DISTRIBUTION OF WINTERING MOOSE IN SOUTH CENTRAL LABRADOR AND NORTHEASTERN QUEBEC

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ABSTRACT: This study was conducted as part of the mitigation program established by the Department of National Defence (DND) to minimize potential impacts resulting from the low-level training conducted over the Québec-Labrador peninsula. Overflights were stated to potentially increase energy deficits of moose during late winter, leading to a decrease in survival or productivity. Strip-transect and block surveys were completed during March 1995 to determine the distribution of moose and examine the validity of moose habitat capability maps, within the Low-level Training Area (LLTA) of Labrador and Northeast Québec. Systematic surveys covered 2,210 km of transects throughout the Churchill, Petit Mecatina, Olomane, and Natashquan River valleys. Moose were often absent from areas of apparently suitable habitat. No moose activity was observed within the Olomane River valley or on the Petit Mecatina River valley south of the Labrador border. Results of 17, 10.5 km^2 block surveys over areas of greatest moose activity showed that estimated densities were much lower than projected by DND (1994). Moose densities typically ranged from 0 to 0.1/km^2, well below values reported for moose elsewhere in their range. Possible factors limiting moose in this apparently suitable habitat are suggested.

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An Environmental Impact Statement (EIS) assessing the present and future low-level training conducted at Canadian Forces Base (CFB) Goose Bay (Department of National Defence 1994) has recently been approved by government. This EIS was conducted under the auspices and scrutiny of the Environmental Assessment and Review Process (EARP). The EIS presented a program for mitigating potential impacts to sensitive wildlife and to study the effects that may result from this activity. Military jets use the area around Goose Bay to conduct training as low as 100 ft. above ground level. Areas containing wildlife sensitive to noise disturbance are protected using spatial and temporal separation based on criteria for avoidance that was reviewed and approved during the EARP. The objectives of this study were to verify the moose habitat maps presented in the EIS and to gather density information on moose wintering areas.

Moose (*Alces alces*) were identified in the EIS (DND 1994) as being potentially sensitive to aircraft noise during late-winter. This was due to the relatively high energetic costs associated with moving through snow and maintaining homeothermy during winter (Schwab and Pitt 1991). Late-winter overflights were suggested to potentially further increase energy deficits of moose, possibly leading to a decrease in survival or productivity. The probability that individual animals would be exposed to repeated overflights in late-winter was considered relatively high, because moose in this region tend to concentrate in large river valleys that have also been used by military aircraft conducting evasive manoeuvres. As part of the mitigation associated with this project, DND (1994) committed to having jets avoid high moose density areas within the Low-level Training Area (LLTA).

Following discussions with provincial

resource management agencies in Labrador and Québec, DND agreed to avoid areas which supported densities $\geq$ 0.5 moose per km^2 in 10 km^2 during this period. Winter habitat capability maps were prepared based on an assessment of 1:500,000 scale vegetation maps, habitat features, and previous aerial surveys of late-wintering moose in the study area (Pilgrim 1977, Audet 1979, Northland Associates. Ltd. 1980, Phillips 1983, André Marsan and Associates 1984, Dalton 1986, St. Martin and Théberge 1986, RRCS Ltd. 1989). Philips (1983) and Dalton (1986) conducted surveys of winter moose distribution in this region and identified river valleys as the most important area of concentration.

Prior to the initiation of this avoidance mitigation, we conducted a series of aerial surveys within areas of High- and Moderate-capability within the southern section of the LLTA (Fig. 1). Objectives of the surveys were to determine the utilization of the indicated areas and to determine the density of moose in relation to the avoidance mitigation criterion.

STUDY AREA

Four survey areas comprised approximately 14,000 km^2 of the Québec-Labrador Peninsula (Fig. 1) and were located in the Interior Labrador Climatic Zone, characterized by long, severe winters with heavy snow accumulation, and short summers (Macpherson and Macpherson 1981). Within the climatic ecoregions of the study area identified by Meades (1990), mean daily air temperature ranged from -13 ° to -21 °C in February, and 9 ° to 13 °C in July. Mean annual precipitation varied from 900 to 1,300 mm and the mean annual snowfall was 4 to 5 m (Environment Canada 1975 *in* Meades 1990).

