Defining Herds Within the Range of 'Bluenose' Barren-ground Caribou in Canada's Northwest Territories and Nunavut

J.A. Nagy[1], A.M. Veitch[2], M.L. Branigan[1], K. Zittlau[3], N.C. Larter[1], D. Cooley[4], B.R. Patterson[5] & C. Strobeck[3]

[1]Department of Resources, Wildlife and Economic Development, Government of the Northwest Territories, Bag Service #1, Inuvik, Northwest Territories, X0E 0T0, Canada. (Fax: 867-777-2418; Ph: 867-777-7305; email: John_Nagy@gov.nt.ca)

[2]Department of Resources, Wildlife and Economic Development, Government of the Northwest Territories, Box 130, Norman Wells, Northwest Territories, X0E 0V0, Canada.

[3]Department of Biological Sciences, University of Alberta, Edmonton, Alberta, T6G 2E9, Canada.

[4]Department of Renewable Resources, Yukon Territorial Government, Box 600, Dawson, Yukon Territory, Y0B 1G0, Canada.

[5]Department of Sustainable Development, Government of Nunavut, Box 316, Kugluktuk, Nunavut, X0E 0E0, Canada

Abstract: Barren-ground caribou (*Rangifer tarandus groenlandicus*) that occupy the northern portion of the Northwest Territories and western Nunavut, Canada, have been considered to be part of the Bluenose herd. Analyses of distribution information documented during surveys done between 1966 and 1993 using a computerized geographic information system (GIS) indicated that

there were three distinct calving and two rutting areas within that range. Caribou herds have been identified based on their fidelity to calving grounds. As a result we hypothesized that there were two, and possibly three, herds within this range. The results of satellite tracking and genetic studies support the hypothesis that there are three herds that use different seasonal ranges (calving and especially rutting) and are genetically distinct. For convenience we refer to these as the Cape Bathurst, Bluenose-West, and Bluenose-East herds. They are genetically different from Porcupine and Bathurst caribou. The subspecific designation of Porcupine caribou should be reconsidered.

Key words: *Rangifer tarandus caribou, R.t. granti*, satellite tracking, microsatellite DNA, co-management, Bluenose caribou, Bathurst caribou, Porcupine caribou.

Rangifer, XX (X): xxx-xxx

Introduction

In 1950, Banfield (1954) described two herds of barren-ground caribou (*Rangifer tarandus groenlandicus*) in the area south of the Arctic coast from the Mackenzie Delta east to Kugluktuk and north of Great Bear Lake in the Northwest Territories (NWT) and Nunavut, Canada. These he named the Great Bear Lake and Colville Lake herds. In 1967, Thomas (1969) assumed that these two herds were one population which he called the Bluenose herd. The area around Bluenose Lake was recognized as the calving area of the 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).

Since the mid-1960's, caribou in this area have been managed as a single unit, the Bluenose herd. The herd's range overlaps the Inuvialuit, Gwich'in, Sahtu, and Nunavut land claim areas, includes 12 user communities on the mainland and two on the Arctic islands, 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 the herd. From 1994 to 1999, these groups worked together to develop a comprehensive co-management plan for the 'Bluenose caribou herd.' In 1994, as part of this planning process, distribution information from 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 herd. That analysis indicated there were three calving and two rutting areas. 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'.

Caribou are an important renewable resource harvested by people across the Northwest Territories and Nunavut. Therefore, it is important that

stakeholders know the number and ranges of herds within the 'Bluenose' range so that the size, vital rates, and total harvest can be determined for each to ensure that the harvest of each is sustainable. In addition, it is important to know which co-management boards, communities, and government agencies need to work together to effectively manage each herd. Therefore, 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 (Fig. 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 (*R. t. groenlandicus*), respectively (Fig. 1).

Methods

Fifteen female caribou from the 'Bluenose herd' were fitted with satellite radio-collars (Telonics Inc., Mesa, Arizona, USA) in March 1996. Collars were deployed in the eastern (n = 5), southern (n = 5) and western (n = 5) portions of the winter range. The caribou were captured using a net gun fired from a Bell 206 helicopter. The collars were programmed to transmit every day during 13 May to 15 July, every 5 days during 15 July to 28 September, every 4 days during 28 September to 26 October, and every 10 days during 26 October to 13 May. Telemetry surveys were done during the first three weeks in June of each year to determine if the collared cows had calved. During 1996, six of the collared caribou died (two were harvested, one

was killed by wolves, and three died of undetermined causes). The collars were recovered from those animals and were re-deployed on female caribou in the eastern and central portions of the winter range.

