Caribou Component Study Addendum, Cartwright Junction to Happy Valley-Goose Bay, Trans Labrador Highway

September 2003

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Executive Summary

This report contains results of comments and questions from reviewers of the Caribou Component Study for Phase 3 of the Trans Labrador Highway submitted in 2002. Comments and questions from reviewers of the Caribou Component Study are answered and/or addressed. In winter 2003, in anticipation of further research on the Mealy Mountain Caribou Herd (MMCH), Science Division in cooperation with Department of Works, Services, and Transportation (WST), deployed 11 additional Very High Frequency (VHF) collars on females caribou from the MMCH. Captures took place in April and deployments were performed relative to caribou densities located during the capture period. Further caribou surveys during calving and post-calving season were required. The work chosen for implementation employed a block-survey design along both the Original and Alternate road routes during both calving and post-calving seasons. During calving season, a total of 377 wildlife observations were made of which 16 were of caribou, totalling 24 individual caribou. Of these observations, 14 were made within survey blocks, totalling 19 individual caribou. The density of caribou observed was more than 3 times higher in the northern survey area than in the southern survey area. Further, caribou density in the eastern survey area was one-third higher than in the southern survey area. As well, density of doe-calf pairs was more than five (5) times greater in the northern survey area than the southern survey area. The eastern survey area had a density of doe-calf pairs more than three (3) times that of the southern survey area. Also, the eastern survey area has a higher density of caribou and a higher density of doe-calf pairs than does the southern survey area. To aid in design and stratification of post-calving season block surveys, three telemetry flights were performed on 15 and 31 July and 12 August 2003 to determine location of all collared caribou from the MMCH. Data collected on these flights strongly suggests that caribou are using forested

areas for cover during this period. Similar to the calving season block survey, a random block survey design was employed during post-calving season. A total of 242 wildlife observations were made of which some contained multiple species. No caribou were observed during this survey.

<u>Takuapekishtakenshu Nishinaikan</u>

Ume mishinaikan uauitakanu kaeissishuanut neta kanantutshissenimakant atiuk eshk eka tutakant neme utapan meshkanau TLH-Phase 3 tshishtakanipan ne mishinaikan pupun etishtet 2002. Uauinepan nenua atiukua auentshent kanantutshissenimakant atiuk. Nene pepuak 2003, nantutshissenimakanipan minuat ne atiuk nete Akamiuapishkut (Mealy Mountain Caribou Herd) ishinikatakanu, katshitetikuet (WST) stsheutshimau ukakusseshima tshikamutatinepan kantutakannit nta ukuianit nenua atikua kutunnu ashu peik (11) ishkuetikua. Shakunnit nene shiship-pishumua katshitinakanipant tshekamutatinakanit nenua kantutakannitshi(VHF) nta ukuiauat ntshent atiukut. Eshk eka pinetikut ne atiuk mak katshi pinetiukut ne atiuk nantutshissenimakanipan tan tshetuakue ntshent atiukut. Nantutshissenimakanipant ntshent atiukut nemenu tsheitamutakanit nenua utapan meshkananu miam eshk eka pinetiukut mak katshi pinetiukut. Miam penetiukut ne atiuk shakunnit, nishtumitashumitunnu ashu nishuas tatunnu uapamakanipant aueshishet muk kutunnu ashu kutuas (16) tat uapamakanipan atiukut, mamu nishunnu ashu neu (24) tatishipant atiukut epapeikussit. Kutunnu nashun neu tatiahipant nta mamu etat ntshent atiukut nta kanantutshissenimakanit atiukut, mamu kutunnunashu peikushteu (19) tatishipant atiukut. Nete kanantutshissenimakanit atiukut nete ninemeu itshet etitu mitshetipant atiukut eku ute mamit akamiuapishkut itetshe apu shuk mitshetit ntshnet atiukut niantutshissenimakanit eukuannu uet animitshentakushiht tshetshi minu nantutshissenimakanit. Nete tshiuetint itetshe ne atiuk niantutshissenimakant etitu mitshetut minuat nte nishuau ishpish mitshetut mak at nete mamit kanantutshissenimakant ne atiuk. Kie ne atiuk uatsheuat utitikussima anu mitshetut nete ninemeu itetshe mak at nete etishet nete mamit kanantutshissenimakant atiuk pitetat (5) tatuau nte minuat ishpish mitshetut nete ninemeu itetshe. Eku nete tshiuetint itetshe nishtuau nte minuat ishpish mitshetut nushetikut uatsheuat utitikussimuaua mak at nete mamit etishet atikussit mak nushetikut. Nishtuau kapampant apatshiakanipan shiatshuapamakanit ntshent atikut ntshent katshikamutationakanit kantutakannitshi nta ukutakanuat ushkat shiatshuapamakanit Shetan-pishumua 15, mak 31 etshishtauakannitshi, mak Upau-pishumua 12 etshishtauakannitshi, 2003, tshetshi nantutshissenimakanit kassinu atiukut katapishkatshiakanit kantutakannitshi nta ukutakanuat ntutshissenimakannut tante tsheituteuakue (MMCH). Kassinu ntshent atiukut katapishkatshiakanit kantutakannitshi nta ukutakanuat nte usham mishkuakanut minashkuat nte eminashkuant. Kie kutakat atiukut kanantutshissenimakanit eshk eka pinetikut nantutshissenimakanipant. Nishumitashumitunnu ashu nneunnu ashu neu (242) tatishipant aueshishet uiapamakanit kie pisse ntshent aueshishet nanishipant kie pisse nanishtipant. Muk apu tut uapamakanit atiukut.

Contents

Section 1 - Responses to Deficiency Statement Questions

"Background" Section

The Mealy Mountain Caribou Herd is described as exhibiting an inherent population cycle. Provide the rationale for that conclusion as opposed to the possibility that past census fluctuation may have resulted from sampling error and/or inadequate methodology in the census surveys.

