Physical Condition of Migratory Caribou in Québec-Labrador

Summary Assessment of Observations from 2001 to 2003

Presented to the
Institute for Environmental Monitoring and Research (IEMR)

by
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Partners in Study Project:

- Société de la faune et des parcs du Québec
- Newfoundland and Labrador Wildlife Science and Research Division
- Institute for Environmental Monitoring and Research
- Department of Biology and Centre for Northern Studies, Université Laval
- Fondation de la faune du Québec, Fonds pour les espèces nordiques
- Caribou Québec
- Natural Sciences and Engineering Research Council of Canada
- Makivik Corporation

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1. Introduction

July 2001 saw the start of a research project aimed at providing a better understanding of the ecology of the main populations, subpopulations, or groups of caribou living in Northern Quebec and Labrador. The project consists of three separate yet complementary components: 1. Use of Space, 2. Physical Condition and Demography, and 3. Genetics. According to the basic hypothesis of the study, which is being carried out under the auspices of Université Laval, the George River caribou herd (GRH) and the Leaf River caribou herd (LRH) should be genetically similar but make up separate, different populations when it comes to their use of space, their physical condition, and their demography. However, they have also established linkages between them, linkages that have now made them a vast caribou metapopulation. According to the most recent surveys available, this metapopulation is one of the largest in the world. Moreover, these two populations do not mix with sedentary woodland caribou even though, in winter, the distribution areas of the two ecotypes overlap. These two ecotypes should therefore remain distinct despite the seasonal passage of thousands of migrating barren-ground caribou. The caribou found in the Joseph Lake and Atikonak Lake sectors (52° 40’ N, 65° 00’ W) are an example of the sedentary woodland ecotype.

Interested in gaining a better understanding of the ecology of the northern caribou in order to ensure optimum management of this resource, the Société de la faune et des parcs du Québec (FAPAQ) is heading up this research project with the help of direct and indirect budgetary contributions from major partners. Since the start-up of the project, the following partners have contributed financially to the study: FAPAQ; Newfoundland and Labrador Wildlife Science and Research Division (Goose Bay, Labrador); Institute for Environmental Monitoring and Research (IEMR, Goose Bay, Labrador); Department of Biology and Centre for Northern Studies, Université Laval; Fondation de la faune du Québec (Fonds pour les espèces nordiques); Caribou Québec; Natural Sciences and Engineering Research Council (grant to J. Huot); and the Makivik Corporation (study of the massive mortality in Tasiujaq, August 2003).

Analysis of the data from the three research components continues, and the first results will be available in 2004. This document, prepared at the request of the IEMR, provides a summary assessment of the observations made in connection with the second component – Physical Condition and Demography.

2. Observations Made Regarding Physical Condition

Between July 2001 and September 2003, thanks to the support of the partners, data were collected on 347 caribou for the purpose of evaluating the physical condition of the animals in the two large herds. These data are contained in the Excel file that was sent to the IEMR in November 2003 (file Condition_2001_03_031123.xls). These data will make it possible to report on two full biological years and to compare the condition of the herds with the data collected in 1980 and 1990.

Measurements were taken primarily of adult females and calves. The variables noted were intended to describe the physical condition of the animals by means of measurements of lipid reserves (e.g., back fat, kidney fat, femur fat) or protein reserves (e.g., peroneal muscle mass) or to help estimate body growth and skeletal stature (e.g., foot length, total length, mandible length). Most of these are common measurements that have already been used by earlier researchers (Parker, 1981; Huot, 1988, 1989; Couturier et al., 1989). Appendix 1 describes more than 110 variables that were noted and included in Excel file Condition_2001_03_031123.xls.

The 2001-03 data are being added to a large database on the physical condition of caribou that brings together biological information about some 3,000 caribou that have been measured since 1970. With data supplied by various sources, this database is the result of the combination of observations from earlier studies on the physical condition of caribou (Couturier et al., 1984; Huot et al., 1985; Huot, 1989; Crête and Huot, 1993; Couturier et al., 1989; Manseau, 1996, about 1,000 observations), data collected on immature caribou (0-24 months) caught for the body growth study (Couturier, S., unpublished data, about 1,600 observations), and data collected on caribou wearing radio-transmitter collars (VHF and Argos collars, Couturier, S., and Jean, D., unpublished data). This database constitutes an invaluable source of information for the current and future conservation of migratory caribou.

