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Effectiveness of spatial mitigation for the George River Caribou Herd within the military training area of Labrador and Québec

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Abstract: The George River Caribou (Rangifer tarandus) Herd (GRCH) regularly migrates through the military Low Level Training Area (LLTA) used for jet training out of 5 Wing Goose Bay, Labrador. Potential disturbance to caribou by military aircraft has been mitigated through the reconfiguration of the LLTA in 1996 away from the traditional migration routes and the establishment of closure areas based on the locations of ≥20 adults fitted with satellite telemetry collars. In 2000 and 2001, we conducted seven aerial surveys to examine the caribou distribution and abundance within the northern portion and adjacent area of the LLTA during post-calving, summer dispersal, pre-rut and late winter. We flew transects to examine approximately 10% of areas traditionally used during each period. The timing and direction of caribou movements through this region were similar to that observed in the 1990s. Collared caribou were a good indicator of movements of the GRCH through the LLTA. Closure areas based on the location of satellite collars and direction of movement, were found to enclose the majority of caribou observed within the LLTA. Most GRCH activity now occurs outside the LLTA as a result of reconfiguration.

Key words: habitat, Labrador, Nunavik, population ecology, range fidelity, Rangifer tarandus, spatial, telemetry.

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Introduction

Areas of critical importance to the George River Caribou Herd (GRCH) have been identified within the boundaries of the area originally proposed for the Low Level Training Area (LLTA) out of 5 Wing Goose Bay (DND, 1994; RRCS, 1995; Harrington, 1996). The GRCH migrated through the former LLTA during the summer and early fall periods for calving, post-calving and the rut. Aerial surveys by the Department of National Defence (DND) reported large aggregations (100 000 or more in one year) within the previous LLTA in 1990 and 1991 (RRCS, 1992). Wetland and other open areas characteristic of these areas of occupation, are important habitats providing forage for lactating females and growing calves and/or relief from biting insects during this period (Crête et al., 1990; Walsh et al., 1992). Consequently, the GRCH was identified by the Department of National Defence as a Valued Ecosystem Component in the Environmental Impact Statement (EIS) on Military Flying Activities in Labrador and Quebec (DND, 1994). Following an extensive public review, DND proposed a mitigation program to address potential impacts on the GRCH.

Mitigation is based on spatial separation of military training aircraft from caribou within the LLTA. Since migrating caribou may continue to occupy the current LLTA during the flight training season, DND reconfigured the boundaries of the LLTA in 1996 away from areas frequented by the GRCH during most of the April through October training period. A second initiative was to implement an annual monitoring program of satellite collared caribou to indicate herd movements and distribution (Table 1). Locations from at least 20 satellite-collared female caribou are received at 5 Wing Goose Bay every four

Table 1. DND (1994) avoidance criteria for the GRCH (Revised February 1999).

Seasonal Sensitivity	Occupancy Sub-Criteria	Closure Sub-Criteria
High Sensitivity		
Calving (15-30 June) Post-calving (1 July-10 August) Rut (10 October-15 November)	Area based on 20 (15-30 June) telemetry collar sample; or sighting a group of 500 animals	Circular closure radius of 36.1 km centred on collar or group
Moderate Sensitivity		
Summer dispersal(11-30 August) Pre-Rut (1 September-10 October) Late Winter (1 March-15 May)	As above	Circular closure with radius of 27.8 km centred on collar or group
Low Sensitivity		
Early winter/winter (16 November-28 February)	As above	Circular closure with radius of 18.5 km centred on collar or group

to five days following signal emission from Provincial wildlife agencies in Labrador and Québec respectively. New locations for the delineation of successive closures were obtained less than three days apart. Individual satellite collared caribou closures often overlapped so caribou rarely moved outside a closure prior to the reception of new data. Only locations with class >0 (Service Argos, Landover, MD, U.S.) are used to determine closures. Avoidance criteria for closures of the GRCH vary according to seasonal sensitivity, speed and direction of the collared animals, and consider activity observed in previous years of monitoring.