Step 1: Satellite Tracking Data

SPANS GIS (Tydac Research Inc.©1999, Nepean, Ontario, Canada) was used to map movements and seasonal distribution of the collared caribou. The movement data for each caribou were colour-coded - based on where they had calved - for a subjective visual assessment of the data.

Step 2: Cluster Analysis

To determine whether there were one or more herds, we performed cluster analysis (Bethke *et al*., 1996) using the radio-collar locations from individual caribou that provided records of movements for a complete caribou year (1 June to 31 May). To use the location data in the cluster analysis, the decimal latitude-longitude coordinate system, upon which the locations were based, were flattened to a common x,y grid. *SPANS* GIS was used to convert the location data to Lambert grid coordinates. We used a Lambert Conformal Conic projection with the first standard parallel at 60^{o} N and the second at 66^{o} N. The projection origin was located at longitude 115^{o} W - its approximate centre.

Based on seasonal changes in activity (Porcupine Caribou Technical Committee, 1993), locations were divided among eight seasons: calving and post-calving (1 June to 25 June), early summer (26 June to 15 July), mid summer (16 July to 7 August), late summer (8 August to 7 October), fall/rut (8

October to 31 October), fall/post-rut (1 November to 30 November), winter (1 December to 31 March), and spring/spring migration (1 April to 31 May). For each caribou the number of observations per season varied depending on the length of the season and the duty cycle of the collars. In order to keep the ratio of observations to variables reasonable as recommended by Bethke *et al*. (1996), we estimated a median easting and northing for each season for a total of 16 variables (i.e., easting and northing medians for 8 seasons) in the cluster analysis. The cluster analysis was performed on data for each year separately and then for data pooled among years using SAS/STAT software (Version 6.12, SAS System for Windows NT©1998, SAS Instutute Inc).

Prior to cluster analysis of the seasonal median locations, the data matrix was standardized to zero mean (SAS Institute, 1988; Bethke *et al*. 1996). Cluster analyses were performed on the seasonal median locations using five common methods: 1) unweighted pair-group method using arithmetic averages (UPGMA); 2) Ward's minimum variance method (WARD's); 3) centroid method (CENTROID); 4) complete linkage clustering method (COMPLETE); and 5) maximum-likelihood method (EML; SAS Institute, 1988; Bethke *et al*., 1996). The division of the cluster dendogram into clusters or herds was based on an objective assessment of the pseudo t^2 statistic (SAS Institute, 1988; Bethke *et al*., 1996).

Step 3: Multiresponse Permutation Procedure (MRPP)

Based on the results of the satellite tracking and cluster analyses, MRPP was used for pair-wise comparisons of the distribution of all possible

'herds' during each season using BLOSSOM statistical software (Slauson *et al*. 1991). This analysis used all satellite location data for caribou that were included in the cluster analyses. MRPP compares the observed intragroup average distances between locations with the average distances that would have resulted from all possible combinations of the data under the null hypothesis (i.e., that the two groups are not different). If the null hypothesis is true, then each of the possible assignments (permutations) is equally likely (Slauson *et al*. 1991).

Step 4: Mapping Population Boundaries

The x,y coordinate data for individual caribou assigned to each 'herd' based on the results of the cluster analyses were analyzed with the harmonic mean range estimator (Dixon and Chapman, 1980) using Range Manager, MapInfo®. This enabled plotting of harmonic contours representing the percent use distribution of caribou tracked in each 'herd'. Since the time interval between successive satellite locations varied during the year, the data set for each caribou was sub-sampled to provide locations on an 8-10 day interval for each year. This removed bias caused by sampling frequency. The 50%, 60%, 70%, 80%, and 90% contours were plotted on maps to visually examine the geographic distribution of the herds.

Step 5: Microsatellite DNA Analyses

In summer 1998, recently cast antlers and skeletal remains or muscle tissue from caribou that died of natural causes were collected from calving areas on Cape Bathurst, west of Bluenose Lake, and east of Bluenose Lake. In

addition, tissue samples were collected from Porcupine and Bathurst caribou that had been harvested on their respective winter ranges by local hunters.

