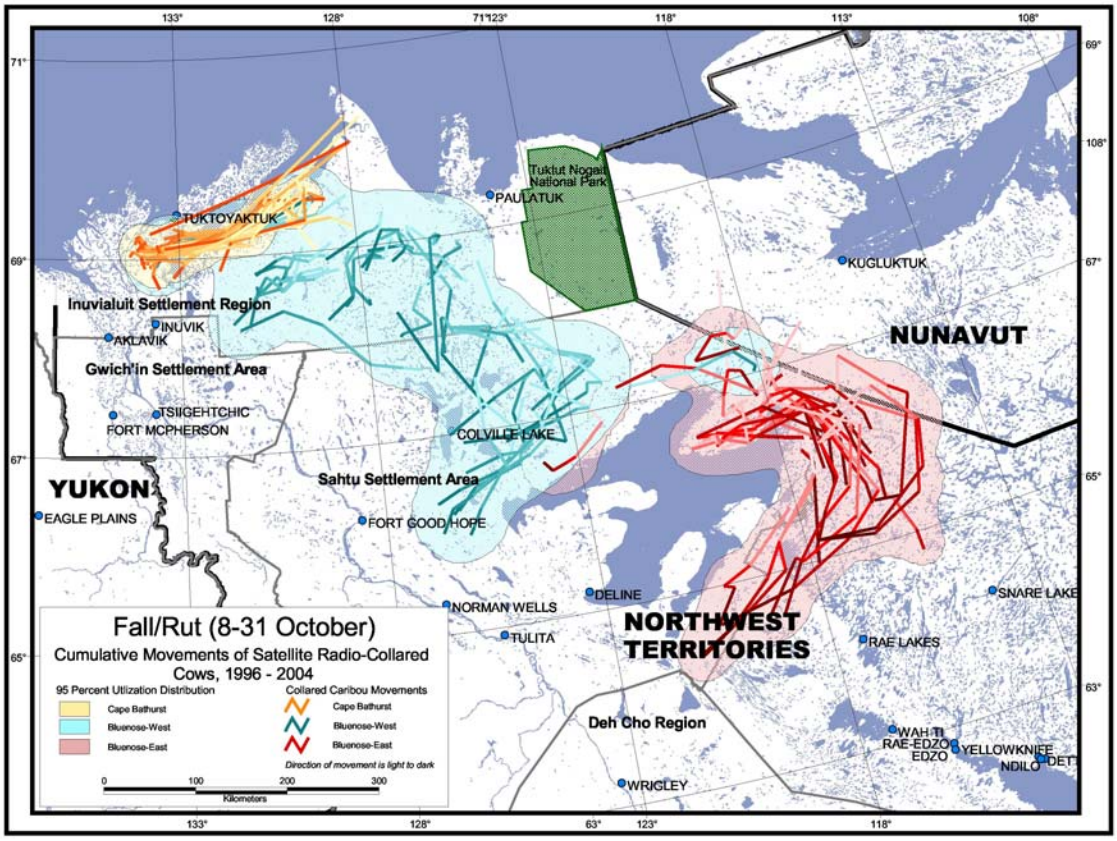

Figure 11. Fall/post rutting ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