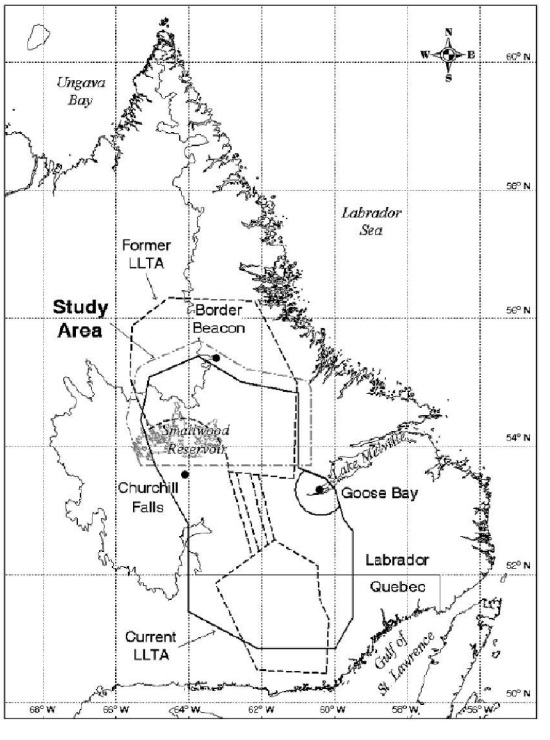

Fig. 1. Location of the former and current LLTA in relation to the study area.

The objective of this study was to compare aerial transect survey information on the distribution and abundance of caribou with the closures around the >20 satellite collars to evaluate the effectiveness of the current mitigation program.

Methods

Aerial surveys were conducted to examine caribou densities within the northern portion of the current LLTA and an adjacent 18.5 km (10 nautical mile) area (approximately 53 220 km^2) (Fig. 1). Surveys were conducted during post-calving (10-16 July 2000, 25-27 July 2001 and 5-6 August 2001), summer dispersal (14-17 August 2000 and 26-29 August 2000), pre-rut (13-18 September 2000) and late winter (11-15 April 2001). Approximately 30% of the study area is forested. Large water bodies and wetlands are common with the remainder of the study area generally open habitat. Detailed descriptions of habitat preferences of the GRCH in general can be found in Crête et al. (1990) and Camps & Linders, (1989).

The study area was divided into two areas of predominant habitat type: open barrens and mature black spruce forest. Survey crews comprised of the pilot plus three observers searched an area approximately 400 m and 500 m wide (on each side of the aircraft) in forested and barren habitats, respectively.

The size of search area varied because it was assumed that caribou sightability would be greater in open areas versus forested habitat types.

Surveys were completed using a Partenavia P68C High Wing twin engine aircraft at a speed of 100 knots and an altitude of approximately 120 m above ground level. The surveys followed north south transects spaced 10 km apart, starting in the east and working westward. Approximately six transects were completed each day. Occasionally, transect spacing was modified (greater spacing in the eastern half, closer spacing in the west) to provide more intensive coverage of that portion of the study area where caribou were more often encountered. Flight tracks and observations were recorded using a Global Positioning System, 1:250 000 National Topographic System maps, and data sheets.

Caribou observations included group size, general sex and age composition and direction of movement. Surveys were completed only during weather conditions that allowed for >500 m visibility from the aircraft. Locations of satellite-collared animals were used to define search areas but not used to locate caribou groups. The approach was not designed to compare animal density or distribution between successive years but to obtain information on the GRCH during the annual cycle when they migrated through the LLTA. Timing and migration patterns of the GRCH may fluctuate annually (Crête et al., 1996; Morneau & Payette, 2000).

