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Population dynamics and critical habitat of woodland caribou in the boreal shield of Saskatchewan

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Outline

- Introduction and Background
- Summary of project results
 - to October 2016
- Conclusions



Funding and Support



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Status of Boreal Caribou

- Federal assessment of boreal caribou as a threatened species (2002)
- Recovery plan under SARA (*Species at Risk Act*)

Table 1. Canadian status and provincial/territorial designations for boreal caribou.

Canadian Status	Provincial/Territorial Designation
SARA – Schedule 1 (Threatened)	NT – Not Listed YT – Not Listed BC – Red Listed (Threatened – Endangered) AB – Threatened SK – Not Listed MB – Threatened ON – Threatened QC – Vulnerable (Special Concern – Threatened) NL – Threatened

Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada

Woodland Caribou, Boreal population



2012

SCIENTIFIC ASSESSMENT
TO INFORM THE IDENTIFICATION
OF CRITICAL HABITAT
FOR WOODLAND CARIBOU
(*Rangifer tarandus caribou*),
BOREAL POPULATION, IN CANADA

2011 UPDATE



Canada

PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Woodland Caribou
(*Rangifer tarandus caribou*), Boreal Population,
in Canada

Woodland Caribou, Boreal Population



2011

Canada



Figure 1. Distribution (i.e. extent of occurrence) of boreal caribou in Canada. The current distribution of boreal caribou is shown in brown. The estimated southern extent of historical Woodland Caribou distribution is indicated by the dashed line.

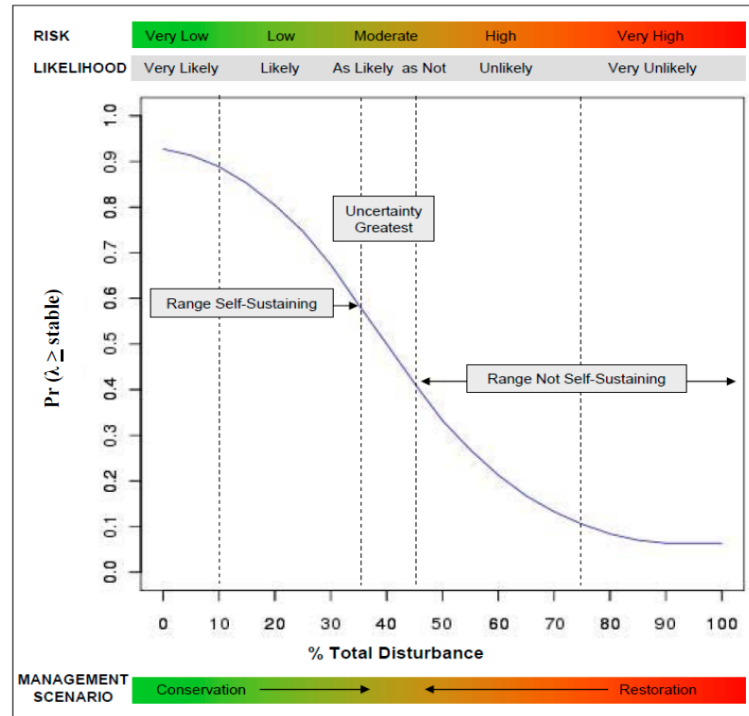


Figure E-1. Disturbance management thresholds: The probability of observing stable or positive growth ($\lambda \geq \text{stable}$) of boreal caribou local populations over a 20-year period at varying levels of total range disturbance (fires ≤ 40 years + anthropogenic disturbances buffered by 500 m). Certainty of outcome, ecological risk, and management scenarios are illustrated along a continuum of conditions.