It is important to understand that the ideas of population fluctuation and sampling error/methodology need not be in opposition. Both can occur simultaneously, and probably do, with any population survey and/or census. With most animal censuses, biologists do not set out to count all individual animals within an area. Instead, a sample is counted and, through well established statistical operations, the results of the sample count are extrapolated to the entire area of interest. Since we know we did not count all animals, we know there is some error in the result, and this error is calculated using well established statistical operations, and reported. Sampling error is generally reported as a confidence interval around the actual estimate, usually as: 1) plus/minus a percentage of the estimate, and/or 2) plus/minus a number of animals. The size of the confidence interval depends on several factors, including number of animals sighted during surveys, fraction of area covered during surveys, and distribution of animals sighted during surveys.

As for the question of inadequate methodology, biologists always attempt to improve methods used for surveys, based on known constraints including size of area, species of interest, budget, and intended use of the result. The methodology used in the 2002 population estimate for MMCH was a strip-transect design during late winter. This is the method suggested by Krebs (1999) for use when: 1) an absolute estimate of density is required, 2) data on individuals is not required (although we collect this for other purposes), 3) organisms are mobile, 4) the population is not being exploited, 5) dispersion is not random, and 6) density is low. Questions about *how* the survey is implemented are important, however, and can probably have an effect on the results. To some degree, the statistical procedure of calculating confidence intervals attempts to quantify the uncertainty surrounding results obtained using particular methods. One must realize, however, that the true number of animals can never be known without a total count, and therefore we can not be sure of the magnitude of effect of how the survey was implemented.

For example, in 1997, a similar survey was completed using a fixed-wing aircraft. This type of aircraft is limited in minimum speed attainable and manoeuverability. During this survey, only 11 caribou were located "on-transect" during surveys. It is probable that caribou were missed on-transect, and the low number of sightings contributed to a large confidence interval (analysis accommodates methodology). Because of these difficulties, a helicopter was used during the census of 2002. Also, the survey took place in late winter when woodland caribou form relatively large groups, and leave evidence of their presence (tracks, feeding craters).

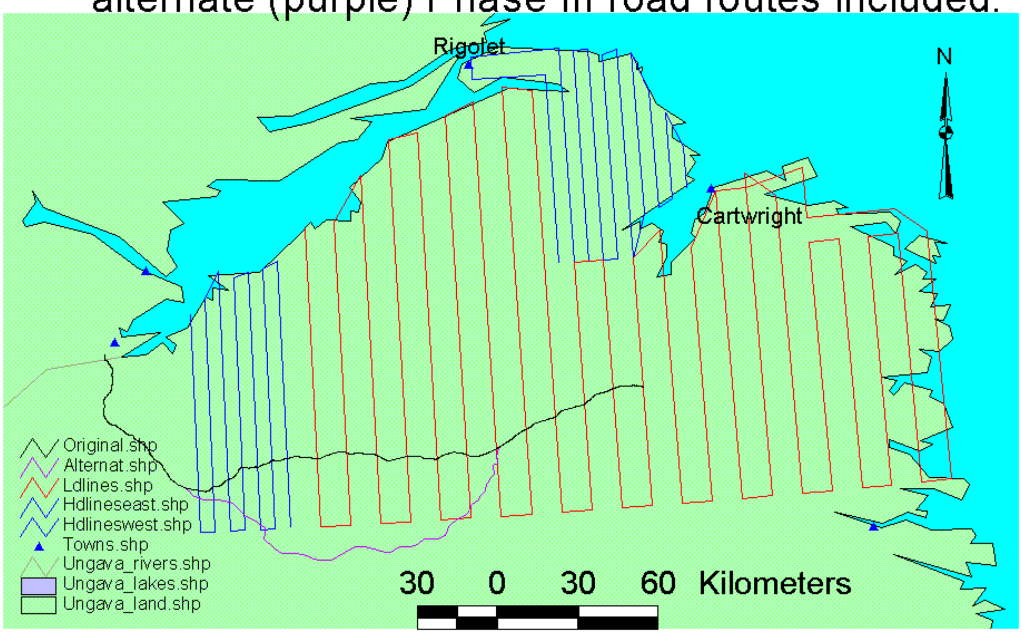
The MMCH lives in an area frequented by several predators including grey wolves (*Canis lupus*), black bears (*Ursus americanus*), lynx (*Lynx canadensis*), and golden eagles *(Aquila chrysaetos*). We also know that the MMCH, as in other caribou herds, does not increase without limit, therefore density-dependent effects on birth rate and/or mortality rate must occur. Because predators do not increase in number without limit, they must display density-dependent demographic rates. Because demographic rates of caribou depend on density of predators, and vice-versa, they cannot exist in perfect balance. Therefore, MMCH numbers must fluctuate naturally over time, creating a population cycle. There is an extensive literature on the effect of predators and forage conditions on the demographics of caribou, including Hayes et. al. 1993, Couturier et. al. 1990, Messier et. al. 1988, Skogland 1986, and Fuller and Keith 1981. When results from past surveys on the MMCH are interpreted including confidence limits, one has to conclude that inherent population cycling occurs. The 1997 MMCH survey estimated 243 ± 291 animals resulting in an upper 90% confidence interval of 534 animals (Schaefer 1997). The 2002 MMCH census estimated 2585 ± 1596 caribou, resulting in a lower 90% confidence interval of 989 caribou. It is very probable that the MMCH underwent population cycling during the period from 1997 to 2002, and based on the best methodological efforts of the day, appears to have undergone wide fluctuations in population in past years.

“Density Distribution Methods” Section

Figure 1: Provide mapping at an appropriate scale. Include in the mapping the viable alternative routes superimposed on the study area. At a minimum the routes identified by the Innu Nation and the Newfoundland and Labrador Outfitters Association must be depicted in relation to the study area.

Provide the source of historic knowledge used to identify high and low density strata and describe how those strata identifications may be affected by caribou density distribution changes.