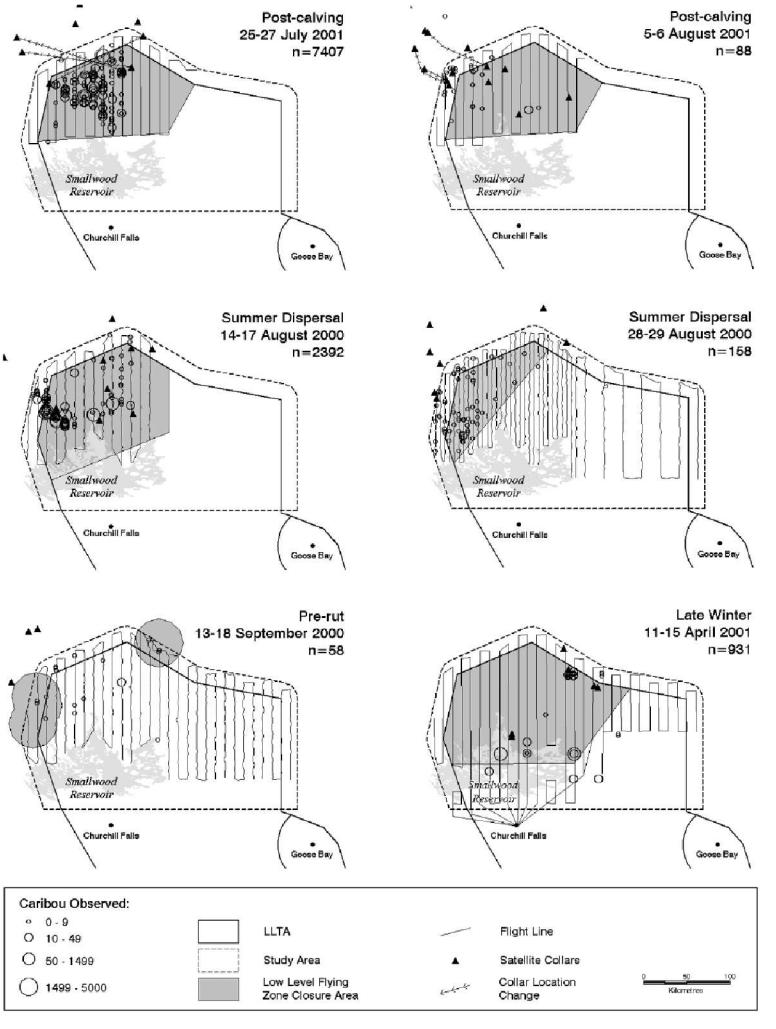

Fig. 2. Caribou observations during aerial surveys in the study area and LLTA during 2000 and 2001.

Results

We conducted seven aerial surveys: four in 2000, three in 2001 (Fig. 2). The results are presented for distribution and abundance and for group size during post-calving, summer dispersal, pre-rut, and late winter periods in the LLTA and entire study area (Table 2).

Distribution and Abundance

A total of 11 037 caribou were observed during all surveys (2611 in 2000 and 8426 in 2001) (Table 2). In 2001, 8295 animals were observed concentrated north of Smallwood Reservoir during the two post-calving surveys. During the summer dispersal surveys in both years all caribou were observed north and north west of Smallwood Reservoir. A similar pattern was observed during the pre-rut survey in 2000. During the late winter survey in April 2001, 931 observed animals were concentrated in the Smallwood Reservoir area and to the east of the Reservoir. The number of satellite collared animals within the study area (i.e., 8) was greatest during the 14-17 August 2000, and 5-6 August 2001, surveys.

Table 2. Number, group size and density of caribou observed during aerial surveys in 2000 and 2001 and number of satellite-collared animals in the study area.