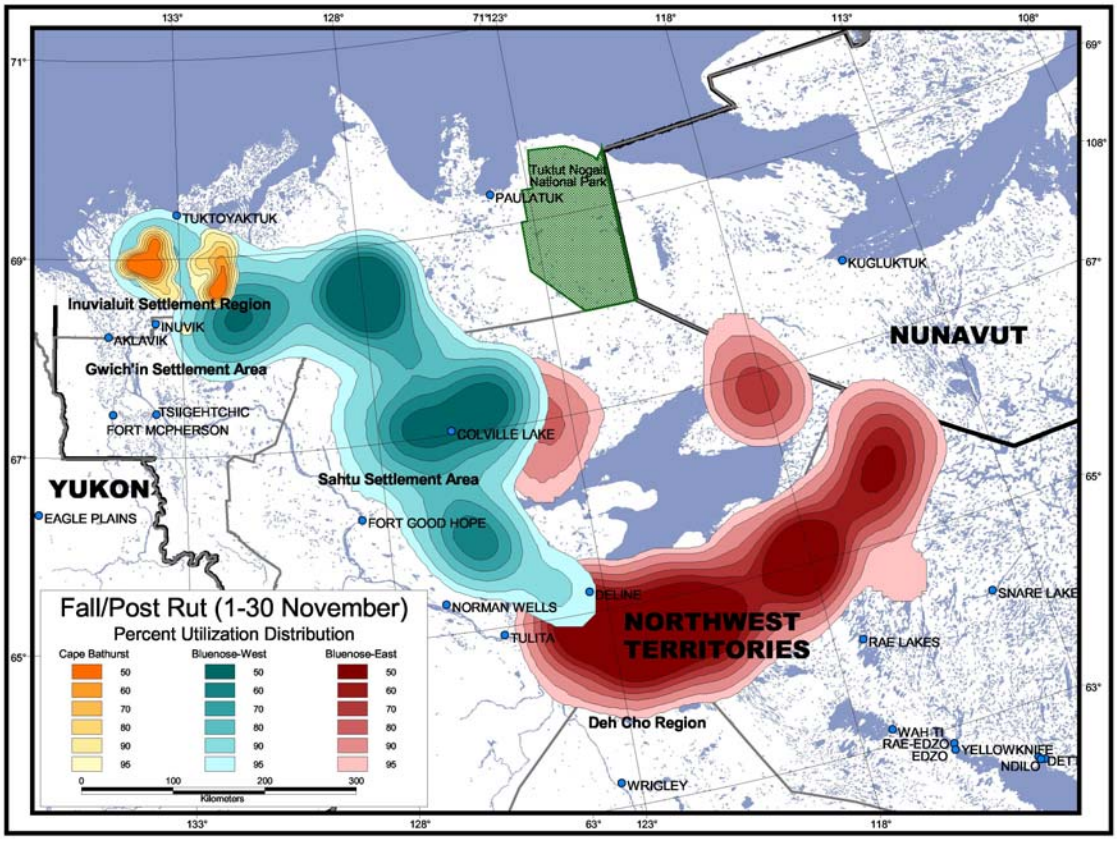

Figure 12. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the fall/post rutting season.