Figure 1. Survey design including high density (blue) and low density (red) survey strata, Mealy Mountain caribou survey 2002. Original (black) and alternate (purple) Phase III road routes included.



Two types of knowledge were used to determine the density strata: traditional knowledge and aerial survey results. Traditional knowledge of caribou locations was incorporated in two ways. First, Schaefer (1997) used traditional knowledge, through discussion with Innu, to establish strata for the

1997 survey. Secondly, for the 2002 survey (Otto 2002), initial survey routes were established similarly to Schaefer (1997), to make comparing survey results easier, but with the exception of expanding the survey area in the southeast to include areas where confirmed sightings of caribou have been made since 1997. Once this process was complete, a meeting with elders from the Innu Nation and Mamit Innuat was held at the Otter Creek Science Division Office in March 2002 to discuss the proposed survey and to hear from elders regarding historic caribou distribution.

The second part of the question appears to ask what the effect will be if the strata identifications do not match actual caribou locations and density. The purpose of strata in this type of survey is to generate a more precise estimate, i.e., make the confidence interval smaller, indicating less range of probable error. This is accomplished mathematically by having more groups of caribou recorded on the survey, and it follows, therefore, that more effort should be directed toward those areas thought to have higher caribou density. The final calculation of estimated population size is simply a sum of estimates from the three separate strata (high density east and west and low density). Each of the three estimates is simply based on how many caribou were observed and the relative coverage of the survey flights (Gasaway et al. 1986). Recall that before 1997, no systematic search or effort at estimating actual population size had been attempted since at least the early 1980s, and one recommendation of the 2002 report was that the western high density stratum be treated as low density in future (Otto 2002).

Compare the survey crew utilized for the Component Study with a standard survey crew and, if not the same, discuss the influence of the difference which could be expected from the survey crew utilized and a standard survey crew.

The crew utilized was a standard survey crew including a pilot experienced in caribou observation from the air, senior biologist of the Science Division, one wildlife technician of the Science Division, and one Innu expert from either Labrador or adjacent Quebec. There was one survey that included another Science Division biologist in place of the wildlife technician.

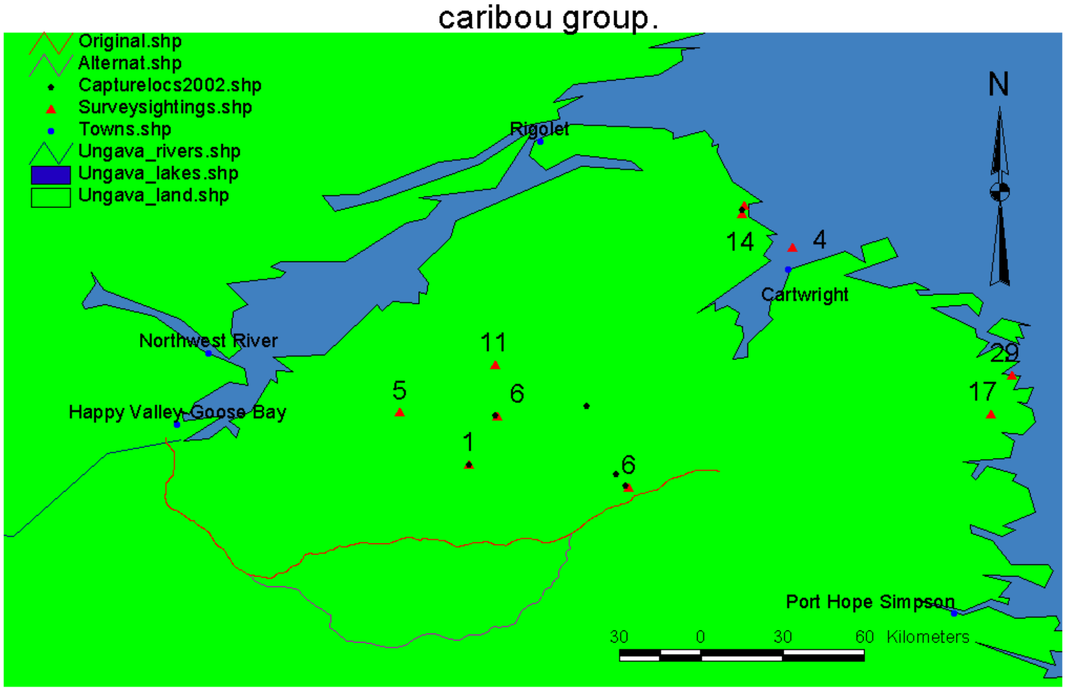
Provide the lengths of transects flown and the duration of each of the flights.

No data specific to the exact lengths and duration of each flight transect were recorded. To elaborate, some of these data would be very difficult to record, as during much of the time, flying was not always along planned transects; often the survey crew were slowing or circling to more closely inspect animal sign. Further, it was the duty of one observer to record required data, but their first duty was to observe animals sign. Making data recording too extensive effectively risks the effectiveness of that observer. The actual flight lines very closely mirrored those planned, and the speed of the helicopter ranged most of the time from 100 to 150 km/h. Of note is that recent advances in inexpensive GPS and related software technology can record such data automatically.

"Results and Discussion" Section

Figure 3: provide mapping at an appropriate scale. Include in the mapping the viable alternative routes superimposed on the study area. At a minimum the routes identified by the Innu Nation and the Newfoundland and Labrador Outfitters Association must be depicted in relation to the study area.

Figure 3. Location of caribou groups found on survey (red triangles) and of caribou captures 2002 (black pentagons). Numbers indicate size of caribou group.



Provide the number or relative densities of caribou associated with each sighting and discuss the implications of the number or relative density for habitat use characterization.

Habitat use characterization requires accurate digital maps of the study area. As none currently exist, there is no opportunity for habitat use characterization with the survey data from 2002, nor for other data on caribou from the area. The number of caribou associated with each survey sighting are shown in Figure 3. One group north of Cartwright is not labelled and contained 55 animals.