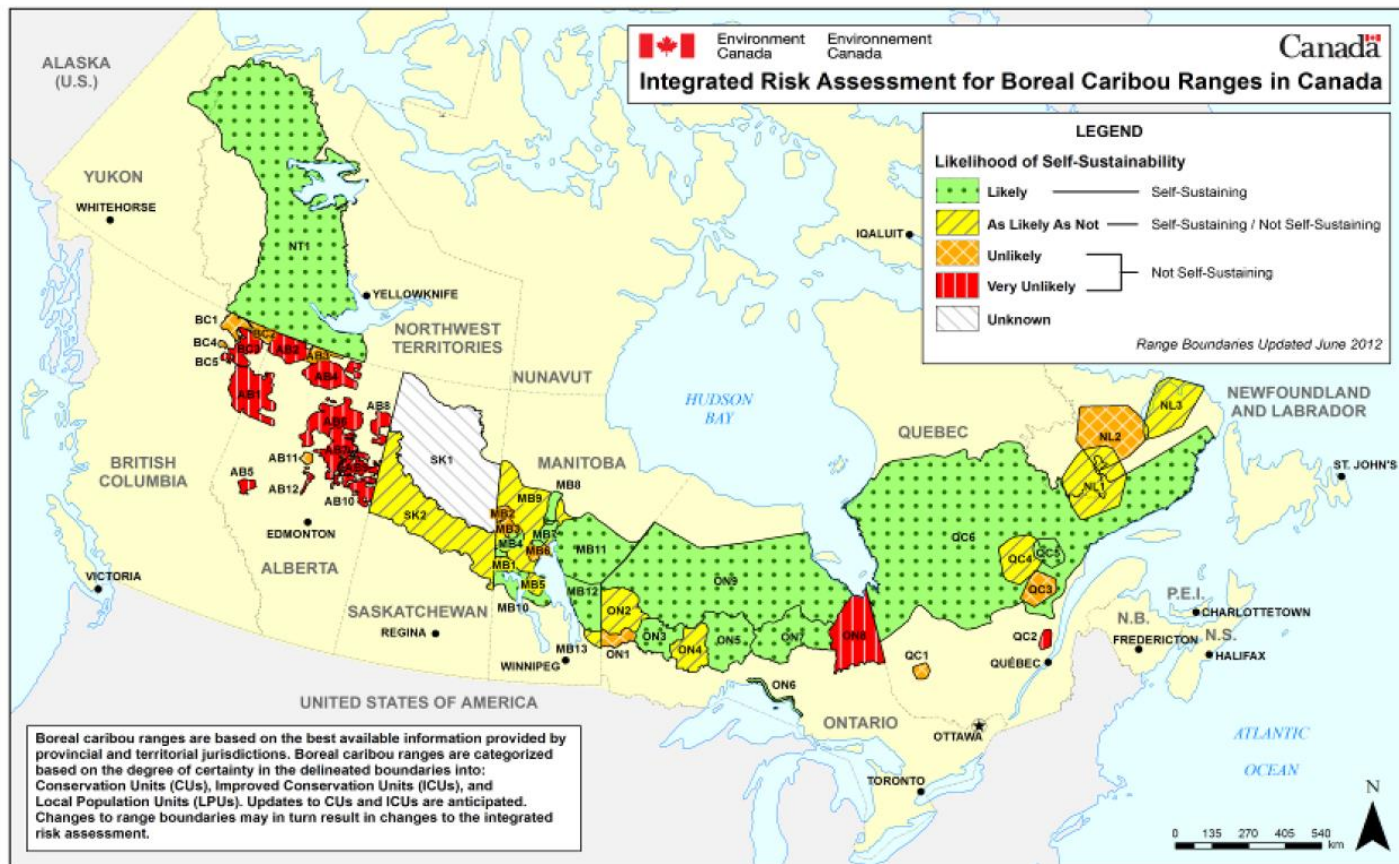


Figure 3. Integrated risk assessment for boreal caribou ranges in Canada, reflecting the capacity of each range to maintain a self-sustaining local population of boreal caribou.

Why the uncertainty?