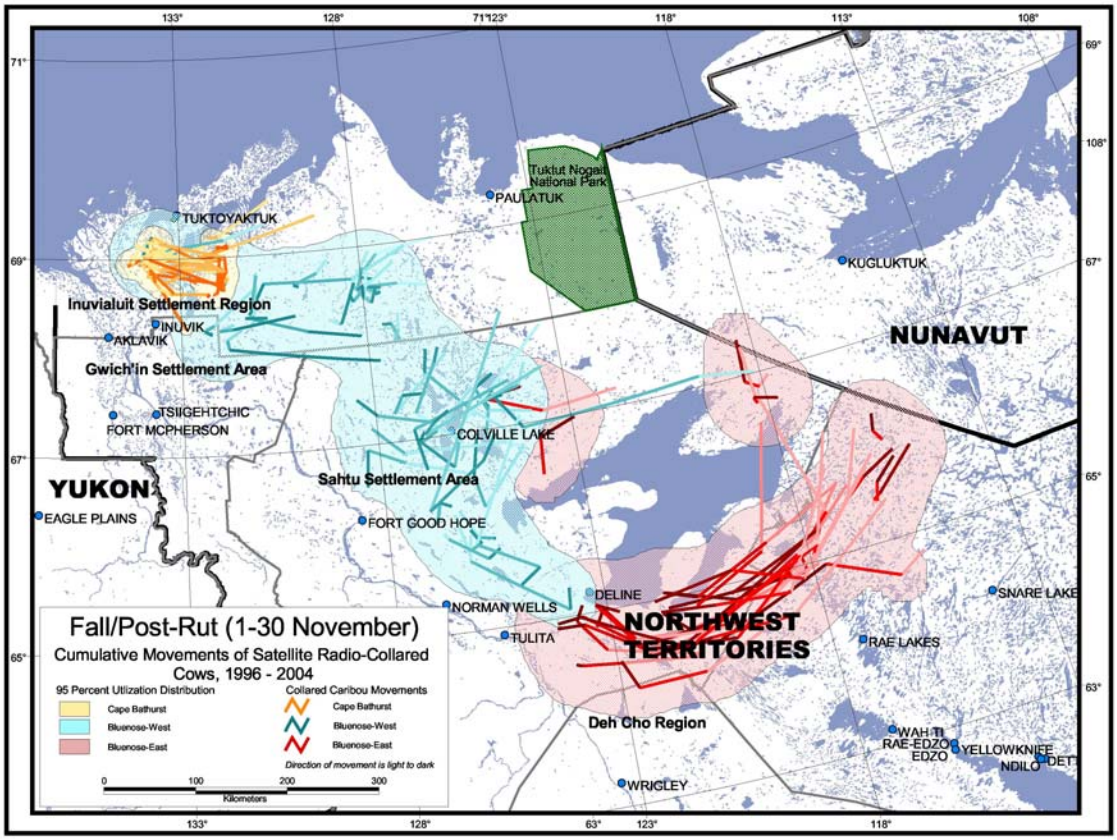

Figure 13. Winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

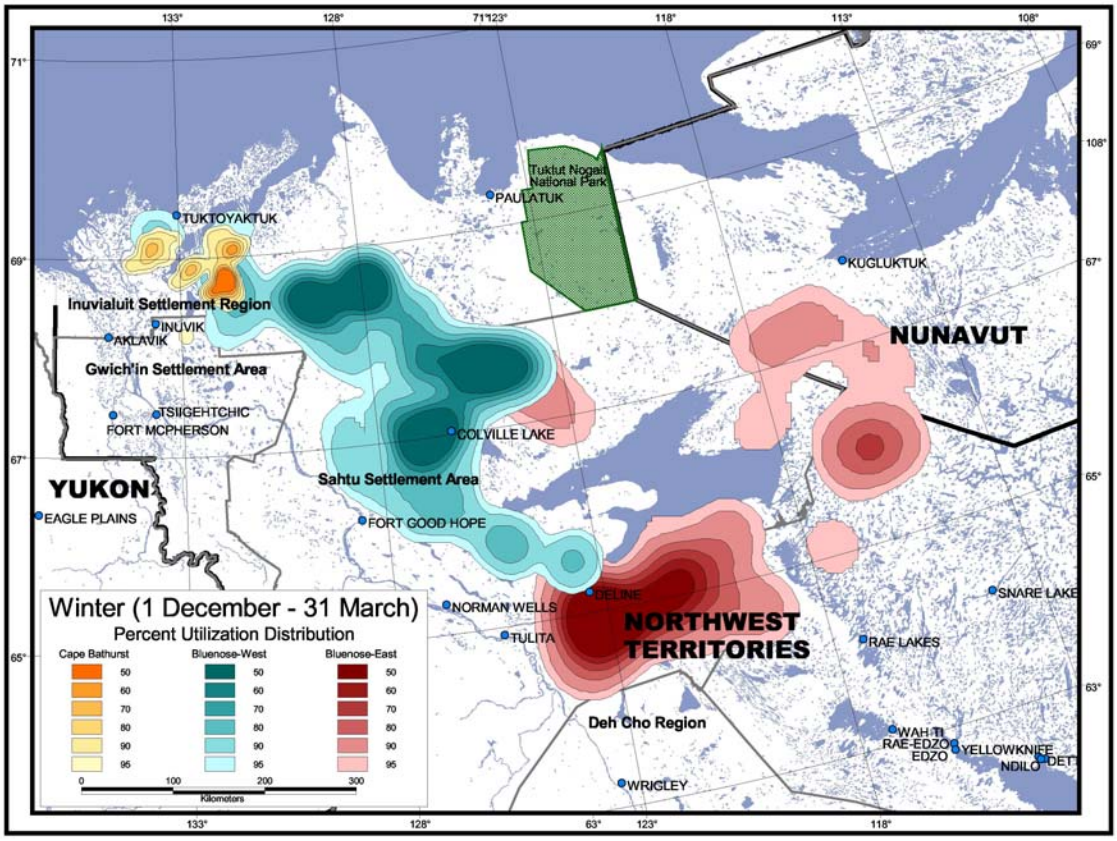

Figure 14. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the winter season.