Provide a summary table for animals that were collared giving estimates of home range size based on 95% MCP and harmonic mean estimators. Discuss the implications of application of home range estimates.

There are two problems with this request. First, a 95% MCP, or minimum convex polygon, requires that a portion (5%) of the data be removed as “outliers” before the calculation of MCP is performed. The Caribou Component Study reported on data for six (6) individual caribou with a minimum of 7 relocations and a maximum of 9 relocations. Therefore it is impossible to remove 5% of the locations, and performing an outlier removal analysis has no effect on the data used to generate the MCP. Second, harmonic mean estimators are very suspect measures of home range and are not recommended for this application (Worton 1987, Worton 1989, White and Garrott 1990, Hooge and Eichenlaub 1997, Kernohan et al. 2001). Therefore estimates of home range based on harmonic mean methods are not presented.

Table 1 outlines home range estimates of caribou collared in 2002. The original study presented data to September 2002 only, but data collected on these animals up to August 2003 is also included in separate estimates for comparison. Estimates of home range based on 75% kernel density estimates are included for comparison.

Estimates of home range are often used in wildlife biology to assay (infer) attributes of the individual organism. Often, comparisons are made. For instance, home ranges of American marten (Martes americana) in Labrador are some of the largest ever recorded, leading to the inference that the low productivity of Labrador forests limits marten prey density, causing marten to require larger areas for survival. Home range estimates should be carefully interpreted

Table 1. Minimum convex polygon and kernel density home range estimates for caribou collared in Mealy Mountains area, 2002. Numbers in brackets following estimates indicate relocation sample size used to generate value.

Animal ID	**Data to Sept 2002 (km^2)**		**All data to date (km^2)**	
	MCP	**Kernel**	**MCP**	**Kernel**
MM2002001	241.00	1109.8 (7)	615.11	1426.0 (15)
MM2002002	34.782	364.52 (8)	676.65	512.88 (10)
MM2002003	494.43	330.18 (9)	570.82	293.37 (12)
MM2002004	990.76	1894.6 (9)	2602.5	1291.1 (17)
MM2002005	481.69	852.38 (8)	2092.2	1515.9 (16)
MM2002006	811.87	1657.0 (7)	1962.3	1515.7 (12)

as they are highly dependent on number of relocations used in analysis. Also, there is some question as to whether home range estimates are useful when applied to caribou (Geist 1998). A cursory examination of Table 1 clearly shows, at least for MCP, a positive relationship between number of relocations and estimate of home range.

Provide the results of the analysis of blood and fecal samples collected and explain their contribution to a preliminary understanding of the general health of the Mealy Mountain Caribou Herd.

Blood samples collected from individuals of the MMCH have been pooled with similar samples from other caribou populations of the Ungava region and, in cooperation with Laval University, are presently undergoing analyses. Results are not available at the present time. Fecal samples have also been pooled with similar samples from other caribou populations in Labrador and, in cooperation with Lakehead University, are presently undergoing analyses. Results are not available at the present time.

Blood samples are expected to yield insights into MMCH biology. An estimate of genetic relatedness to other caribou populations, both sedentary and migratory, is anticipated. Such results are central for assessing distinctiveness of this population, as a guide for recovery efforts on this Threatened species. Fecal sample analyses will provide information on parasite loads in the population, perhaps a factor in present population demographics. Comparisons with samples from the other populations will hopefully provide for interesting insights.

Provide information on group sizes, locations, and dates for classified caribou. Compare sex ratios and recruitment data to historical data for the Mealy Mountain Caribou Herd and data available from other Northern caribou herds with particular reference to the Red Wine and Lac Joe Herds. Provide an explanation for the conclusion that the observed sex ratio contributes to extremely high survival rates.

Tables 2 and 3 summarize requested information. The observed sex ratio indicates high survival rates because of the general observation that female caribou live longer naturally than

Table 2. Group size, location, and date for spring classification, Mealy Mountains caribou herd, 2002.

Date	**Group Size**	**Latitude**	**Longitude**
6 April	4	53.7	57.0
6 April	29	53.3	55.9
6 April	17	53.2	56.0
7 April	14	53.9	57.3
7 April	55	53.9	57.2

males. Maximum longevity for female caribou perhaps approaches 20 years, with the maximum known age of a female caribou in Labrador at 16 years (Otto, unpubl. data). Maximum longevity for males approaches 10-12 years. If male and female calves survive to adulthood equally, and very few animals succumb to premature death, sex ratios will skew toward females. If predation and other mechanisms of premature death operate on a herd, the shorter relative life span of males becomes less important to demography, assuming such mechanisms operating more or less equally on males and females. When sex ratios approach 1:1, the inference can be that survival rates are relatively low with few animals surviving past 10-12 years or fewer.

Table 3. Historical classification results for the Mealy Mountain caribou herd.

Year	Season	Stags	Does	Calves	Stags/ 100 does	Calves/ 100 does	% Calves
1981	Winter	118	227	86	52.0	37.9	20.0
1985	Spring	227	359	172	63.2	47.9	22.7
1985	Fall	46	118	37	39.0	31.4	18.4
1987	Winter	431	698	242	61.7	34.7	17.7
1989	Spring	218	420	89	51.9	21.2	12.2
1990	Spring	398	725	125	54.9	17.2	10.0
1992	Spring	98	291	35	33.7	12.0	8.3
1994	Spring	119	290	62	41.0	21.4	13.2

“Recommendations’ Section

Provide the rationale for the two recommendations provided and the contribution of each recommendation to knowledge of effects assessment or mitigation which may apply to the Mealy Mountain Caribou Herd.