DNA isolated from these samples using Qlamp spin columns (QIAGEN Inc.) was amplified at eight microsatellite loci (RT1, RT5, RT6, RT7, RT9, RT24, RT27; Wilson *et al.*, 1997; and BM4513; Bishop *et al.*, 1994) using the polymerase chain reaction (PCR). One primer from each pair was fluorescently labeled. Cycling conditions were 1 min at 940C, followed by three cycles of 30 s at 940C, 20 s at 540C and 5 s at 720C, followed by 33 cycles of 15 s at 940C, 20 s at 540C and 1 s at 720C, and then 30 min at 720C. Alleles were resolved using polyacrylamide gel electrophoresis on 373A and 377 Automated Sequencers (PE Biosystems) using Genescan® and Genotyper® software.

The genetic variation in each population was estimated by the mean number of alleles per locus, unbiased expected heterozygosity (H_E), and unbiased probability of identity (P_{ID}). H_E is the proportion of individuals in a population that are expected to have two different sized alleles at a particular locus. P_{ID} is the chance that two randomly chosen, unrelated individuals will have the same genotype at all eight loci analysed.

The genetic distinctness of each herd was determined by an assignment test, a G-test for heterogeneity, and the likelihood ratio distance (D_{LR}). The assignment test uses the allele frequencies of each population to assign individuals' genotypes to the herd from which they most likely originated (Paetkau et al., 1995). D_{LR} compares each individuals' genotype to the allele

frequencies of each population to determine the genetic distance between populations (Paetkau et al., 1997).

Results

Satellite Tracking

We obtained movement data for 14 females in 1996-97, 14 females in 1997-98, and 13 females in 1998-99 for which we could ascertain the area where they calved. All of these females were found either among caribou that were calving or were in post calving aggregations during surveys done during the first three weeks in June.

Maps showing the movements of the satellite radio-collared caribou colour-coded based on where they had calved, strongly indicated that there were three separate caribou herds within the study area (Fig. 2). These are:

1) caribou that calve on Cape Bathurst, rut east of Husky Lakes, and winter in the Tuktoyaktuk Peninsula-Husky Lakes area,

2) caribou that calve west of Bluenose Lake, rut along the Anderson River, and winter in the Tuktoyaktuk Peninsula area south into the Sahtu, and

3) caribou that calved east of Bluenose Lake, rut northeast of Great Bear Lake, and winter north, east, and south of Great Bear Lake.

Cluster Analysis

Due to caribou mortalities during the year, only nine collars provided records of movements for a complete caribou year in 1996-97, 13 in 1997-98,

and ten in 1998-99. The results of the cluster analyses of the seasonal median locations for these caribou, the pseudo t^2 statistic remained small when caribou were grouped at the eight to three cluster levels, but increased nine-fold between three and two clusters (Fig. 3). This suggests that dissimilar groups were being clustered. At the three cluster level, all caribou that calved in the Cape Bathurst area formed one group, those that calved west of Bluenose Lake formed a second group, and those that calved east of Bluenose Lake formed a third group (Fig. 4). At the two cluster level, caribou that calved in the Cape Bathurst area were grouped with those that calved west of Bluenose Lake. The caribou that calved east of Bluenose Lake were grouped with these at the one cluster level. The caribou were grouped in this way when the cluster analysis was performed on the data for each year separately and on the data pooled among years. The results were independent of cluster method used, indicating that the separation of caribou into the 3 herds was relatively robust.

Multiresponse Permutation Procedure (MRPP)

The probability values (*p*-values) of a smaller or equal delta for pair-wise comparisons of the distribution of radio-collared caribou that calved on Cape Bathurst, west of Bluenose Lake, and east of Bluenose Lake by season by year and pooled among years support rejection of the null hypothesis that the seasonal distributions of these caribou are not different (Table 1).

Mapping Population Boundaries

Harmonic contouring (50%, 60%, 70%, 80%, and 90%) shows a clear separation in the distribution of radio-collared Bluenose-East and Bluenose-

West caribou (Fig. 5). There was some overlap in the distribution of radio-collared Cape Bathurst and Bluenose-West caribou (Fig. 5).