Survey Dates	# Caribou (# groups)	Average Group Size (range)	# of individual caribou[1] (% overall)	Area Searched km² (%)	Density (Caribou /km²)	Collars in Study Area
10-16 Jul 2000	3 (2)	1.5 (1-2)	1 (33.3%)	1124 (9.4)	0.005	0
25-27 Jul 2001	7407 (194)	38.2 (1-4 000)	21 (0.3%)			3
5-6 Aug 2001	88 (22)	4.0 (1-15)	4 (4.5%)			82
14-17 Aug 2000	2392 (91)	26.3 (1-1 200)	18 (0.8%)	1162 (9.7)	2.06	8
26-29 Aug 2000	158 (65)	2.4 (1-10)	27 (17.1%)	2201 (18.4)	0.07	22
13-18 Sep 2000	58 (18)	3.2 (1-14)	7 (12.1%)	1124 (9.4)	0.05	0
11-15 Apr 2001	931 (47)	19.8 (1-500)	3 (0.3%)			0
Totals 2000	2611	8.7 (1-1 200)	58 (2.2%)	-	-	-
Totals 2001	8426	20.6 (1-4 000)	28 (0.3%)	-	-	-

[1] number of sightings of lone caribou.

[2] one additional collar was within 5 km of study area.

Post-calving Surveys

Only three caribou were observed during the 10-16 July 2000 survey. No collared animals were identified within the study area during this survey and therefore no closure areas to military training were established.

During the 25-27 July 2001 post-calving survey, the largest group of caribou observed (4000 animals) was located approximately 60 km north of Smallwood Reservoir. Other concentrations of 800 to 1200 animals were sighted to the north and west of the larger group with numerous smaller groups (<50 animals) scattered in the area between Smallwood Reservoir and the northern boundary of the study area (Fig. 2). The closure area placed around the three collared animals within the LLTA encompassed the main concentration of caribou with a conservative buffer from training activity.

The post-calving survey in August 2001 found 88 animals in study area with the distribution pattern similar to that observed during the July 2001 survey (Fig. 2). Although a relatively low number of animals was observed during this survey and the aggregations were small, eight satellite-collared animals were present in the survey area albeit moving rapidly in a north west direction. At least three of these animals had probably moved outside the LLTA boundary (based on subsequent satellite information) by the time that area was surveyed (Fig. 2). The closure area established the previous month remained in effect, although numerous fresh tracks and trails indicated most caribou had departed the LLTA.

Summer Dispersal Surveys

The summer dispersal survey on 14-17 August 2000 recorded 2392 animals, the largest number of caribou observed during surveys that year. The distribution and movement of caribou was remarkably similar to the activity observed in 2001. All animals were north and north west of Smallwood Reservoir. The largest aggregation was north west of Smallwood Reservoir where 2100 caribou were observed (Fig. 2). It was learned later that eight satellite-collared animals were present in the north west portion of the study area during this survey. At least three additional collared caribou were within 50 km of the study area. Again the closure area encompassed the caribou migration through the LLTA.

Although the distribution of animals was similar to the first summer dispersal survey in 2000, groups of caribou were smaller and more dispersed on the second survey 26-29 August. Most groups (totalling 158 animals) were west and north west of Smallwood Reservoir (Fig. 2). Remaining caribou were west of Border Beacon. Two collared animals were at the northern and western boundary of the study area with four others immediately outside LLTA. The closure area had been revised to reflect the rapid movement of animals towards the northwest. A survey of the entire study area indicated that less than 10 caribou were outside the closure area.

Pre-rut Survey

During the pre-rut survey 13-18 September 2000, small groups of caribou were widely dispersed over the area between Smallwood Reservoir and the

northern boundary of the study area (Fig. 2). No collared animals were located within the study area at the time of the survey although three were recorded 35 km north west of the study area. The survey of the entire study area indicated that closure areas at the periphery of the LLTA, encompassed all but approximately 30 animals in the LLTA.

Late Winter Survey

During the late winter survey 11-12 and 15 April 2001, the largest concentration of animals occurred in the area of Smallwood Reservoir and directly east of the Reservoir (Fig. 2). Several groups of <50 animals were also observed approximately 90 km north east of the Reservoir, near the study area boundary. Four collared animals were located within the study area at the time of the survey resulting in a large closure area prior to the start of the flying season.

