

The influence of snow depth and hardness on winter habitat selection by caribou on the southwest coast of Newfoundland.

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Abstract: LaPoile Herd caribou winter in the coastal margin of their range in southwestern Newfoundland. Reduced snow depths near the coast (0-20 km inland), as a result of moderated winter temperatures and low elevations, appear to provide more favourable foraging conditions than do areas further inland. In the latter areas greatly increased snow depth and hardness combine to create very extreme winter conditions and these areas are avoided by caribou throughout the winter period.

Keywords: Caribou distribution, snow depth, Newfoundland, grazing.

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Introduction

The depth and hardness of snowcover are important factors which not only affect caribou (*Rangifer tarandus*) feeding strategies (Brown and Theberge 1990), but also affect caribou movements, distribution (Pruitt 1959) and social behaviour (Vandal and Barrette 1985). LaPerriere and Lent (1977) stated that neither depth nor hardness alone determine caribou wintering areas, but that both factors influence selection of feeding areas.

LaPoile herd caribou, on the southwest coast of Newfoundland, winter in the coastal region of their range and rarely are animals found more than 20-25 kilometres (km) inland from the coast during this time of year (Mahoney *et al.* 1989). This preference is believed to be related to the availability of winter forage, particularly as influenced by snow depth and hardness. This study presents the preliminary findings of an ongoing investigation into snow characteristics on the LaPoile herd's range gathered between February 1988 and February 1990.

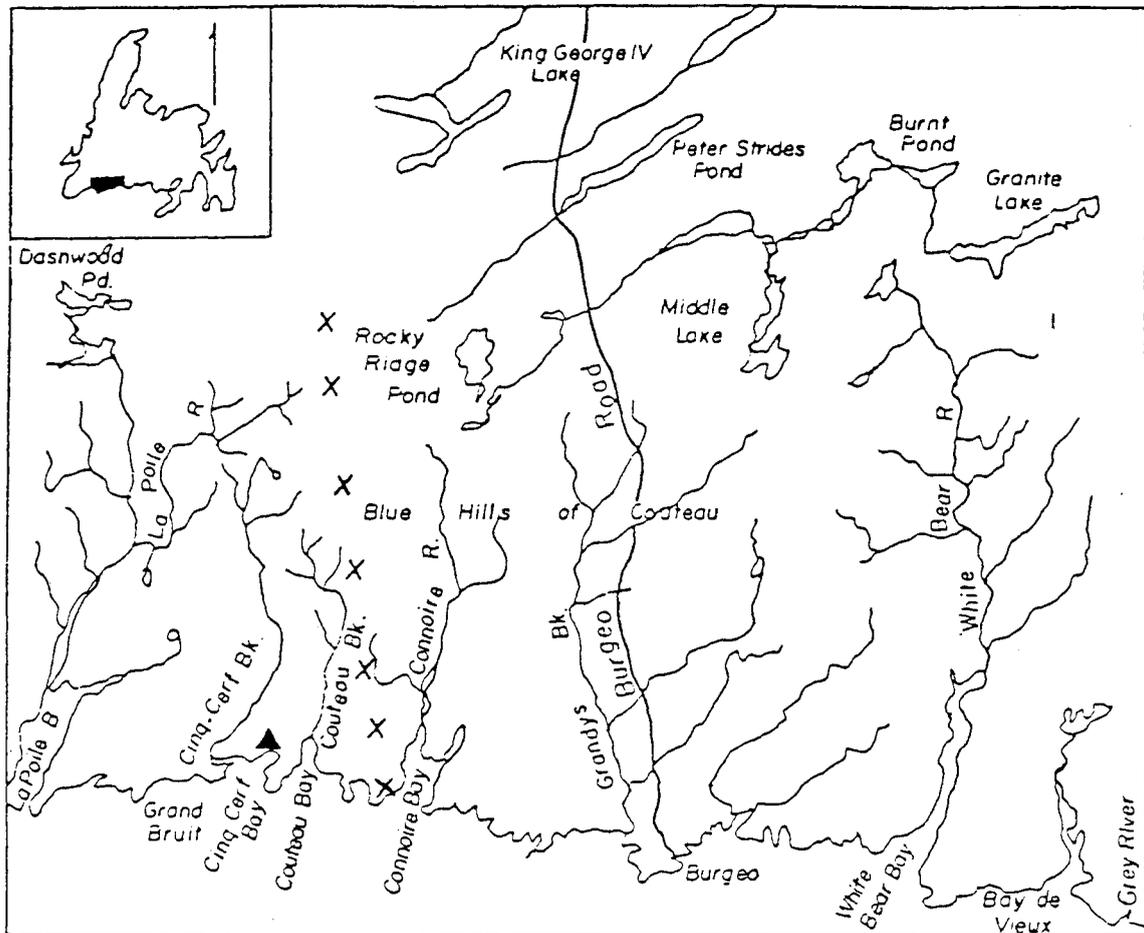
The study was conducted while simultaneously studying the effects of the Hope Brook Gold Mine on the LaPoile caribou herd. Funding was

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Study area

The study area is located on the southwest coast of Newfoundland (Figure 1). The area is characterized by barren lands interspersed with forested river valleys, ponds, and shallow bogs. While portions of the coastline are rugged, much of the inland area is of gentle relief with occasional high summits.