Recommendation #1 was "annual demographic surveys to estimate recruitment and survivorship." Recommendation #2 was to conduct " a follow-up survey in March 2004 that uses mark-recapture methods to estimate population size. When demographic parameters were recorded and population size estimated in 2002, only a portion of the herd was observed. This is often the case in caribou surveys, and is why we call these observations "samples" and the numbers generated "estimates". We know that caribou segregate themselves by sex and age to differing degrees at various times of the year, although during autumn (rut) and late-winter this is less pronounced. We also know that caribou move, sometimes substantially, throughout the year. Therefore the chances of a single sample differing from the "true" values is greater than if several samples are taken through time. When multiple samples are taken, calculations will more closely approximate the "true" values. If our intention is to further our ability to conduct effects assessment or implement mitigative measures, we should have the best, most reliable baseline from which to make comparisons.

Compare the recommended program employing mark-recapture method with other programs that may achieve the same ends. Comment on the program strengths and weaknesses and the discuss the justification for its use in providing accurate estimates compared to other survey methods.

Mark-recapture models for estimation of population size have several advantages that make them attractive for caribou surveys. As noted previously, line transect methods are recommended for the situation we have with the MMCH. But in future we have the added advantage of a known sample of animals marked (collared). This means that for the suggested 2004 census, we will require data on individuals (collared or not), making mark-recapture techniques possible (Krebs 1999).

The suggested technique for the 2004 survey was the Petersen method mark-recapture. Other mark-recapture methods include the Schnabel method and the Jolly-Seber method (Krebs 1999). The Schnabel and Jolly-Seber methods requires multiple recaptures, and as such are not a realistic consideration for this work (cost). These methods were developed to provide more precise estimates, and for application to open populations (those with emigration and immigration). However, with radios as marks, we can easily meet the Petersen method assumption of a closed population, as we determine number of active radios the day after the survey ends (assume no immigration emigration over those few days). Table 4 outlines the advantages and disadvantages of these different methods.

Table 4. Comparison of mark-recapture methods.

Method	**Open vs Closed Pop.?**	**# Required recaptures**	**# Required markings**	**Allow eval. of assumps?**	**Relative Cost**
Petersen	closed	one	one	no	low
Schnabel	closed	multiple	multiple	yes	high
Jolly-Seber	open	multiple	multiple	yes	high

"New - Caribou Habitat" section

Conduct a literature review and access local and traditional knowledge to provide an approximation of caribou habitat for calving, rutting, overwintering, and summer use and to approximate other areas of current and historical importance to caribou. Describe how snow conditions known to occur from local and traditional knowledge in the study area are likely to affect caribou habitat use and range distribution in the overwintering period.

Armitage and Stopp (2003) provide an excellent summary of Innu knowledge of historic range use by the MMCH. They describe an historic large calving area extending from the headwaters of the English river south to the Eagle river. This observation is closely mirrored by present telemetry data. Also, the authors report an area near to Crooks and Eagle lakes called *ushakatik*, meaning “a place where there are always caribou.” This observation is also closely mirrored by the results of the calving block survey (see Section 2). Historic data on caribou distribution from Science Division files indicates that during winter, the eastern Mealy Mountains and the Strand - Flatwaters brook areas contained the highest densities of caribou. Other smaller groups of caribou were found from the Kenamu river area east through the mountains, and along the southern shore of Lake Melville (Science Div., unpubl. data).

Due to the extreme snow accumulations that typically in central Labrador (approx. 5-6 metres annually), caribou actively seek areas where snow cover is reduced. This includes areas of high relief (mountains, ridges, exposed areas) or windswept areas (extensive open bogs, burns) as well as areas that receive less snowfall or precipitation in other forms such as rain (coastal areas). Also, snow characteristics can change substantially throughout the snow season, ranging from deep powder to hard-pack and ice. As winter progresses through toward spring, the snowpack compresses and areas with significant accumulation become very difficult for caribou due to extreme energy expenditures required for excavating feeding sites (Geist 1998). Again, areas of little snow accumulation are those attractive to caribou.

Conduct a literature review and access local and traditional knowledge to identify the known intrusion of the Red Wine Caribou Herd into Mealy Mountain Caribou Herd habitat in the vicinity of Happy Valley - Goose Bay.

Since the 1980's the Province of Newfoundland and Labrador, in partnership with the Department of National Defence (DND), have collared and relocated via aerial telemetry, individual caribou from the Red Wine caribou herd (RWCH). In the almost 20 years since this program began, no collared caribou have moved east of the Kenamu river (Schaefer et al. 1999). Movements into the vicinity of Mud Lake south of the Churchill river are rare, with one female known to use this area in two successive summers during calving period (Science Div. Unpubl. data). However, it is only since the 1990s that the RWCH has moved south to the Churchill river area nearer to Goose Bay (Schaefer et al. 1999), and were probably not present in the area before this time. Innu traditional knowledge records caribou just west of the Kenamu river (Armitage and Stopp 2003), and it is probable that, based on extensive collar data from the RWCH, these animals were from the MMCH.

Section 2 - New Research Efforts and Surveys, 2003

Caribou collaring, Winter 2003

In winter 2003, in anticipation of further research on the MMCH, Science Division in cooperation with Department of Works, Services, and Transportation (WST), deployed 11 additional Very High Frequency (VHF) collars on females caribou from the MMCH. Captures took place in April and deployments were performed relative to caribou densities located during the capture period. Table 1 summarizes these captures and locations are presented in Figure 1.

Figure 1. Location of Mealy Mountain caribou captures, April 2003. Original (red) and Alternate (purple) Trans-Labrador Highway routes are depicted.