These four areas encompass major river systems and occupy three ecoregions as defined by Meades (1990). The *High Boreal Forest - Lake Melville* ecoregion (comprising the majority of the Churchill River survey area) was dominated by black spruce (*Picea marianna*), balsam fir (*Abies balsamea*), trembling aspen (*Populus tremuloides*), and white birch (*Betula papyrifera*) forest types. The typically closed spruce forest became more open on drier sites within this ecoregion. The *Low Subarctic Forest* ecoregion (comprising the northern sections of the Petit Mecatina, Olomane, and Natashquan River survey areas) was dominated by open to closed black spruce-moss forest with open lichen woodland on sandy river terraces and dry hills. The *High Boreal - Natashquan* ecoregion was similar to that of the *Boreal Forest - Lake Melville* (comprising the southern sections of the Petit Mecatina, Olomane, and Natashquan River survey areas), except that the former contained a greater abundance of more southern flora (Meades 1990).

Average daily temperature during the survey was approximately -5°C although conditions ranged from -15 to +14°C over the nine days (13-21 March 1995) of the survey. There were three snowfalls over this period and snow depths averaged 90 cm in most locations during opportunistic sampling.

METHODS

High capability habitats were defined as areas that provided dense forest for cover and browse which can sustain high densities of wintering moose (DND 1994). These habitats were delineated within the lower to middle reaches of river valleys and adjacent stands of deciduous mixed-wood forest, as well as within areas of high moose concentration previously identified by other researchers (Phillips 1983 and Dalton 1986). High capability moose habitat and moose concentration areas were identified in the Churchill, Goose, Petit Mecatina, Olomane, Natashquan, and Aquanus river valleys. Moderate capability habitat was similar except that the

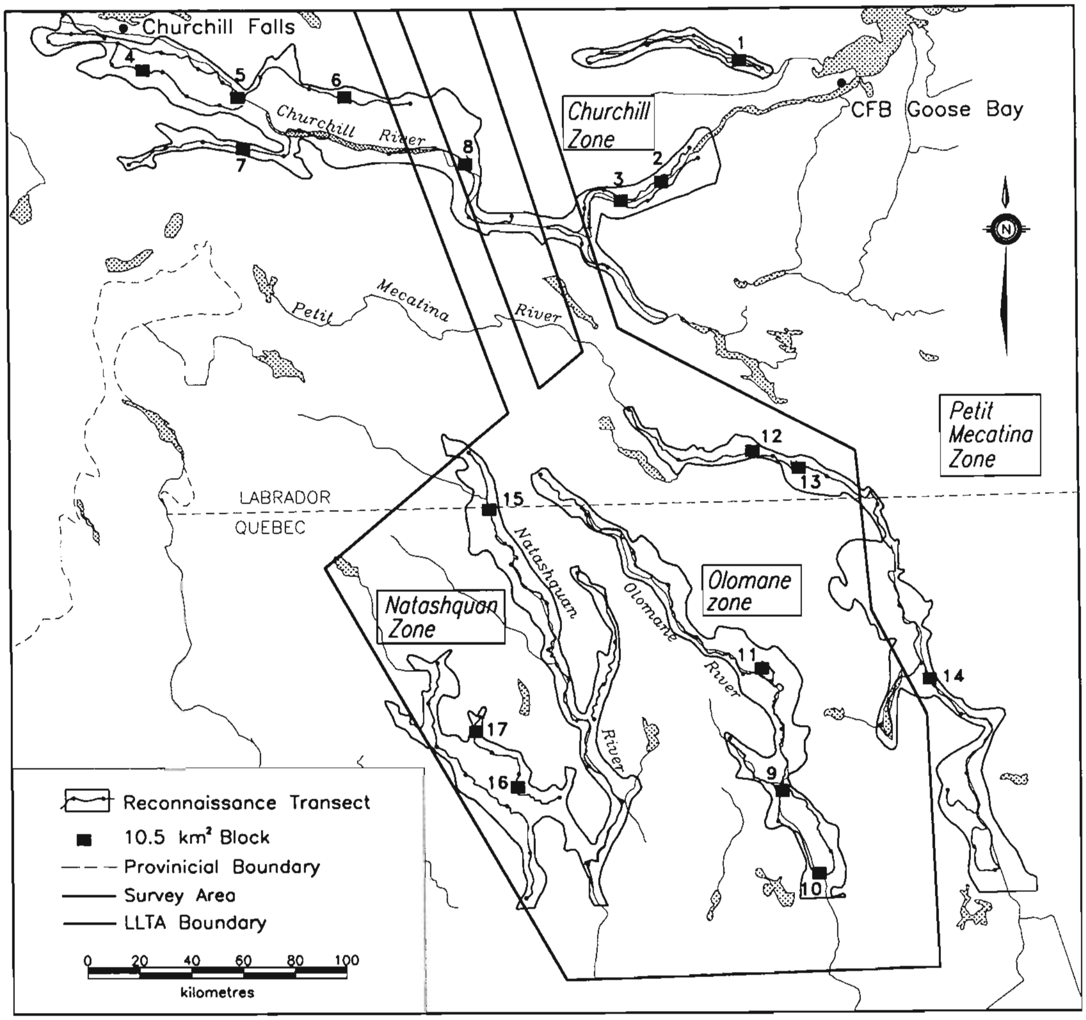

Fig. 1. Location of Transect and Block surveys in Relation to the Low Level Training Area (LLTA), March 1995.

forage in these areas was considered limited by climate or elevation or by a sub-optimal interspersion of dense forest cover and areas of deciduous forage. Low capability habitat contained large areas of dense coniferous forest, with limited access to forage or shelter.