- Saskatchewan contributed outlier data with respect to both of the two predictor variables of the EC model:
 - 1) forest fire, with Saskatchewan having the highest coverage of any jurisdiction; and
 - 2) anthropogenic disturbance, where we possess some of the lowest human activity within caribou range in Canada.
- Doubly skewed nature of our input data was unique

Environment Canada. 2012. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. xi + 138pp.

Of the 51 boreal caribou local populations, 14 are “self-sustaining”, 26 are “not self-sustaining”, 10 are “as likely as not self-sustaining”, and one is “unknown”, based on Environment Canada’s (2011b) methodology and updated data from provincial and territorial jurisdictions (see Figure 3 and Appendix F). In the population and distribution objectives, “not self-sustaining” local populations refers to both the local populations assessed as “as likely as not self-sustaining” and those assessed as “not self-sustaining”. The high fire in combination with very low anthropogenic disturbance estimates for northern Saskatchewan’s Boreal Shield range (SK1) represent a unique situation that falls outside the range of variability observed in the data that informed the disturbance model used by Environment Canada (2011b) as a component of the integrated risk assessment framework. The probability of self-sustainability is reported as “unknown” due to the uniqueness of the disturbance regime and the uncertainty about the status of the population. Nevertheless, the high fire (55%) observed for northern Saskatchewan’s Boreal Shield range (SK1) warrants caution with respect to additional anthropogenic disturbance. See detailed explanation in Appendix F.