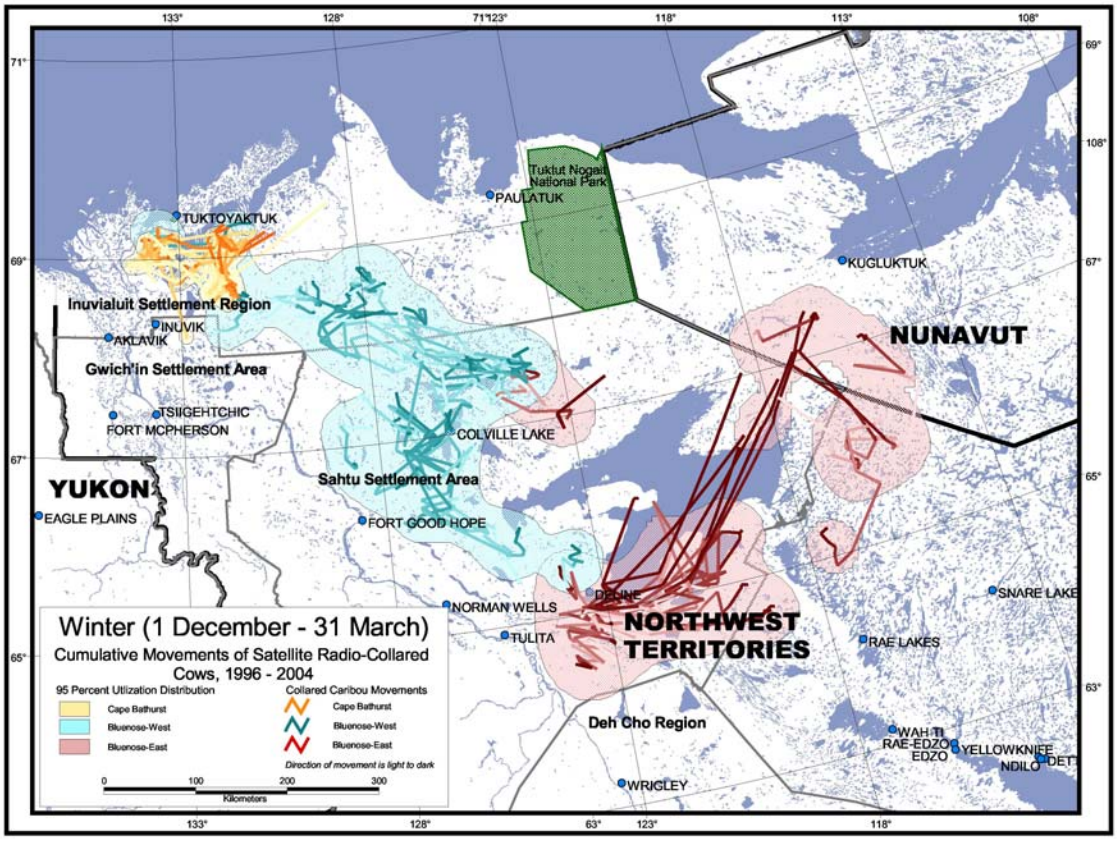

Figure 15. Spring, spring migration, and pre-calving ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

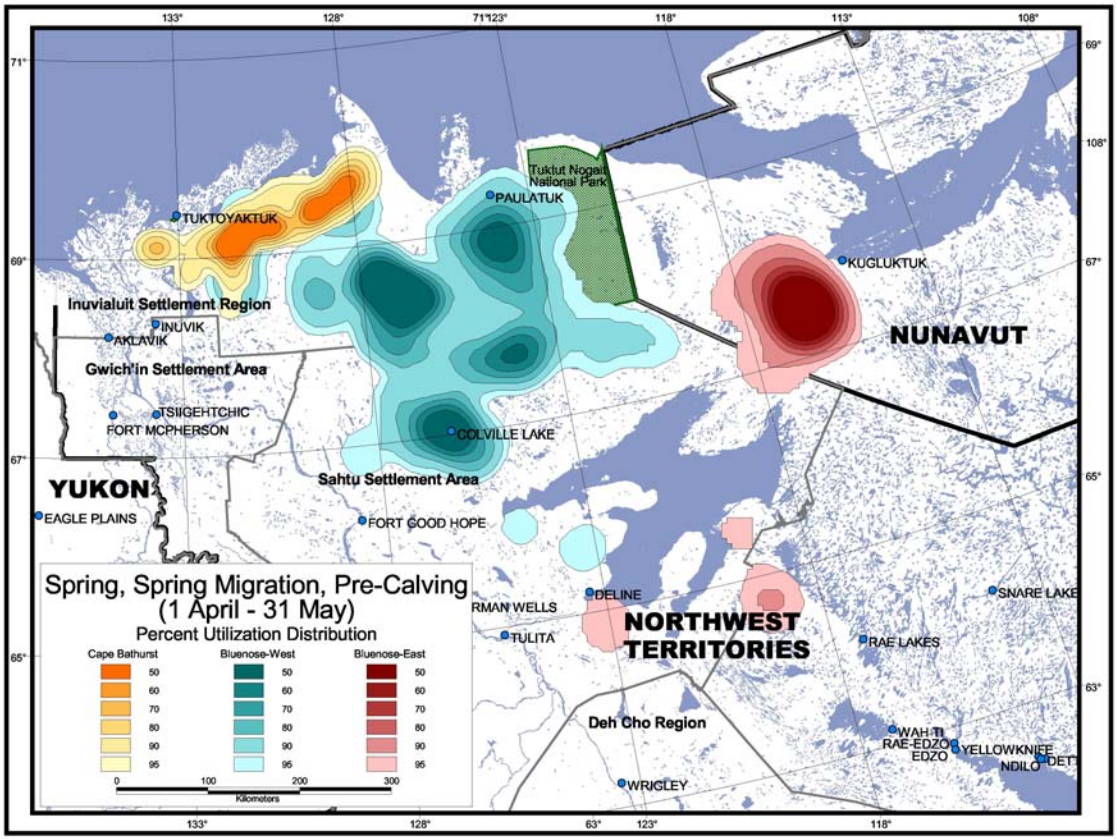

Figure 16. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the spring, spring migration, and pre-calving season.