The distribution of moose in river valleys was examined to determine the densities in areas of highest potential habitat. Surveys were conducted using a Bell 206L helicopter, and employed a pilot, a forward navigator/ observer, and two rear observers. An area 250 m either side of the aircraft was searched intensively although greater coverage was achieved in open habitat. Surveys were conducted during 13-21 March 1995. Surveys occurred between 0900 and 1600 hrs. and did not exceed 5.0 hr. per day, due to long ferry distances. Two survey techniques were employed to examine the relative density and distribution of moose within each river valley. The first technique employed was the strip transect survey (Timmermann 1974). Transects were focused primarily along lines 250 m from rivers or large water bodies. Location of transects, observed moose, old and fresh (since most recent snowfall) tracks were plotted on 1:50,000 scale topographic maps with the aid of a Global Positioning

System (GPS). Each river valley or section thereof (used for density estimates) was completed within the same day flying at an altitude of 100 m above ground level (agl) and groundspeed of 100 km/h. Incidental observations included weather and light conditions, track visibility, survey team positions, other wildlife, and survey start and stop times. Information on moose kills by wolves (*Canis Lupus*) and habitat conditions were investigated opportunistically. Age of moose kills were estimated based upon days since last snowfall and carcass condition (Mech 1981).

The second survey technique involved the determination of moose density estimates by first calculating the number of individual fresh tracks and/or moose recorded for each 10 km section of the transect survey. Areas where no tracks and/or moose were observed were considered unoccupied at that time. Approximately 10% of the 10 km sections with the highest moose activity were surveyed in detail through intensive searches of 10.5 km^2 (3 x 3.5 km) blocks. Block surveys were conducted within two days of the initial transect survey such that shifts affecting changes in density were not expected given the restrictive snow depths during the survey (Kelsall 1969). Each 10.5 km^2 block was centred over and examined 3 km either side