The ocean has a moderating effect on the climate of the entire area with the strongest marine influence occurring on the southern portion (0-20 km inland) where elevations are higher (range 300-650 m above mean sea level) and the moderating effect of the ocean is progressively diminished resulting in colder winter temperatures. Reported mean temperatures for the southern section (0-20 km inland) of the study area are -4.4 C (January) and 14.4C (July). The mean annual precipitation is 127 cm with 19.6 cm, water equivalent, occurring as snowfall. With distance from the coast snow cover usually increases in extent and persistence, at least during most winters.



0 100 200 Km
 ▲ MINE SITE
 X SNOW STATIONS
 LAPOILE CARIBOU STUDY AREA

Figure 1. The location of the seven permanent snow stations in the LaPoile caribou herd study area located on the southwest coast of Newfoundland.

Methods

In 1988 seven permanent snow stations were established along a north-south transect running through the range of the LaPoile herd (Figure 1). At each snow station eight measurement sites were chosen so as to ensure coverage of all microrelief conditions. A wooden stake, maked at ten centimetre (cm) intervals, was driven vertically into the ground at each site. These stations were visited on seven occasions between February 1988 and February 1990. During each visit snow depth, measured at each stake, and snow ram hardness, measured using a Ramson-

de penetrometer and calculated using an equation by Skogland (1978), were determined.

At each snow station the eight snow depth measurements were averaged to obtain mean snow depth while all ram hardness scores were averaged to derive a mean snow hardness value. In addition, average snow depth and average snow hardness per station were multiplied together to produce an integrated ram hardness score.

All visits were made by helicopter and snow measurements at all stations were usually completed within two days.

Results

On every occasion that snow characteristics were measured, a general increase in snow depth was observed as distance from the coast increased (Figure 2). Mean snow depths within 1 km of the coast ranged from 6 to 41 cm while mean snow depths 36-42 km inland from the coast ranged from 55 to 118 cm.

Mean snow ram hardness for each of the snow stations are shown in Figure 3. With the exception of the Feb. 25, 1988 data, which for some unknown reason appears highly anomalous, maximum snow hardness generally occurred between 20 and 36 km inland from the coast (average 53 kg, range 5-201 kg). Near the coast (0-20 km inland) hardness values were slightly lower (average 44 kg, range 4-149 kg) while hardness values 42 km inland were lower still (average 36 kg, range 14-66 kg).

A general increase in snow integrated ram hardness was recorded as distance from the coast increased (Figure 4). Again, with the exception of the Feb. 25, 1988 data, maximum integrated ram hardness was generally found 20

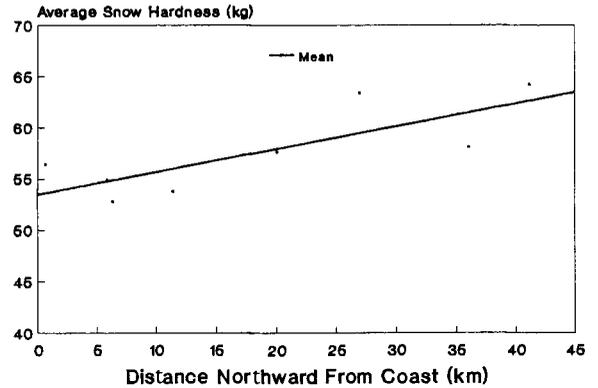
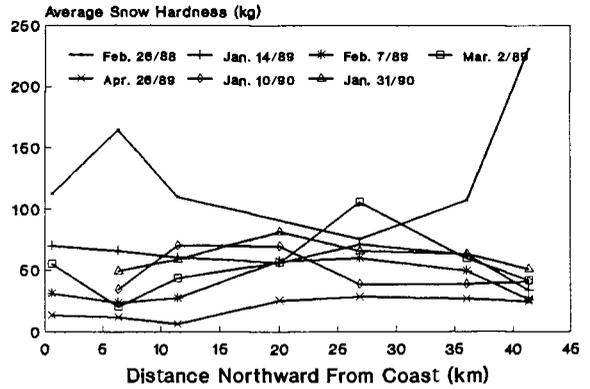


Figure 3. Mean snow ram hardnesses measured at snow stations running north-south through the range of the LaPoile caribou herd.

to 36 km inland (average 3,804 kg.cm, range 0-40,200 kg.cm). Near the coast (0-20 km inland) snow integrated ram hardness averaged 1,563 kg.cm (range 0-29,055 kg.cm) while it averaged 2,564 kg.cm (range 0-13,200 kg.cm) 42 km inland.

Discussion

The vast majority of the LaPoile caribou herd, now estimated to number over 11,000 animals, winter within 25 km of the coast over an area of 1,800 km² (Mahoney *et al.* 1989). The reasons for this selection are believed related to snow conditions with snow depth and hardness considered to be the two most influential factors.