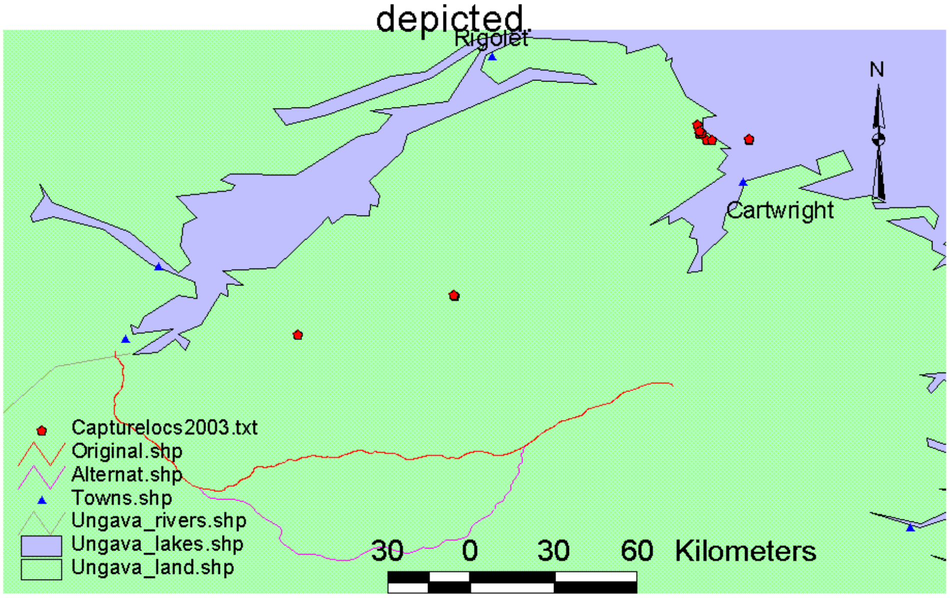


Table 1. Summary of capture data for Mealy Mountain Caribou Herd 2003.

Animal ID	Date	Location	Latitude	Longitude	Sex
MM2003001	3 April	South Mealies	53º24	58º38	F
MM2003002	21 April	SW Mealies	53º18	59º30	F
MM2003003	21 April	South Mealies	53º25	58º38	F
MM2003004	21 April	Strand	53º55	57º15	F
MM2003005	21 April	Strand	53º53	57º15	F
MM2003006	26 April	Packs Hbr	53º50	56º59	F
MM2003007	26 April	Packs Hbr.	53º51	56º58	F
MM2003008	26 April	Strand	53º51	57º12	F
MM2003009	26 April	Strand	53º51	57º11	F
MM2003010	26 April	Strand	53º53	57º14	F
MM2003011	26 April	Strand	53º53	57º15	F

Calving Season Block Survey

Background

As per the Deficiency Statement of the caribou component study 2002, further caribou surveys during calving and post-calving season were required.

Methods

Work chosen for implementation used a block-survey design along both the Original and Alternate road routes during both calving and post-calving seasons. Briefly, the proposal stated that one quarter (25%) of all 5 km by 5 km blocks within a 10 km buffer of both the original and alternate road routes be surveyed by helicopter during calving season (June). As both routes have common east and west sections, there were essentially four (east, west, south, and north) sub-areas to be surveyed (see Figure 2, Results section). Also, because of the presence of east and west common areas in the two routes, 70% of total search effort was directed toward the north and south sub-areas, and 30% toward the common route ends. To aid in navigation, block size was modified to encompass 2.5 minutes of latitude (approx. 5.55 km) and 5 minutes of longitude (approx. 4.66 km) while still maintaining a similar block area. Buffer areas were drawn on a map and blocks overlaid. Blocks were considered for survey if greater than 50% of their area was within the 10 km buffer surrounding a route. All potential blocks were classified as either bog (estimated > 50% bog) or forest (estimated >50% forest) from maps. Bog areas were surveyed at twice the rate at which they occurred in each of the four sub-areas and were chosen randomly from available blocks, with the remaining required blocks were randomly chosen from the available forest blocks. All blocks were labelled with an alphanumeric code denoting sub-area, number, and cover type.

Surveys were flown using an A-Star 350D helicopter from 13-21 June 2003. Blocks were covered in a north-south fashion on "lines" spaced approximately 500 m apart, for approximately 10 lines per block. When survey efficiency required, number of lines per block was modified slightly. All wildlife sightings made were recorded and geo-referenced. When caribou were sighted, all reasonable effort was made to classify the animal(s) by age and sex.

Results

A total of 306 block were identified to be predominantly within the 10 km buffer areas. Table 2 summarizes the block structure and classification of the four sub-areas, including the total number of bog and forest blocks surveyed by sub-area.

Table 2. Total number and classification of blocks by sub-area, caribou block survey Phase III, Trans Labrador Highway, 2003.

Sub-area	**Total Blocks**	**# Bog Blocks**	**# Forest Blocks**	**# Blocks Surveyed**	**Target % Bog**	**# Bog Surveyed**	**# Forest Surveyed**
East	51	19	32	9	74	**7**	**2**
North	79	29	50	23	78	**18**	**5**
South	102	25	77	30	50	**15**	**15**
West	73	6	67	14	16	**2**	**12**

A total of 377 wildlife observations were made (Appendix 2) of which 16 were of caribou, totalling 24 individual caribou. Of these observations, 14 were made within survey blocks, totalling 19 individual caribou. Table 3 summarizes caribou observations and locations made during calving surveys. Figure 2 shows locations of caribou observed within survey blocks.

Figure 2. Location of caribou groups found during Block Survey, calving season 2003. Each of the four Sub-areas are delineated. Numbers indicate caribou group size.

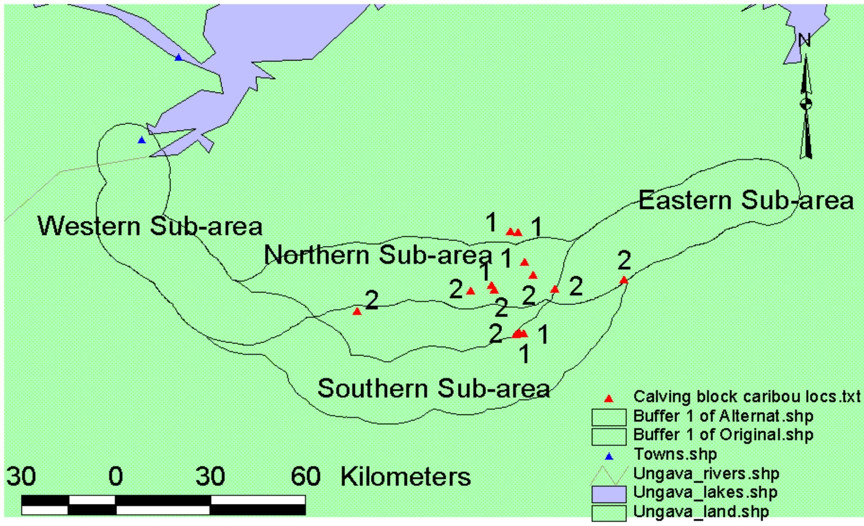


Table 3. Caribou observations during block surveys at calving season along Phase III Trans Labrador Highway routing options, June 2003.