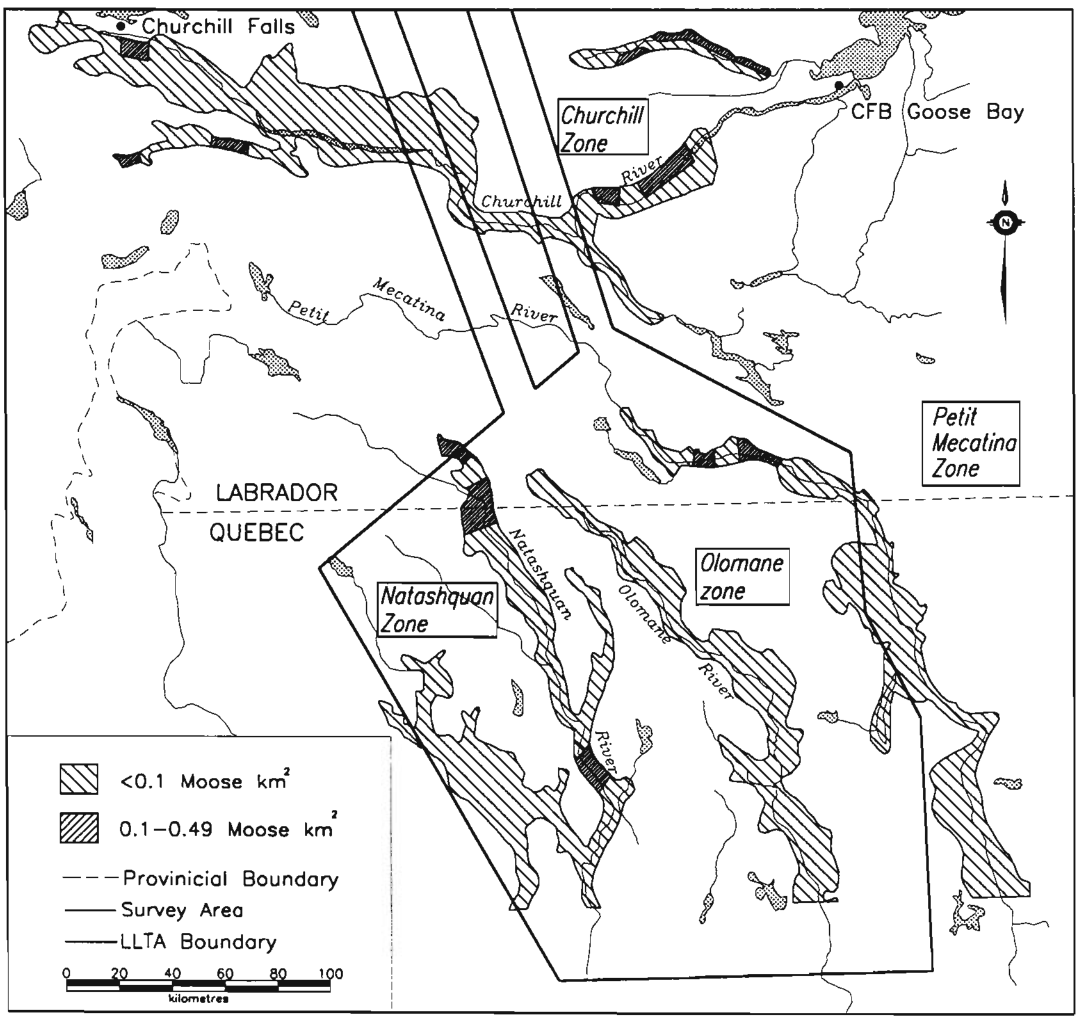

Fig. 2. Estimated Moose Densities within the Low Level Training Area (LLTA), March 1995.

of the selected strip transect. The block was searched using a similar methodology to the transect surveys except that the aircraft was lower (20-30 m agl) and slower (at a ground-speed of 70-80 km/h except when hovering), following a combination of overlapping transects at 250 m intervals and hovering/circling along key terrain features until the team was satisfied that all moose within the block had been observed.

Block surveys that yielded >5 moose (or a density of at least 0.5 moose/km^2) were to be recommended for closure from LLF activities. Analogous 10 km transects with equivalent number of tracks and/or moose were also recommended for closure. No correction factors were developed or employed for this survey given the low density of moose in the study area (Gasaway *et al.* 1986).

RESULTS

During 13-21 March 1995, we surveyed 221, 10 km transects throughout areas identified by RRCS (1994) as high- and moderate-capability habitat in the 4 survey areas (Fig. 1). The low level of activity along areas of high- and moderate-capability led us to also conduct transects in more marginal areas (i.e. on more upland areas away from the mixed habitat of the river valley). Overall, utilization by moose (i.e. animals or new sign) was confirmed in 50 (23%) transects (Table 1). The distribution of moose activity varied between river valleys. No moose utilization was observed on the Olomane River. The Churchill River exhibited the highest level of activity with 30 (40%) of transects.

Seventeen 10.5 km^2 blocks were searched intensively over the most active and/or attractive transects in each of the survey areas (Fig. 1). The density of moose in each block did not exceed $0.5/km^2$, and was usually $<0.1/km^2$ (71%) (Table 2).

Habitat descriptions of each survey area, completed during the transect surveys, were consistent with habitat capability ratings identified by RRCS (1994) with the exception of the Olomane survey area (Table 1). We found few deciduous species along the Olomane River and identified only 62% of the 10 km transects as being of high- or moderate-capability for moose. This compared with 100% for the Petit Mecatina and Natashquan surveys areas, and 94% for the Churchill survey area.

Wolves or their sign were observed on 14% of all 10 km transects and in each of the survey areas except the Olomane (Table 1). A pack of five wolves was observed 500 m from a 2-day old kill of an adult moose in the Churchill survey area and an abandoned >5-day old kill of an adult female moose was found 25 km from tracks of five wolves (1 individual was observed) in the Natashquan survey area. These recent kills and several

Table 1. Occurrence of moose and wolves in 10 km transects in Labrador and Northeast Quebec, March 1995.

Survey area	area (km^2)	No. Transects all habitats	No. Mod - high habitats	No. Mod - high with moose sign	No. Habitats with wolf sign
Churchill	6,422	80	75	30 (40)	8 (10)
Petit Mecatina	2,328	52	52	3 (6)	4 (8)
Olomane	2,174	37	23	0	0
Natashquan	3,002	52	52	17 (33)	19 (37)
TOTAL	13,981	221	202	50 (25)	31 (14)

[1]Percentage values are indicated in parentheses.

Table 2. Density (km^2) of moose in 10.5 km^2 survey blocks in Labrador and Northeast Quebec, March 1995.