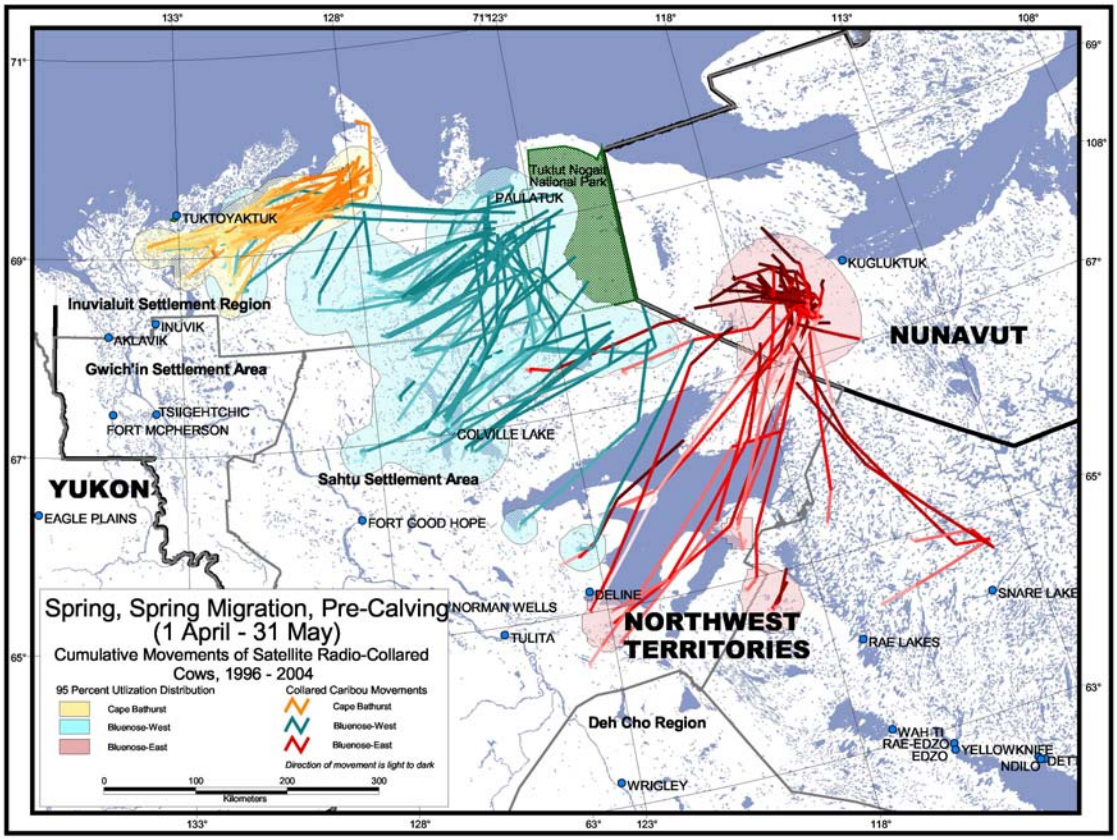

Figure 17. One satellite collared Bluenose-East caribou wintered with the Bathurst herd near Yellowknife during winter 1999-2000, but returned to its normal early summer range by late June 2000.