Microsatellite DNA Analyses

The number of alleles per locus, H_E, and P_{ID} indicates that each herd exhibits a high degree of genetic variation (Table 2). The assignment test indicated that there is genetic differentiation among all herds (Table 3). The Porcupine caribou herd is the most genetically distinct, although the genetic differences between this herd and the other four herds is not as large as was expected given the subspecific designation of this herd. The G-test for heterogeneity revealed that the herds were genetically different ($p<.001$).

The D_{LR} between the Cape Bathurst, Bluenose-West, and Bluenose-East herds (0.21 - 0.33) are similar to the D_{LR} between these herds and the Bathurst herd (0.29 - 0.34) (Table 4). This indicates that the Cape Bathurst, Bluenose-West, and Bluenose-East herds are as genetically distant from each other as they are from the Bathurst herd. The D_{LR} between these four herds and the Porcupine herd ranged from 0.78 to 1.05 (Table 4), indicating that the Porcupine caribou herd is more distantly related, but is still closely related to these herds.

Discussion

The results of our satellite tracking and DNA analyses strongly support the hypothesis that there are three herds of barren-ground caribou within the

range previously ascribed to the Bluenose caribou herd. The data shows that these herds use different seasonal ranges (calving and especially rutting) and are genetically distinct. For convenience we have referred to these herds as the Cape Bathurst, Bluenose-West, and Bluenose-East herd. We recommend that the appropriate communities and wildlife co-management boards work together to name these herds. In addition, the subspecific designation of Porcupine caribou should be reconsidered.

The results of this study will have significant implications for future research and co-management of caribou in the northern NWT and western Nunavut. For example, the three herds have been treated as a single unit for surveys done to determine size, vital rates, and total harvest. Most of the work to date has been done on the Cape Bathurst and Bluenose-West herds, but the information collected was not segregated by herd. The Bluenose-East herd has never adequately been surveyed.

The number of caribou harvested by communities within the range of the 'Bluenose' herd has been documented during studies implemented under the Inuvialuit, Gwich'in, Sahtu, and Nunavut land claims. This data now needs to be partitioned among the three herds. Also, until recently, Bluenose-East caribou harvested south of Great Bear Lake, which in some years has numbered several thousand animals, were included in the annual total harvest of Bathurst caribou thereby inflating harvest figures for that herd.

There will also need to be significant changes in the co-management of these caribou. Although four land claim wildlife co-management boards, 14

user communities, and four government regions of the NWT and Nunavut have worked to develop a single co-management plan for the 'Bluenose Caribou Herd' - we may need to separate this into three individual herd co-management plans.

The Department of Resources, Wildlife, and Economic Development, Government of the Northwest Territories and the Department of Sustainable Development, Government of Nunavut are continuing to monitor the movements of female caribou from each of these three herds using satellite radio-collars. Work is underway to census each herd and to obtain information on vital rates and total harvest.

Movement data for satellite radio-collared caribou collected at regular intervals in combination with microsatellite DNA analysis to assign caribou that calve in different areas either to the same or different herds has provided a powerful tool that should be used to delineate caribou into appropriate herds across their circumpolar range.

Acknowledgments

This study was co-funded by the Wildlife Management Advisory Council (N.W.T.), Inuvialuit Game Council, Gwich'in Renewable Resource Board, Sahtu Renewable Resources Board, Nunavut Wildlife Management Board, Parks Canada Agency, and the Department of Resources, Wildlife, and Economic Development (DRWED), Government of the Northwest Territories. Ed McLean and Graham Van Tighem, DRWED, Inuvik, assisted with the

statistical analysis of the data and helped prepare the maps. A. Gunn, DRWED, Yellowknife, provided Bathurst caribou tissue samples.

References

Banfield, A.W.F. 1954. Preliminary investigation of the barren-ground caribou. - *Can. Wildl. Serv. Wildl. Mgmt. Bull., Ser. 1, No. 10A.*

Bethke, R., Taylor, M., Amstrup, S. & Messier, F. 1996. Population delineation of polar bears using satellite collar data. - *Ecological Applications, 6(1): 311-317.*

Bishop, M.D., Kappes, S.M., Keele, J.W., Stone, R.T., Sunden, S.L.F., Hawkins, G.A., Toldo, S.S., Fries, R., Grosz, M.D., Yoo, J., & Beattie, C.W. 1994. A genetic linkage map for cattle. - *Genetics 136:619-639.*