Block[1]	Track [2]	Last snowfall (days)	Effort (min)	Moose	Density
1	13	3	26	4	0.38
2	11	3	28	2	0.19
3	7	3	20	0	0
4	1	4	32	2	0.19
5	0	4	36	1	0.09
6	1	4	21	0	0
7	2	5	30	1	0.09
8	0	1	27	1	0.09
9	0	1	20	0	0
10	0	1	24	0	0
11	0	1	19	0	0
12	3	1	31	2	0.19
13	0	1	18	0	0
14	0	1	21	0	0
15	19	2	50	5	0.48
16	0	4	20	1	0.09
17	0	4	22	0	0

[1] Block 1-8 Churchill; 9-11 Olomane; 12-14 Petit Mecatina; 15-17 Natashquan

[2] Track count in 10 km section during initial transect survey

nearby observations of wolf tracks, suggested that areas of higher moose activity were correlated with wolves.

DISCUSSION

The Goose Bay EIS (DND 1994) has identified areas of habitat capability for moose based on previous surveys, a review of information, and an examination of the vegetative characteristics of the LLTA. A shortcoming in this earlier work was the absence of actual field data for the areas in question. Our results and knowledge of the area have suggested that the habitat rating was accurate such that areas of greatest potential were usually identified as being of higher- or moderate-capability. The definition between these two habitat types was based on the estimation of suitable browse and cover, compared to the apparent absence of either in the low-capability habitat. The surprising observation was the low density of moose throughout the study area including areas of previously identified concentration (Phillips 1983, Dalton 1986). Moose in this region have not been observed to utilize open barrens during winter as observed on the south-coast of Newfoundland (Albright and Keith 1987).

Moose activity in our study area was infrequent and often absent in apparently suitable habitat. We felt that indirect features of winter habitat along these river valleys (linear alignment, suitable habitat) tended to concentrate moose in areas which enhance vulnerability to predation and hunting. Both legal and illegal hunting have been increasing with enhanced access (snowmobiles) combined with the logistical challenges of patrolling such a large and remote area. Phillips (1983) and recently, Conservation Officers (B. Duffett, pers. comm.), have been observing an increased number of infractions in the vicinity of the Quebec-Labrador border in the last 10 years. Wolves have been known to have a limiting effect on moose populations in some areas (Ballard and Larsen 1987). We frequently observed the use of river valleys as travel corridors by wolves which has also been described by others (Phillips 1983, Dalton 1986, RRCS 1989).

The densities of moose in river valleys of this study (Fig. 2, Table 2) were considerably lower than reported at various locations in the boreal region of North America (Brassard *et al.* 1974, Fryxell *et al.* 1988, Boer 1992) but were consistent with those reported by others for this area of Labrador and northeastern Québec. In 1980, Phillips (1983) conducted a strip-transect survey of Labrador from the Churchill River south to the Québec border, including the upper drainage of the Petit Mecatina River. The 1980 study determined an average density of 0.044 moose/km^2 based on moose track aggregations observed over 3,080 km^2. Northland Associates (1980) calculated an overall density of 0.11 moose/km^2 for the Churchill River valley. Dalton (1986) reported line transect estimates of 0.126, 0.047, and 0.096 moose/km^2 in the lower, mid and upper regions of the Churchill River valley and tributaries, in river valley habitat. Moose densities for that region of Québec within the study area have been previously estimated at 0.04/km^2 (Brassard *et al.* 1974), 0.05/km^2 for the Lower North Shore (Barnard 1983), 0.009/km^2 for the Middle North Shore (Andre Marsan and Associates 1984). A late-winter strip-transect survey over the study area in 1988 also identified an overall moose density of 0.05/km^2 with specific concentrations in the Natashquan, Petit Mecatina, and Churchill River valleys (RRCS 1989). With the exception of two survey blocks (1 and 15), none of the densities observed in this study approximated a density of 0.5 moose per km^2 in high-capability habitat.

MANAGEMENT IMPLICATIONS

Estimated moose densities for all survey blocks were below the mitigation criterion of 0.5 moose per km^2 for area >10 km^2; however exclusion zones to LLF were recommended for blocks 1 and 15 due to their close approximation to the 0.5 moose per km^2 criterion. Extreme snow depths, illegal harvest, and wolf predation have probably contributed to the low moose activity observed during this study. We believe that the winter distribution of moose has not been influenced by the present low-level flying regime, which occurs from April to November. Given the low density of moose in the study area and the fact that the habitat of greatest potential for moose was searched in 1995, further monitoring surveys to determine concentrations of moose within the LLTA and whether additional avoidance is necessary should be delayed for at least 5 years.

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