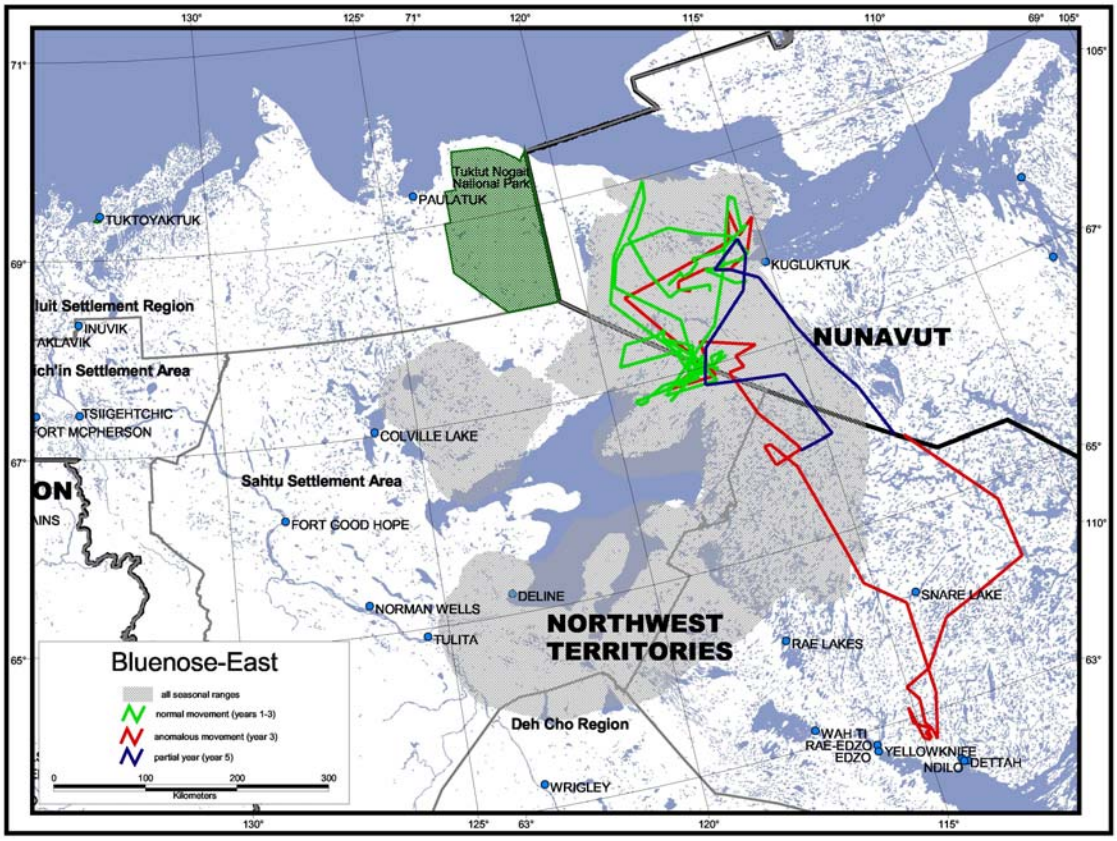

Figure 18. Two satellite collared Cape Bathurst caribou wintered on the Bluenose-West winter range near Colville Lake during winter 2003-2004.

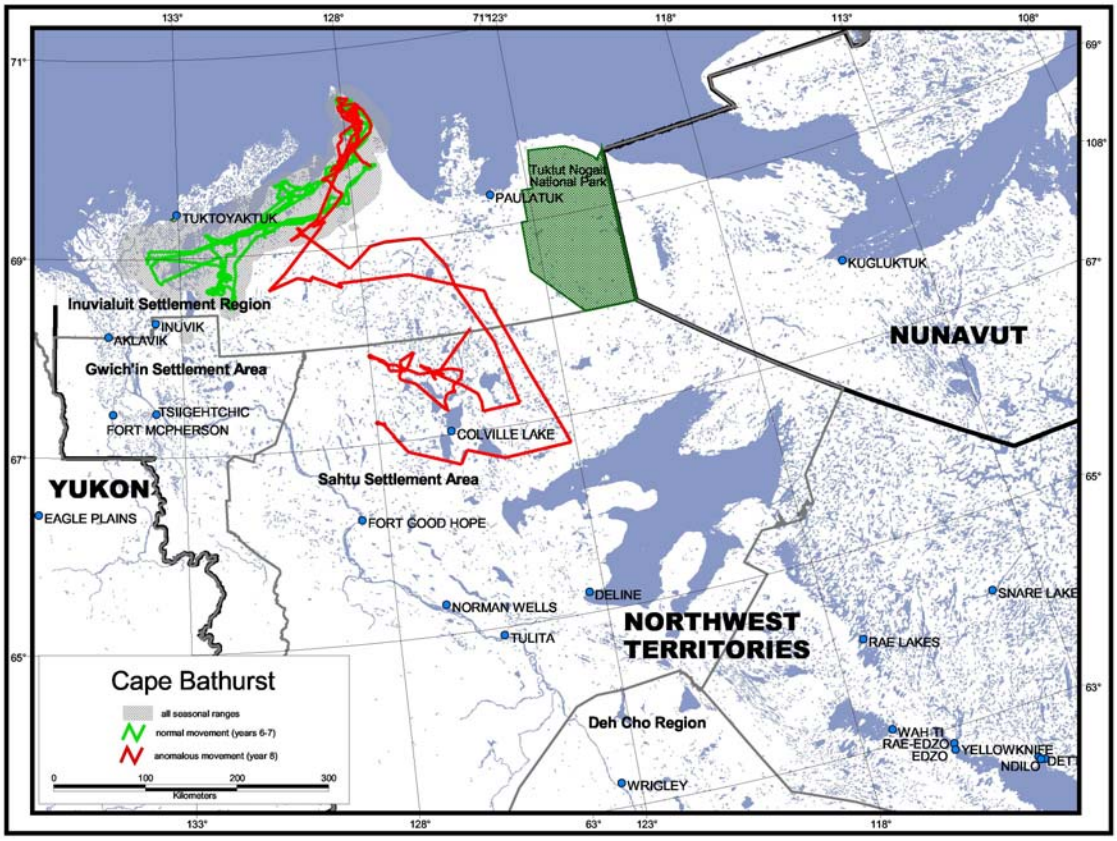

Figure 19. Frequency of caribou use of areas within the range of the Cape Bathurst barren-ground caribou herd.