Brackett, D., Spencer, W. & Hall, E. 1979. Bluenose caribou calving ground survey, 1979. - *Northwest Territories Wildlife Service, unpublished report. 36 p. (Available from Department of Resources, Wildlife, and Economic Development, Government of the Northwest Territories, Yellowknife, N.W.T., Canada X1A 2L9)*

Dixon, K.R. & Chapman, J.A. 1980. Haromonic mean measure of animal activity areas. -*Ecology 65:1040-1044.*

Gunn, A. & Miller, F. L. 1986. Traditional behaviour and fidelity to caribou calving grounds by barren-ground caribou. *Rangifer Spec. Issue No. 1: 151-158.*

Hawley, V., Hawley, A, Poll, D., and Brown, R. 1979. The Bluenose caribou herd, 1974 - 1976. -*Canadian Wildlife Service manuscript report, Edmonton, Alberta. 113p. (Available from Canadian Wildlife Service, Edmonton, Alberta, Canada).*

Paetkau, D., Calvert, W., Stirling, I. & Strobeck, C. 1995. Microsatellite analysis of population structure in Canadian Polar bears. - *Mol. Ecol. 4: 347-354.*

Paetkau, D., Waits, L., Clarkson, P., Craighead, L. & Strobeck, C. 1997. An empirical evaluation of genetic distance statistics using microsatellite data from bear (*Ursidae*) populations. - *Genetics 147: 1943-1957.*

Porcupine Caribou Technical Committee. 1993. Sensitive habitats of the Porcupine caribou herds. *International Porcupine Caribou Board. 28p.*

SAS Institute Inc. 1988. SAS/STAT™User's Guide, Release 6.03 Edition. - *Cary, NC:SAS Institute Inc., 1988. 1028p.*

Slauson, W.L., Cade, B.S. & Richards, J.D. 1991. User Manual for BLOSSOM Statistical Software. - *Midcontinental Ecological Science Center, National Biological Survey, 4512 McMurray Ave., Fort Collins, Colorado 80525. 59p*

Thomas, D. C. 1969. Population estimates and distribution of barren-ground caribou in Mackenzie District, N.W.T., Saskatchewan, and Alberta-March to May, 1967. - *Can. Wildl. Serv. Report Ser. No 9, Ottawa, Ontario, Canada. 44 p.*

Wilson, G.A., Strobeck, C., Wu, L. & J. Coffin, J. 1997. Characterization of microsatellite loci in caribou *Rangifer tarandus*, and their use in other artiodactyls. - *Mol. Ecol.* 6: 697-699.

Zittlau, K., Coffin, J., Farnell, R., Kuzyk, G., & Strobeck, C. Genetic relationships of three Yukon woodland caribou herds determined by DNA typing. *Rangifer, in press.*

Fig.1. Ranges of the Porcupine (Canada), Bluenose, and Bathurst caribou herds.

Fig. 2. Movements of the radio-collared female caribou tracked by satellite, 1 June 1996 to 31 May 1999.

Fig. 3. Distribution of the pseudo t^2 statistic for 1-8 clusters, based on cluster analysis of the seasonal median locations of radio-collared caribou using: unweighted pair-group method using arithmetic averages (UPGMA); Ward's minimum variance method (WARD's); centroid method (CENTROID); complete linkage clustering method (COMPLETE); and maximum-likelihood method (EML).

Fig. 4. Cluster dendogram based on the Euclidean distance between the means of the last cluster joined from unweighted pair-group method using arithmetic averages (UPGMA) for data pooled among years, illustrating the division and assignment of radio-collared caribou to those that calved on Cape Bathurst, west of Bluenose Lake, and east of Bluenose Lake.

Fig. 5. Harmonic contours illustrating the 50%, 60%, 70%, 80%, and 90% utilization distribution for the Cape Bathurst, Bluenose-East, and Bluenose-West caribou herds.

Table 1. Approximate probability value (*p*-value) of a smaller or equal delta for pair-wise comparisons of the distribution of radio-collared Bluenose-East, Bluenose-West, and Cape Bathurst caribou by season by year and pooled among years. Test results are presented for adjacent herds.