3. Physical Condition: A Few Preliminary Results

It is difficult, even impossible, to quantify the quality and level of habitat use by a large herd of migratory barren-ground caribou, hence the need to use an indirect approach involving measurements of the animals' condition. Moreover, it has been demonstrated that the physical condition of ungulates reflects the condition of their habitat, but also that their condition is influenced by other environmental characteristics, such as climate. Large-scale climatological phenomena like the North Atlantic Oscillation (NAO) could even synchronize the demography of ungulate populations, as was recently suggested for caribou and musk ox in Greenland (Post and Forchhammer, 2002). The study of the animals' condition therefore becomes a more complete integrator for describing an ungulate population and its relationship with its habitat and its environment (Huot, 1988).

The initial work on the physical condition of the GRH caribou was carried out in 1963-65 by Bergerud (1967), in April 1980 by Parker (1981), and in 1983 and 1984 by Dr. Jean Huot of Université Laval (Huot and Beaulieu, 1985; Huot and Goudreault, 1985; Huot and Picard, 1988; Huot, 1989). With regard to the GRH, deterioration of the calving grounds and the summer habitat has already been identified as the major factor causing the demographic changes that occurred in the late 1980s (Couturier et al., 1988 a and b, 1990; Huot, 1989; Crête and Huot, 1993; Manseau, 1996). Habitat deterioration apparently first caused a decline in the overall physical condition of the animals in the herd, and this subsequently led to a decrease in recruitment starting in 1984 (Couturier et al., 1988 a and b, 1990) and an increase in the adult mortality rate in the late 1980s and early 1990s (Hearn et al., 1990; Crête et al., 1996). The study of the physical condition of these animals in summer therefore becomes an important component of our project, and this represents the first data collected on their condition since the data

collected in 1988 on the LRH and the GRH by Crête and Huot (1993) and the data collected in 1993 on the GRH by Manseau (1996).

Although it must be kept in mind that our results are still preliminary, it is nonetheless possible to point to certain trends in the physical condition of the adult females observed in late July when lactation is at its peak. The condition of the GRH females appears to have been better recently than it was in 1988 or in 1993. Also, for both herds, almost all of the physical condition indicators were lower in 2002 than they were in 2001. It may be that the late spring in 2002 had a negative impact on the condition of the caribou.

It can be seen as well that the overall condition gradient for the GRH and the LRH seems to have reversed itself and that the GRH is now in better condition than the LRH. Indeed, judging from preliminary results, it is apparent that the condition indicators for the GRH were below those for the LRH in 1988, whereas the opposite is almost always true in 2001-02. Even the stature of the lactating adult females appears to have changed since 1988, and in 2001-02, total length was greater for the GRH in the samples that were compared (Mann-Whitney, $p<0.05$).

The condition of the calves seems to be following the trends observed in the mothers. According to our preliminary observations, the mass of GRH calves now appears to be greater than it was in the summer of 1988 (Crête and Huot, 1993) or in 1993 (Manseau, 1996). Furthermore, GRH calves now appear to be bigger than LRH calves, while the opposite was observed in 1988 (Crête and Huot, 1993). Unfavourable weather conditions or another factor in 2002 may have had a negative effect on the condition of the calves as well.

These few preliminary trends with regard to the condition of individuals from both herds seem to be in line with the changes that have occurred in the demography of these populations. The apparent improvement in the condition of the GRH took place while the size of the herd was dropping from a peak of 775,000 animals in 1993 (Couturier et al., 1996) to about 440,000 at the time of the last survey, in 2001 (preliminary, Couturier, S. et al. under preparation; see also Boudreau et al., 2003). Moreover, the apparent deterioration in the condition of the LRH was observed between 1991 and 2001, during a significant increase in the number of animals (Couturier, S. et al., under preparation). It is possible that the two herds are following the same demographic trajectory and that this is reflected in the animals' physical condition in summer, hence the significance of our results. The current physical condition of the LRH in summer is similar to that of the GRH in the late 1980s.