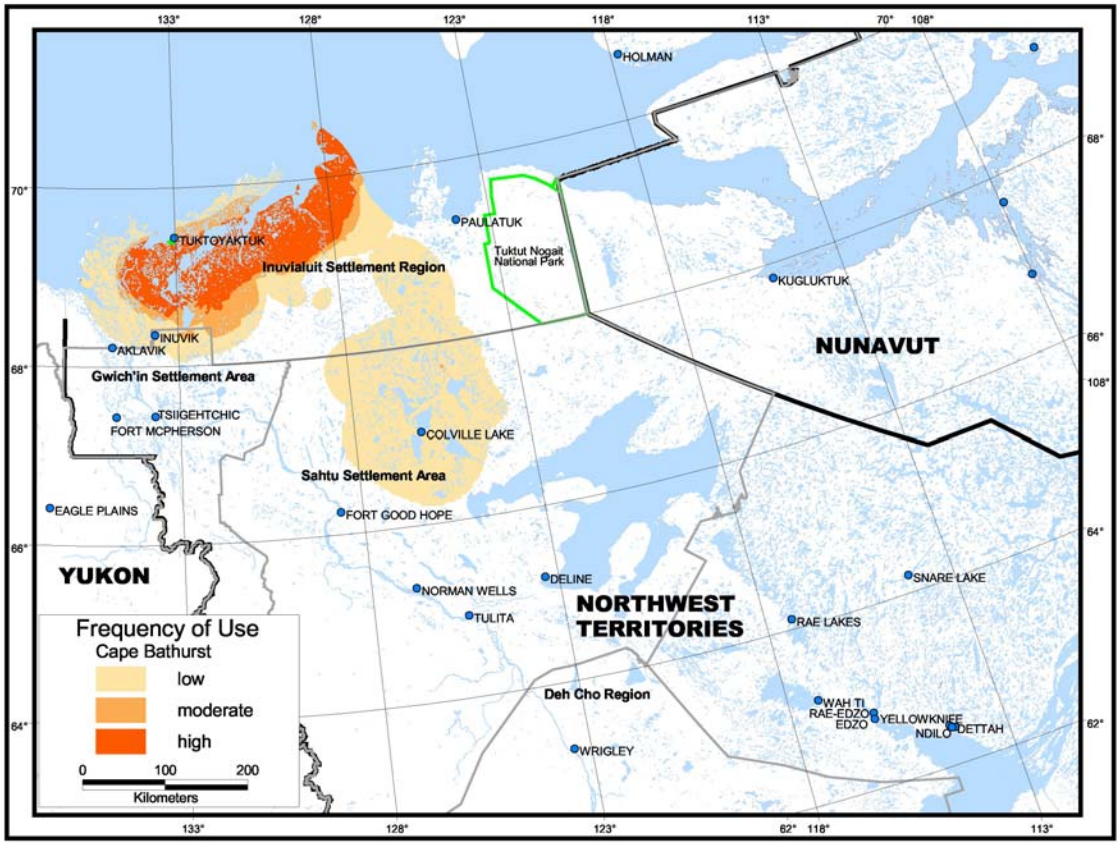

Figure 20. Frequency of caribou use of areas within the range of the Bluenose-West barren-ground caribou herd.