Group Size, Composition and Density

A total of 438 groups were recorded during the seven surveys, with group size ranging from 1 to 4000 animals (Table 2), average group size was 25.1 animals. Limited data were collected on sex and age of observed caribou. However, groups observed tended to be dispersing females with calves and no large groups of males were observed, including the pre-rut period. Based on observations of animals and fresh tracks, caribou tended to use an area comprising approximately 11 940 km^2 in the north west of the study area during the seven surveys. Extrapolating the results of the area searched (based on 400 and 500 m search patterns on either side of the aircraft), estimates indicated that a density of 2.06 caribou/km^2 or as many as 24 584 caribou may have been present in this portion of the study area during Survey 2 (Table 2). These values are extrapolated without consideration of correction factors (for observer error) or adjustments for water bodies and other potentially unused sections of this area.

Movement

Caribou trails and their general orientation were recorded during the surveys. Trails were more numerous and better defined in the western half of the LLTA than in the eastern portion. During late July and early August of both years, caribou entered the LLTA from the north in the vicinity of Border Beacon, and departed to the northwest. The most common orientation of trails were west to east in the central-western portion, and north to south in the northwestern part of the LLTA. Older trails were noted as well, in a similar orientation.

Discussion

The results of this study to date are compared with earlier studies reporting on GRCH distribution, abundance, and group size and composition, during post-calving, summer dispersal, pre-rut, and late winter periods in the study area and LLTA. General habitat use and movement trends are also discussed.

Distribution and Abundance

Post-calving

Satellite telemetry data have confirmed that the calving range for the GRCH is outside of the current (since 1996) LLTA (Schaefer et al., 2000). However, post-calving animals begin moving in a northeasterly, southwesterly or northwesterly direction as they disperse from the calving range. Those animals moving southwest could be present in, or pass through, the northwest portion of the LLTA. Composite mapping of the seasonal distribution of 68 adult female caribou between 1987 and 1996 indicates the presence of collared animals inside the current LLTA during the post-calving period (DFRA, 1997). A review of RRCS (1992) indicates that out of the large number of caribou present in the former LLTA in July 1991, approximately 10 000 to 12 000 animals would have been inside the western boundary of the current LLTA.

Only three caribou were observed during the 2000 post-calving survey. As no collared caribou were located within the LLTA or adjacent area at that time, it was believed the post-calving movement had not yet reached the LLTA. The observed animals may have been part of the Red Wine Mountains Caribou Herd (Schaefer et al., 1999). In the first 2001 post-calving survey, conducted approximately two weeks later than the 2000 survey, over 7000 animals were observed in the north western portion of the LLTA. During the second 2001 post-calving survey 10 days later, the number of animals observed in the north western portion of the LLTA had declined to 88, possibly indicating a 2-3 week window in late July when aggregations of caribou move through this area.

Three collared caribou were in the LLTA at the time of the July 2001 survey when the largest aggregations (i.e., 4000, 1200, or 800 caribou) were observed. However, because of the buffer zone placed around each collared animal, closure zones encompassed the majority of animals in the study area. As noted earlier, several collared animals in the north western portion of the LLTA during the 5-6 August 2001 survey period, moved directly out of the LLTA in a north westerly direction, possibly indicating the onset of summer dispersal.

Summer Dispersal

Consistent with the findings of earlier studies (DFRA, 1997; Messier, 1992) caribou were common in the north west portion of the LLTA during late August. Ten collared animals were present in the area during the 14-17 Aug 2000 survey while all collared animals were either on the boundary of the LLTA or beyond, during the 26-29 August survey.

Pre-Rut

The results of the September 2000 survey were consistent with the results of earlier studies in that small groups of caribou were present in the north west portion of the LLTA, and collared animals were present outside the boundary.

Late Winter

Descriptions of range use by female GRCH over a 12-year period (1986-1998), indicate that during Mar and Apr the probability of female caribou occurring in the study area is generally low (Bergman, 1998). VHF-radio tracking from 1982 through 1991 indicates a similar pattern with most collar locations during Mar and Apr located north or north east of the study area (Messier, 1992). The results of the 2001 survey support these trends in that less than 1000 caribou were observed in the study area, suggesting that while some caribou of the GRCH winter in this area, the main herd appears to winter outside. No collared animals were located in the LLTA during the late winter survey period, a further indication that caribou numbers in the study area were not high at this time.