Date	Block	Latitude	Longitude	Classification
21 June	E-03-B	52.829	58.522	2 (1 doe, 1 calf)
17 June	N-04-B	52.796	59.450	2 (1 doe, 1 stag)
18 June	N-11-B	52.838	58.917	2 (1 stag, 1 unk)
18 June	N-16-B	52.849	58.817	1 (stag)
18 June	N-16-B	52.836	58.805	2 (1doe, 1 calf)
18 June	N-18-B	53.002	58.715	1 (stag)
18 June	N-18-B	53.000	58.681	1 (stag)
18 June	N-19-B	52.911	58.659	1 (unk)
18 June	N-24-B	52.872	58.623	2 (1 doe, 1 calf)
21 June	S-12-B	52.706	58.680	1 (stag)
21 June	S-12-B	52.705	58.717	1 (stag)
21 June	S-12-B	52.709	58.702	1 (stag)
21 June	S-25-B	52.843	58.195	2 (doe and calf)
18 June	S-08-B	52.628	58.942	1 (stag) **In Transit**
18 June	S-72-F	52.970	58.371	1 (stag) **In Transit**
18 June	S-72-F	52.708	58.677	3 (unk) **In Transit**

No caribou were observed in the west sub-area. In the east sub-area, 2 caribou were observed. In the south sub-area, 5 caribou were observed in blocks, including 1 doe-calf pair. Five other caribou were observed in the south sub-area during transit flights. The north sub-area contained the greatest number of caribou observations with 12, including 4 doe-calf pairs. Figure2 shows caribou observation locations during calving period.

Caribou density per block ranges from 0.52 for the northern sub-area to 0.167 in the southern sub-area. Further, caribou density ranged from 0.0204 caribou / km^2 in the northern sub-zone to 0.00654 caribou / km^2 in the southern sub-zone. Table 4 outlines these summary statistics.

Table 4. Summary statistics for caribou observed during caribou block surveys, Phase III Trans Labrador Highway, calving season 2003.

Sub-area	**# Caribou per block**	**Caribou density (per / km^2)**	**Doe-Calf pair density (per / km^2)**
East	0.222	0.00871	0.00436
North	0.522	0.0205	0.00682
South	0.167	0.00654	0.00131
West	n/a	n/a	n/a

Discussion

Of the 24 caribou observed during these surveys, the majority (12) were observed in the northern sub-area. This includes four (4) doe-calf pairs, as opposed to one (1) doe-calf pair in each of the southern and eastern sub-zones (Figure 2). A total of five (5) caribou were observed in the southern sub-zone, and two (2) in the eastern sub-zone. No caribou were observed in the western sub-zone.

Of note, all caribou observations made within blocks during surveys were made in blocks denoted as predominantly bog. The two caribou observations made within predominantly forest blocks were made in-transit and were within bogs in the forest block. It is obvious that sightability of caribou was very much related to predominant cover. Recall that 18 bog blocks were surveyed in the northern sub-zone and 15 bog blocks were surveyed in the southern sub-zone. Regardless, the northern sub-zone contains a higher percentage of bog and was found to have a higher number of caribou during calving season. This is not surprising as woodland caribou in Labrador exhibit classic dispersal behaviour at calving (Bergerud and Page 1987) and require security areas (bogs in southern Labrador) for surveillance and rapid flight (Geist 1998).

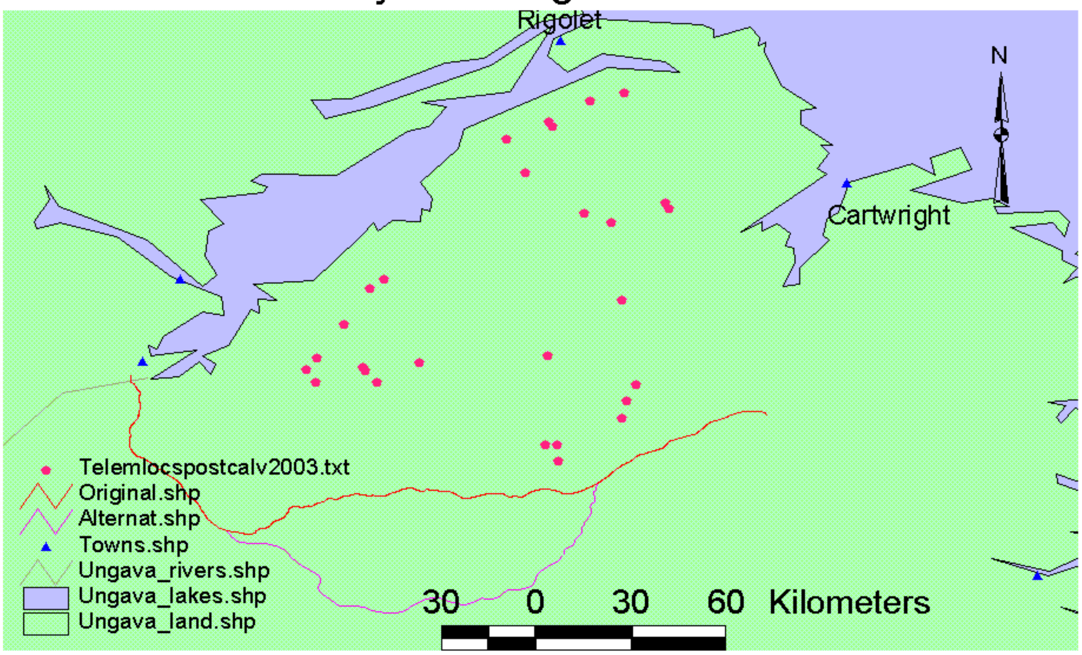
Five caribou were observed "In Transit" within the 10 km buffer around the southern sub-area. These caribou are not considered in the comparison because the southern sub-area was the greatest distance from Goose Bay and fuel caches, therefore requiring the most transit time to visit for surveys. Also, the southern sub-area contained the most survey blocks, therefore requiring the most transit time between blocks.