Season	1 June 1996 - 31 May 1997		1 June 1997 - 31 May 1998		1 June 1998 - 31 May 1999		1 June 1996 - 31 May 1999	
	BE[A] vs BW[B]	BW vs CB[C]	BE vs BW	BW vs CB	BE vs BW	BW vs CB	BE vs BW	BW vs CB
Calving and post-calving	0.21×10^{-27}	0.66×10^{-34}	0.11×10^{-53}	0.17×10^{-43}	0.48×10^{-38}	0.99×10^{-34}	0.14×10^{-117}	.52 x 10-^{114}
Early summer	0.15×10^{-22}	0.21×10^{-31}	0.43×10^{-42}	0.47×10^{-36}	0.21×10^{-30}	0.68×10^{-27}	0.25×10^{-90}	0.11×10^{-91}
Mid summer	0.46×10^{-05}	0.44×10^{-05}	0.30×10^{-11}	0.64×10^{-06}	0.39×10^{-08}	0.39×10^{-04}	0.38×10^{-21}	0.23×10^{-12}
Late summer	0.87×10^{-15}	0.89×10^{-14}	0.70×10^{-28}	0.60×10^{-10}	0.15×10^{-19}	0.71×10^{-11}	0.28×10^{-60}	0.33×10^{-31}
Fall/rut	0.41×10^{-06}	0.28×10^{-07}	0.25×10^{-11}	0.51×10^{-06}	0.41×10^{-08}	0.11×10^{-04}	0.31×10^{-22}	0.19×10^{-23}
Fall/post-rut	0.81×10^{-04}	0.10×10^{-04}	0.66×10^{-06}	0.56×10^{-03}	0.41×10^{-05}	0.25×10^{-03}	0.23×10^{-13}	0.42×10^{-09}
Winter	0.56×10^{-14}	0.16×10^{-19}	0.42×10^{-24}	0.44×10^{-11}	0.73×10^{-20}	0.24×10^{-12}	0.18×10^{-55}	0.36×10^{-38}
Spring/spring migration	0.82×10^{-25}	0.16×10^{-37}	0.15×10^{-48}	0.28×10^{-36}	0.60×10^{-34}	0.84×10^{-18}	0.84×10^{-105}	0.56×10^{-84}

[A] BE = radio-collared Bluenose-East caribou.
[B] BW = radio-collared Bluenose-West caribou.
[C] CB = radio-collared Cape Bathurst caribou.

Table 2. Measures of genetic variation.

Barren-ground Caribou Herd	Measures of Genetic Variation			
	Sample Size	Mean No. of Alleles/Locus	Heterozygosity (H_E)	Probability of Identity (P_{ID})
Porcupine	76	14.25	0.878	5.43×10^{-12}
Cape Bathurst	31	11.25	0.867	2.31×10^{-12}
Bluenose-West	82	14.13	0.869	3.23×10^{-12}
Bluenose-East	83	13.00	0.861	1.32×10^{-12}
Bathurst	35	12.00	0.860	1.47×10^{-12}

Table 3. Percent of individuals from each herd's sample that were assigned to each herd within the study area (assignment tests).

Barren-ground Caribou Herd	Percent of individuals from each herd's sample that were assigned to each herd in the study area				
	Porcupine	Cape Bathurst	Bluenose-West	Bluenose-East	Bathurst
Porcupine	56.6 (n = 43)	13.2 (n = 10)	7.9 (n = 6)	11.8 (n = 9)	10.5 (n = 8)
Cape Bathurst	9.7 (n = 3)	32.3 (n =10)	19.4 (n = 6)	16.1 (n = 5)	22.6 (n = 7)
Bluenose-West	7.3 (n = 6)	23.2 (n = 19)	29.3 (n = 24)	23.2 (n = 19)	17.1 (n = 14)
Bluenose-East	14.5 (n = 12)	14.5 (n = 12)	18.1 (n = 15)	37.3 (n = 31)	15.7 (n = 13)
Bathurst	11.4 (n = 4)	14.3 (n = 5)	14.3 (n = 5)	17.1 (n = 6)	42.9 (n = 15)

Table 4. Genetic distances (D_{LR}) between herds.

Caribou Herd	Porcupine	Cape Bathurst	Bluenose-West	Bluenose-East	Bathurst
Porcupine	0				
Cape Bathurst	0.802	0			
Bluenose-West	1.051	0.213	0		
Bluenose-East	0.775	0.332	0.242	0	
Bathurst	0.832	0.286	0.288	0.343	0