

# THE DISTRIBUTION OF WOODLAND CARIBOU AND MOOSE IN RELATION TO FORESTRY OPERATIONS IN NEWFOUNDLAND'S 'WOLFLESS' BOREAL FOREST

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## 1 Introductions

### Forestry:

- Forestry operations can have a major impact on local biodiversity by altering the landscape and influencing the distribution of animals and the species composition<sup>1</sup>

### Caribou and Moose:

- Space-use patterns, habitat selection and predator prey interactions of woodland caribou and moose is affected by forestry<sup>2</sup>
- Caribou avoid moose and harvested landscapes because of the higher risks of predation and alternatively inhabit areas with lower risk<sup>3,4</sup>
- Moose respond well to cutovers, increasing in these areas and as a consequence attracting a shared predator, the wolf
- The avoidance behaviour of caribou to cutovers and predation risk is used to develop most forestry regulations and species management plans

### Newfoundland (NL):

- Offers an interesting scenario for forestry regulations, caribou management and studying the spatial distribution of caribou from cutovers and predation risk
  - The caribou here have coexisted with moose for nearly 100 years without wolves
  - There is an extensive history of forestry
  - The coyote, a caribou predator, recently occupies the island

## 2 Objective & Predictions

### Objective:

- Examine if the space use patterns of woodland caribou, moose and coyotes of central NL reflect similar spatial separation and habitat partitioning presented in studies where wolves are present.

### Predictions:

- High use areas (core areas) for caribou will be located away from habitats attributed to high predation risk; cutovers and roads will be avoided.
- Caribou will spatially seclude themselves from moose and coyotes because of perceived and actual predation risk and thus have:
  - Low indices of overlap
  - Different preferred habitats



## 3 Methods

### Study Area:

- Study area in central NL (figure 1)
- Dominated by coniferous stands and open landscapes
- Logging operations (clear-cutting) ongoing since the 1920s<sup>4</sup>
- Woodland caribou populations are of the sedentary ecotypes and are not threatened

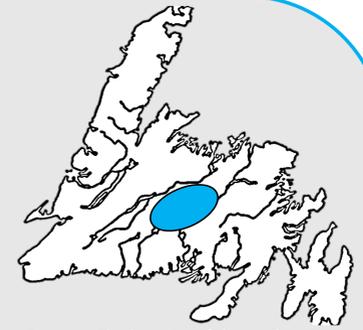


Figure 1: The location of the study area in NL(49°N, 56°W) . Approximately 670 km<sup>2</sup>

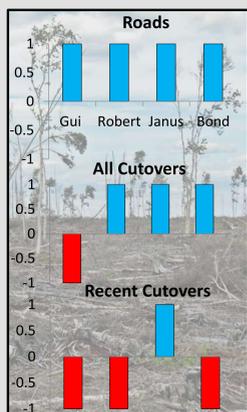
### Prediction 1:

- Core areas were constructed for 4 GPS collared caribou in 2008
- A distance based approach was applied to examine if the locations of caribou within their core areas are located further than expected from roads and harvested areas
- The distances of caribou locations were compared to 10,000 random points within study area

### Prediction 2:

- Caribou, moose, or coyote signs (tracks or scat) were observed throughout the summer of 2011
- The location and surrounding landscapes were recorded for each sign
- Cells of 10km<sup>2</sup> were placed over the study area in ArcGIS to calculate indices of overlap
- Proportions were created for each landscape features containing signs

## 4 Results – Prediction 1



- The localizations for all 4 caribou were significantly further than expected (using sign test) from roads (Figure 2)
- 3/4 of caribou were significantly further from all cutovers (≤ 2008yr) and 3/4 were significantly closer to recently cut areas (1999 – 2008)
- All observations of Caribou (females and calves included) were observed in recent cutovers or on roads surrounded by recent cutovers (Figure 3)

Figure 2: The location of four caribou in relation to roads, all cutovers (≤ 2008) and recent cutovers (1999–2008). Caribou with values of +1 (blue) are significantly further and caribou with values with -1 (red) are significantly closer than expected to each landscape feature.

## 4 Results – Prediction 2a



Signs of	Number of cells containing	Percent of cells containing
Caribou	41	57.7
Moose	58	81.7
Coyote	18	25.4
Caribou & Moose	20	28.2
Caribou & Coyote	11	15.5
Moose & Coyote	4	5.6
All 3	11	15.5



- 307 signs were observed in 71 cells containing either an individual species or a combination. The most common sign was moose with 175 signs, followed by caribou with 105 and coyotes with 27. The most observed animal in the cells was moose with approximately 82% of the cells containing moose signs. A total of 11 cells (15.5%) contained the signs of all species.

	Index of overlap
Caribou/moose	0.59
Caribou/Coyote	0.33
Moose/Coyote	0.34

- The Schoener index of overlap was greatest for caribou and moose with approximately 59% overlap followed by moose and coyote 34% and caribou and coyote with 33% overlap.

## 4 Results – Prediction 2b

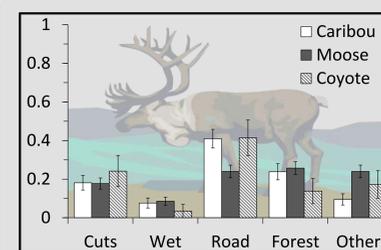


Figure 4: The proportion of caribou, moose, and coyote signs located with the landscape types.

- The landscape type with the least amount of signs was wet habitat, n = 24, and the highest was roads, n = 97
- No significant difference in the proportion of signs in each landscape except for roads and other
- The proportion of caribou and coyotes signs on roads were similar, however moose were significantly lower.
- Other landscape type had a higher proportion of moose signs than caribou signs

Figure 3: Pictures A & B are of two separate observations in summer 2011 illustrating woodland caribou using roads and recent cutovers in central NL.



## 5 Discussion & Conclusions

### Prediction 1:

- The biodiversity of relatively similar ecosystems may be affected by disturbances in different ways. In this case, cutovers do not have the same influence on the spatial patterns of NL caribou as other caribou in N. America
- NL Caribou were close to recent cutovers and shared similar habitats to moose and coyotes
- Caribou may be attracted to recent cutovers for better forage or they may not avoid cutovers yet it is forestry operators that are attracted to the areas where caribou are commonly found (old growth forests)

### Prediction 2:

- Being close to cutovers may expose caribou to higher predation from bears and coyotes (caribou predators in NL) since they are found in higher abundance in these areas<sup>4,6</sup>
- Forestry guidelines in NL should incorporate that woodland caribou are close to recent cutovers which may expose them to higher mortality and lower calf survival
- Core areas should be mapped for caribou and few cutovers should be planned within these areas until studies compare the mortality rate of caribou with different proportions of cutovers

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