From the results obtained with this survey (total of 24 caribou), it is apparent that the density of caribou observed was more than 3 times higher in the northern sub-zone than in the southern sub-zone. Further, caribou density in the eastern sub-zone was one-third higher than in the southern sub-zone. As well, density of doe-calf pairs was more than five (5) times greater in the northern sub-area than the southern sub-area. The eastern sub-area had a density of doe-calf pairs more than three (3) times that of the southern sub-area. Also, the eastern sub-area has a higher density of caribou and a higher density of doe-calf pairs than does the southern sub-area.

Summer telemetry flights, 2003

To aid in design and stratification of post-calving season block surveys, two telemetry flights were performed on 15 July and 12 August 2003 to determine location of all collared caribou from the MMCH. As well, Science Division carried out a third telemetry flight on 31 July as contribution to research and monitoring efforts on the MMCH. Data on cover characteristics of collared caribou locations was required to refine the stratification process used for post-calving block surveys. Previous experience with woodland caribou from the MMCH indicates that during late summer, forested areas with high canopy closure are used frequently (R. Otto, unpubl. data). Figure 3 shows all locations of Mealy Mountain caribou found during July and August (post-calving period), 2003.

Figure 3. Location of Mealy Mountain caribou found during post-calving season telemetry flights, July and August 2003.



During these three telemetry flights (2 helicopter, 1 fixed-wing) all efforts were made to make visual observations of collared animals. Due to presence of collared caribou in heavily wooded forest, visual observation was often not possible. As well, for animals that were found with reasonable certainty (but without direct observation) notes were made on landcover characteristics of the site. In total 28 relocations were made, with 19 relocations made in forest cover or very heavy forest cover. Nine relocations were made in areas ranging from bog to wetland to open lichen forest.

Data collected on post-calving season telemetry flights strongly suggests that caribou are using forested areas for cover during this period. These results are consistent with observations made on collared individuals from the MMCH during post-calving season 2002, and for individuals collared caribou from other populations including the Red Wine Mountains herd (RWCH) and the Lac Joseph herd (LJCH) during post-calving season.

Post-calving season block survey

Methods

Similar to the calving season block survey, a random block survey design was employed during post-calving season. Changes to the stratification procedure were two-fold. First, survey effort on each of the four sub-areas was equal relative to number of available blocks in each sub-area. Also, based on results from post-calving telemetry surveys, forest and bog blocks were randomly chosen for survey based on their relative abundance within specific sub-areas; i.e., if bog blocks made up 25% of available blocks, then 25% of survey effort was directed at bog blocks.

Surveys were flown using a Bell 206L or a Bell 206B helicopter from 12-21 August 2003. Blocks were covered in a north-south fashion on "lines" spaced approximately 400-500 m apart, for approximately 10-12 lines per block. Effort per block was expanded to attempt to compensate for decreased sightability of caribou within forest cover. When survey efficiency required, number of lines per block was modified slightly. All wildlife sightings made were recorded and geo-referenced. A logging GPS was used to track all flight lines flown during the survey. These files were converted to a format acceptable for importing into Arcview geographic information system for plotting.

Results

A total of 76 blocks were surveyed for caribou presence. Of these, 18 were in the western sub-area, 13 in the eastern sub-area, 20 in the northern sub-area, and 25 in the southern sub-area. Table 5 provides the breakdown between number of bog blocks and forest blocks surveyed in each sub-area. Figure 4 shows a plot of all survey lines flown during surveys.

Table 5. Number of forest and bog blocks surveyed during post-calving season block survey, Phase III, Trans Labrador Highway, 2003.

Sub-area	**Total blocks**	**Forest blocks**	**Bog blocks**
West	18	17	1
East	13	8	5
North	20	12	8
South	25	19	6

A total of 242 wildlife observations were made (Appendix 3) of which some contained multiple species. No caribou were observed during this survey.

Discussion

There are two explanations why no caribou were observed on this survey. First, any animals in the area could have moved to areas of higher relief (north toward the Mealy mountains) seeking refuge from biting insects in areas of higher wind, and cooler temperatures. Collar data suggests that some caribou do perform such movements during summer (Science Div., unpubl. data). This explanation is not, in my opinion, probable.

Second, animals in the area could have moved into forest cover and been hidden from view. Results from the calving season block survey indicate that few animals were observed in the forest (n=2). If caribou present in the area were in forest cover, they would have been extremely difficult to observe. This explanation, in my opinion, is probable. In fact, this is why post-calving demographic surveys are essentially non-existent in woodland caribou literature. Further, collared caribou from the MMCH move little during the time interval from the June calving period through the post-calving season (July and August). Degree of movement depends on two factors: sex and presence of calf. Generally, males and females without calves move more than females with a calf. During calving season through post-calving season 2003, mean maximum movement by collared female caribou 13.3 km (n=13, S.D.=13.16). One movement of over 50 km was recorded, and with this data point omitted, mean maximum movement by collared caribou was 9.98 km (n=12, S.D.=6.61) during calving seasons through post-calving season.

It cannot be assumed that there were no caribou in the blocks surveyed during post-calving season. The conclusion must be that the animals were in forest cover and not observable, but did not move significantly from locations during calving season.

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