It can also be assumed that the condition of the LRH in summer is dependent on the condition of the habitat it frequents. It just so happens that the use of the LRH's space has changed immensely since the 1980s. The LRH's calving range was located near Payne Lake in 1986, whereas it is now found to the southwest of Kangiqsujuaq. The habitat used during post-calving aggregations in July has changed as well, and this could have had an effect on the physical condition of the LRH caribou. Whatever the case, this discussion is preliminary only, and the final analyses will make it possible to detect the significant trends in the physical condition of the caribou. The detailed data from the four observation periods spread over 14 years are a valuable source of information that may enable us to identify the factors behind the trends observed.

4. Conclusion

In view of the recent demographic trends that we have observed in the two large herds, our study seems particularly timely and will make it possible to better guide the resource-allocation decisions that will result from the Québec management plan now being prepared. Our initial observations suggest that the demography of the migratory barren-ground caribou is closely related to their use of space (e.g., emigration of the GRH towards the LRH) and their physical condition. The final analysis of the data collected will therefore help us to predict the LRH's evolution over the medium term, which could resemble the recent evolution of the GRH. Not only is the current physical condition of the LRH similar to that of the GRH in the late 1980s, but its pattern of space use and some of its demographic characteristics are similar as well. In addition, it is important that our study document the condition of the GRH in an attempt to predict whether the decline in the number of animals has stopped or whether it is still going on. The study under way on genetic status will add a new dimension to the comparison between the herds and the ecotypes and will help us to determine whether the various caribou herds actually do form a vast metapopulation. This project consists of several components that will make it possible to submit a certain number of scientific articles for publication in specialized journals. A final report will be available in 2004.

5. References

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Appendix 1

Study on the physical condition of caribou, 2001-2003
List and description of measured variables
(from Excel file Condition_2001_03_031123.xls)

Variable Name	Description and/or coding if needed
Line1	Line number
FieldNo	Field number
CariNo	Unique caribou ID number
Date1Num	Date in numerical format
Date2	Date in Excel format
Yr	Year
Mo	Month
Day	
Julian	Julian Day from 1 to 365: January 25th=25, February 5th=36, etc.
Season	1= June, 2= July-August, 3=Sept-Oct, 4= March
Expe	Field Expedition number
Herd	1= GRH, 2= LRH
S	1= male, 2= female
Classage	1=0-11 months, 2=12-23 months, 3=24-35 months, 4= 36-59 months, 5= 60 months and over
AgeMonth	Age in months
AgeWear	Age from the analysis of eruption and wear pattern
AgeLayer	Age determined by cementum layer analysis
Milk	Current milk condition of female: 1= Yes, 2= No
MilkBefore	Milk status during previous reproductive year, 1= Yes, 2= No
AtHeel	Calf at heel: 1= Yes, 2= No
LinkWith	Parental link with another animal number
LinkConfidence	Confidence in link determination based on field observation (in %)
Teeth	Tooth observation
Antlers	Antlers observation
AntlerNb	Antlers number: 0, 1 or 2
AntlerWeight	Rigth Antler weight in g
LatD	Latitude Degree
LatM	Latitude Minute
Lat	Latitude in decimal format
LonD	Longitude Degree
LonM	Longitude Minute
Lon	Longitude in decimal format
HLL	Hind leg length in cm
MetaLength	Approximate Metatarsus length in cm (from external measurements)
Neck	Minimum neck girth in cm
GirthAtHeart	Girth at heart in cm (behind the rump)