Group Size and Composition

RRCS (1993) observed that collared caribou were associated with larger aggregations during late calving, post-calving, and during the rut. A post-calving photo-census in 1993 indicated caribou were the most aggregated at that time (Russell et al., 1996). The smallest groups occurred during pre-calving, August dispersal, and during pre-rut.

Post-calving

After leaving the calving grounds, females and calves rejoin yearlings, barren females and males to form post-calving aggregations as they disperse toward summer range. These groups may be large. In the 1990s, the largest group reported for the current LLTA was 2000 animals in the northwestern portion of the area (RRCS, 1992). The largest group observed during the two years of post-calving surveys, was an aggregation of 4000 caribou during 25-27 July 2001.

Summer Dispersal

The second (26-29 August) summer dispersal survey in 2000 recorded small group sizes and a larger percentage of individual animals (Table 2) compared to earlier summer dispersal studies of the GRCH. The first survey (14-17 August) results were more typical.

Pre-Rut

During this period, caribou that had been part of the post-calving aggregations (both sexes and all age classes) began to come together in preparation for the move toward the rutting range (Skoog, 1968). Although larger groups may form, the number of single animals may remain relatively high. The survey of 13-18 September 2000, indicated that group size was larger than recorded on the second summer dispersal survey, and the percentage of individual animals had decreased.

Habitat

Relief from insect harassment is a primary determinant for summer range as animals spend less time feeding and more time avoiding this parasitism (Roby, 1978). Windswept, upland plateaus (Walsh et al., 1992) and locations where snow patches remain into summer (Ion & Kershaw, 1989), offer such relief. Several researchers have recently raised the issue of overgrazing and/or climate effects on habitat, particularly on summer range, as an explanation for greater energy expenditure and effects on productivity (Jacobs et al., 1996; Couturier et al., 1994; 1996; Crête et al., 1996).

Movement

It is clear from the review of earlier studies that the greatest caribou presence in the current LLTA occurs in the northwestern portion of the area, and movement in and out of this area is from the north and west. The location and orientation of the trails recorded on the surveys support this contention. During spring and fall migration, caribou from the GRCH travel approximately 20 km per day (Schaefer, 1995). Values for July have been reported as daily ranging from 1 to 40 km (Harrington & Luttich, 1991). With improved software for sorting inaccurate locations (Rettie & Messier 1998), Bergman et al. (2000) noted average caribou movements of 1.25 km per day in winter, versus 9.5 km per day during the post-calving period and 14.5 km per day during summer.

During surveys, higher numbers of caribou were observed when more collars were present in the study area. The distribution of caribou observed during the 2000 and 2001 surveys appear to confirm that the northwestern portion of the current LLTA

remains within the GRCH core range only for a short period of time.

The main difference between the 2000 surveys and those during the 1990s was in the density of animals observed. However, the current LLTA is configured further south than the former LLTA, thus there is less overlap with the GRCH migration and lower densities of caribou would be expected.

Conclusions

Based on surveys in 2000 and 2001, the 1996 reconfiguration of the LLTA, i.e. moving the training area south of the main GRCH migration route, was an effective means of mitigating spatial overlap (potential disturbance). During the course of the current training season in recent years (i.e., April – October), caribou appear to only migrate through the current LLTA in late July and early August. Caribou densities within the LLTA, were lower than observed prior to reconfiguration in 1996.

The use of satellite collared caribou as a tool to implement avoidance restrictions is an effective form of temporal mitigation. Conservative closure areas based on >20 collared animals contained the majority of caribou present in the LLTA. No large groups and few caribou were observed outside of closures. Satellite collars were effective in monitoring movements and distribution of migrating caribou.

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