In the range of the LaPoile caribou herd snow depth increases as distance from the coast increases. Along the coast winter temperatures are moderated by the ocean and occasional thaw periods and winter rains reduce snowfalls and impede accumulations. Inland the moderating effect of the ocean is progressively diminished while elevation increases, resulting in col-

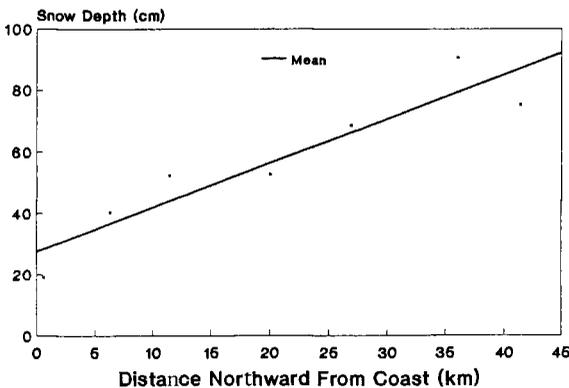
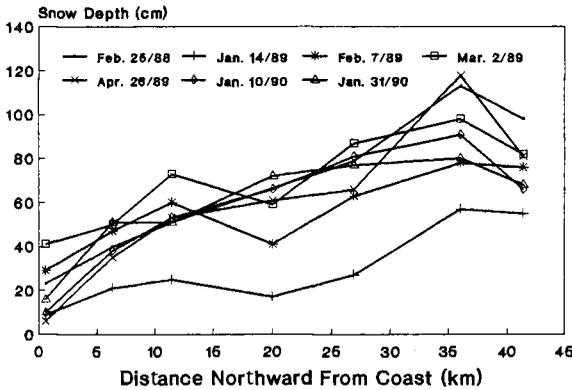


Figure 2. Mean snow depths measured at snow stations running north-south through the range of the LaPoile caribou herd.

der temperatures. These colder temperatures result in the majority of the precipitation falling as snow leading to greater snow accumulation and a more persistent snow cover.

Due to the different climatic conditions between inland and coastal areas snow ram hardness in the range of the LaPoile caribou herd does not increase proportionally with distance from the coast. The milder temperatures in the coastal margin (0-20 km inland) result in winter rains leading to the development of ice layers in the snow cover. These ice layers cause the snow nearer the coast to be harder than that of further inland (42 km from the coast) where the formation of ice layers in the snow is much reduced. Thus, snow inland, although much deeper than that near the coast, is generally softer than that found in the coastal margin.

In the intermediate zone (20-36 km from the coast) the moderating effect of the ocean is still sufficient to produce significant ice layers in the snow. Furthermore, in this zone higher elevations lead to greater snowfalls and accumula-

tions resulting in greater snow depths compared to coastal areas. Essentially this «transition zone», 20-36 km inland, combines the influence of ice layers and increased snow depths resulting in greater snow hardness and the most extreme foraging conditions to be encountered in the herd's range.

Although snow hardness varies with distance from the coast, snow hardness in most areas of the LaPoille range is so great that caribou can walk and run on the snow without fracturing the upper surface. The wet conditions near the coast, in addition to the high winds both near the coast and inland, result in compacted hard snow which is typical of the entire area during the winter. In the intermediate zone, and further inland, these conditions appear sufficiently severe to prohibit caribou winter time use. These nival conditions appear to substantially restrict the total range available to caribou in this region of Newfoundland during winter and thus may ultimately influence the maximal size of resident populations. Confirmation of such a relationship will necessitate forage evaluation studies, planned for the summers of 1991 and 1992.

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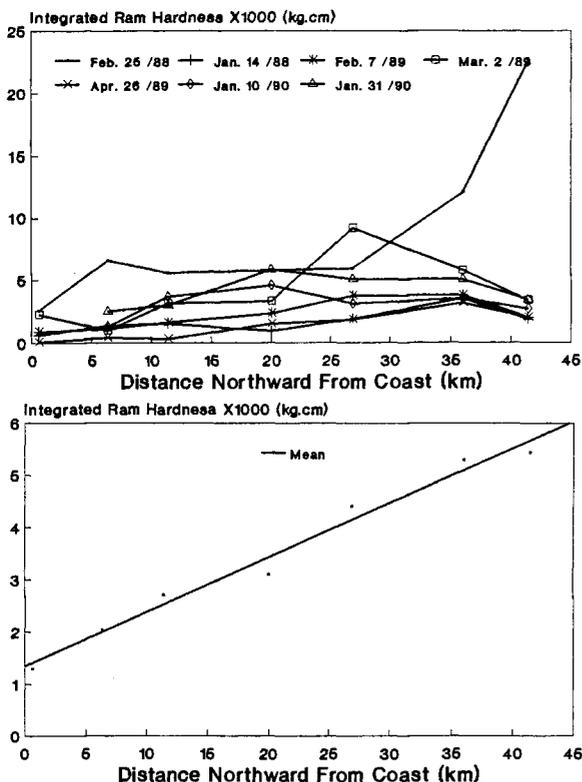


Figure 4. Mean snow integrated ram hardnesses measured at snow stations running north-south through the range of the LaPoile caribou herd.