GirthAtHump	Girth at hump in cm (over the rump)
TotalLength	Total body length in cm
BodyMass	Total live body mass in kg (may include small correction for blood losses)
EviscBodyMass	Eviscerated body mass (Total mass minus gastro-intestinal organs and contents, and reproductive tract)
Fem	Femur collected: 1=yes
Per	*Peroneus* collected: 1=yes
Blo	Blood collected (DNA): 1=yes
Ear	Ear sample collected (DNA): 1=yes
Jaw	Lower jaw collected: 1=yes
Tee	Teeth collected (aging): 1=yes
Met	Metatarsal bone collected: 1=yes
Rum	Rumen content collected: 1=yes
Abo	Abomassum and its content collected: 1=yes
Fec	Feces collected: 1=yes
Ova	Ovaries collected: 1=yes
Ant	Antlers collected: 1=yes
BackFatMax	Back Fat maximum depth following Riney (1955) in mm
BackFatMean	Back Fat mean depth following Riney (1955) in mm
PeroMass	*Peroneus* mass in g
KidneyRTip	Kidney fat on the tip in g - Right
KidneyRRin	Kidney fat following Riney (1955) in g - Right
KidneyR	Kidney mass in g - Right
KidneyLTip	Kidney fat on the tip in g - Left
KidneyLRin	Kidney fat following Riney (1955) in g - Left
KidneyL	Kidney mass in g - Left
KidneyRin	Kidney fat following Riney (1955) in g - Mean
KidneyTip	Kidney fat on the tip in g - Mean
KidneyMass	Kidney mass in g - Mean
AsymKidney	Asymmetrical kidney ratio: Right/Left
MetaFat	Metatarsal marrow fat in %
FemurFat	Femur marrow fat in %
JawFat	Lower jaw marrow fat in %
FemurLength	In cm
KFIRiney	Kidney fat Index following Riney (1955)
LnKFIR	Natural log of KFIRiney
KFITotal	Kidney fat index using total fat (include fat on the tip)
KFFI	Kidney Femur Fat Index (KFIRiney*FemurFat)
Age0_1	Age: calf=0, other=1
FatPercent	Body Percent fat (%)
Prot_Mass	Protein mass in kg
WaterMass	Water mass in kg
IFBM	Ingesta-free body mass
HeartCystiTaranNb	*Cysticercus tarandi* in the heart (nb)
LungKystNb	Hydatical cysts in lungs (nb)
FlukesNb	Liver flukes (nb)

LiverCystiTenuiNb	*Cysticercus tenuicollis* in liver (nb)
MuCystiTaran	*Cysticercus tarandi* in muscles (nb)
Fetus	Fetus presence: 1=yes, 2=no
FetusSexe	Fetus sex: 1=male, 2=female
FetusMass	Fetus mass in kg
FetusTotLength	Fetus total length in cm
FetusHLL	Fetus Hind leg length in cm
Photo	Photo taken in the field: 1=yes, 2= no
I1	Total Lower jaw length at I1 in mm
C1	Lower jaw length in mm
Diastema	Diastema length in mm
MentonnR	Lower jaw length at *mentonni foramen* in mm - R
MentonnL	Lower jaw length at *mentonni foramen* in mm - L
Mentonni	Mean of two previous measures
AsymMent	Asymmetrical *mentonni foramen* ratio: rigth/left
JawHeigthR	Jaw height in mm - R
JawHeigthL	Jaw height in mm - L
JawHeigth	Mean of two previous measures
AsymJawHeigth	Asymmetrical jaw height: rigth /left
M1R	Tooth M1 height in mm - R
M1L	Tooth M1 height in mm - L
M1	Mean of two previous measures
AsymM1	Asymmetrical M1 height: rigth /left
PM2R	Tooth PM2 height - R
PM2L	Tooth PM2 height - L
PM2	Mean of two previous measures
AsymPM2	Asymmetrical PM2 height: rigth/left
Fece_Prot	% protein in feces (N * 6,25)
Rumen_Prot	% protein in rumen content (N * 6,25)
Diff_Fece_Rum	Fece_Prot - Rumen_Prot
BackFemur	Back fat Max * FemurFat
BackMeta	BackFat Max * MetaFat
Fatness	(EviscBodyMass/(HLL3 * 1000))
Comments	