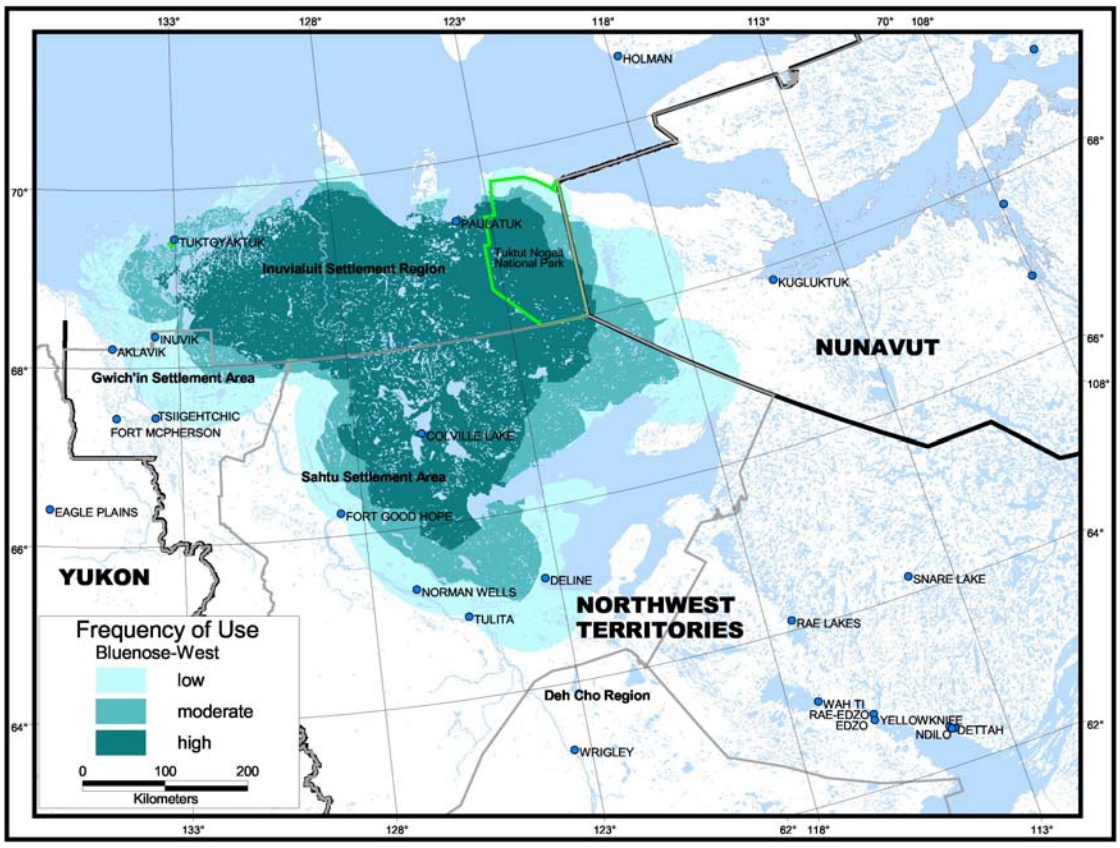

Figure 21. Frequency of caribou use of areas within the range of the Bluenose-East barren-ground caribou herd.

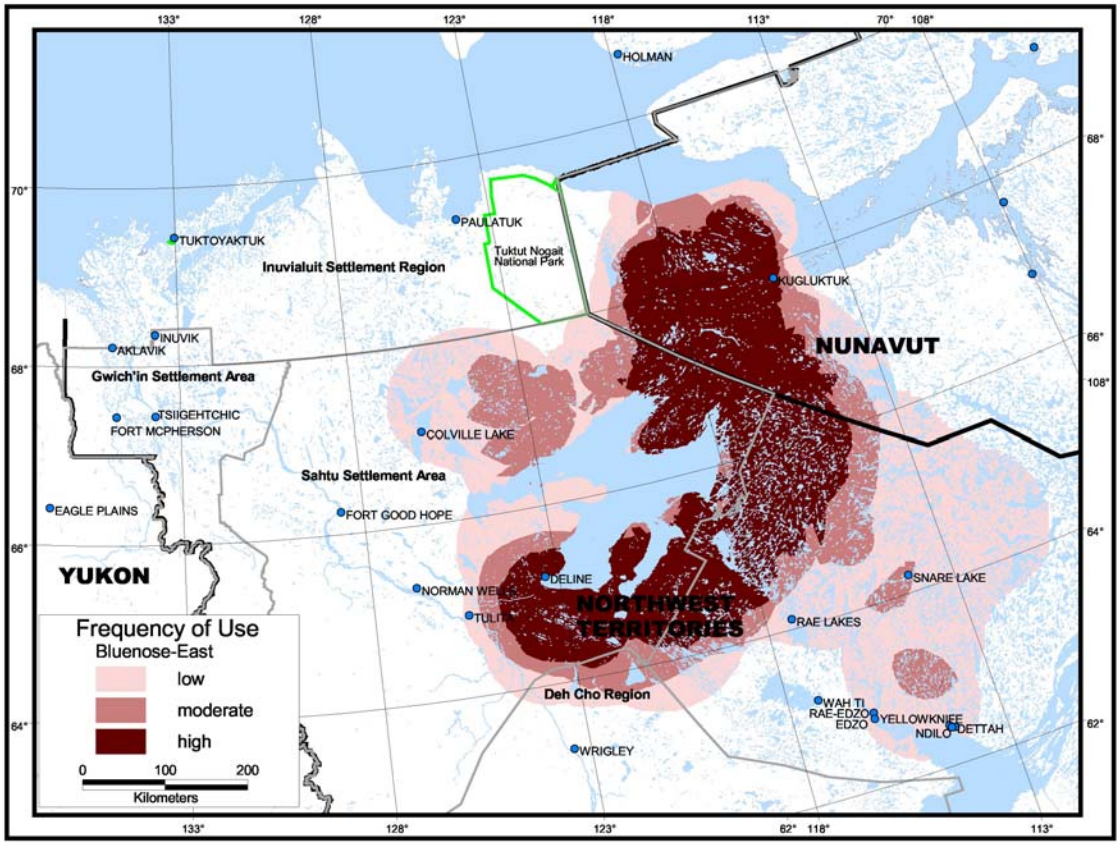

Figure 22. Frequency of caribou use of areas within the cumulative range of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herd.