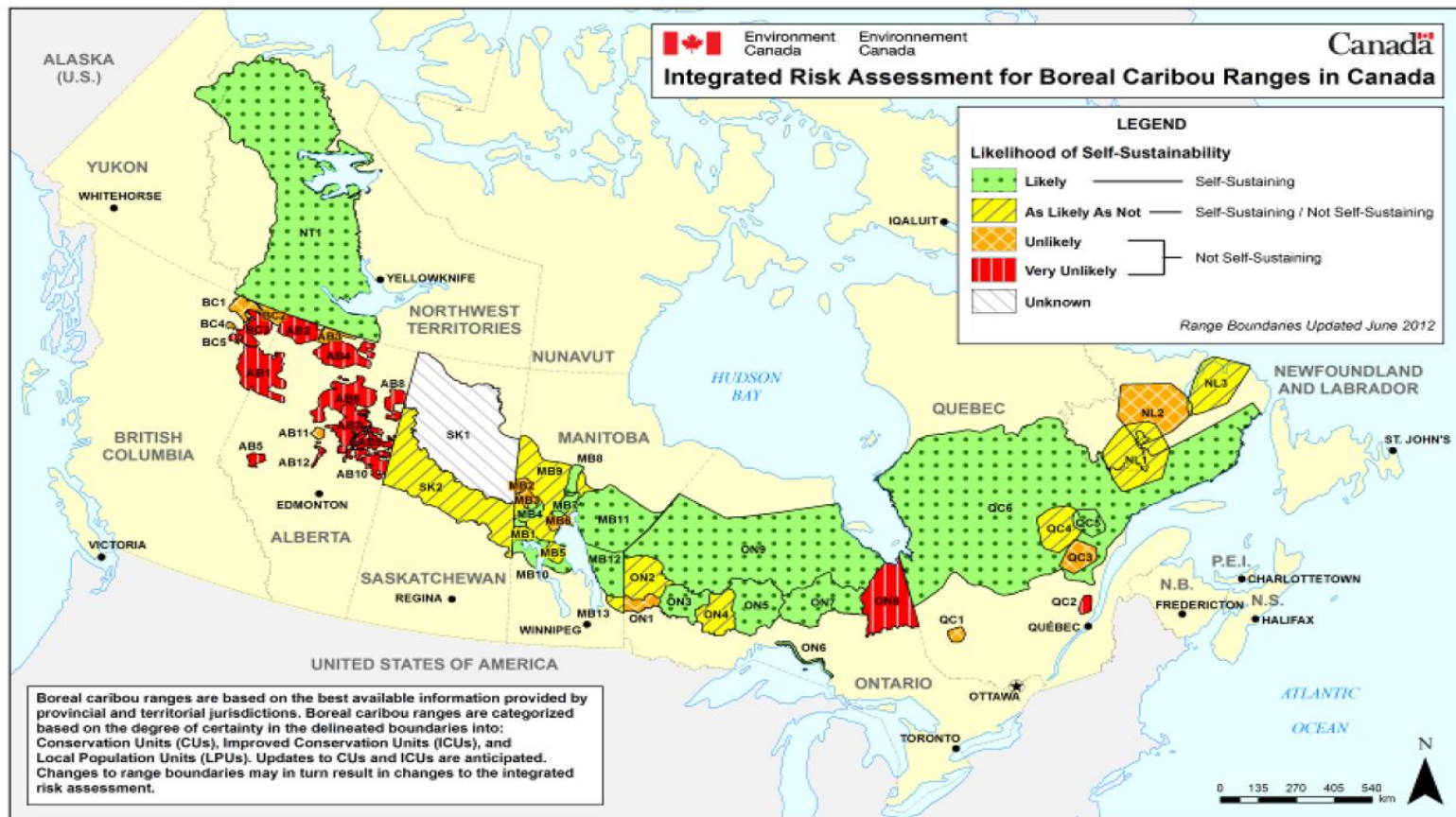


Figure 3. Integrated risk assessment for boreal caribou ranges in Canada, reflecting the capacity of each range to maintain a self-sustaining local population of boreal caribou.

Environment Canada. 2012. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. xi + 138pp.

Table 6. Schedule of studies required to complete the identification of critical habitat in the Boreal Shield range (SK1) in northern Saskatchewan.

Description of Activity	Rationale	Timeline
Collect population information (size, trend, etc.) for a minimum of 2 years in SK1 where population condition is unknown.	The effect of a high fire and very low anthropogenic disturbance habitat condition on the SK1 local population is unknown. These activities will provide the necessary information to identify critical habitat.	Population data collected and critical habitat identified for SK1 by end of 2016.
Update disturbance model in Environment Canada's Scientific Assessment (2011b) by including population information for SK1 to incorporate situations of high fire and very low anthropogenic disturbance.		
Identification of critical habitat in SK1.		

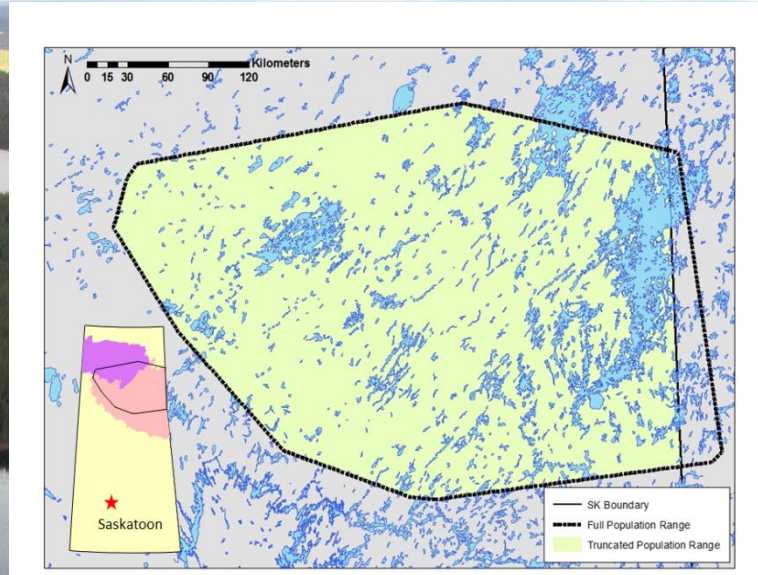
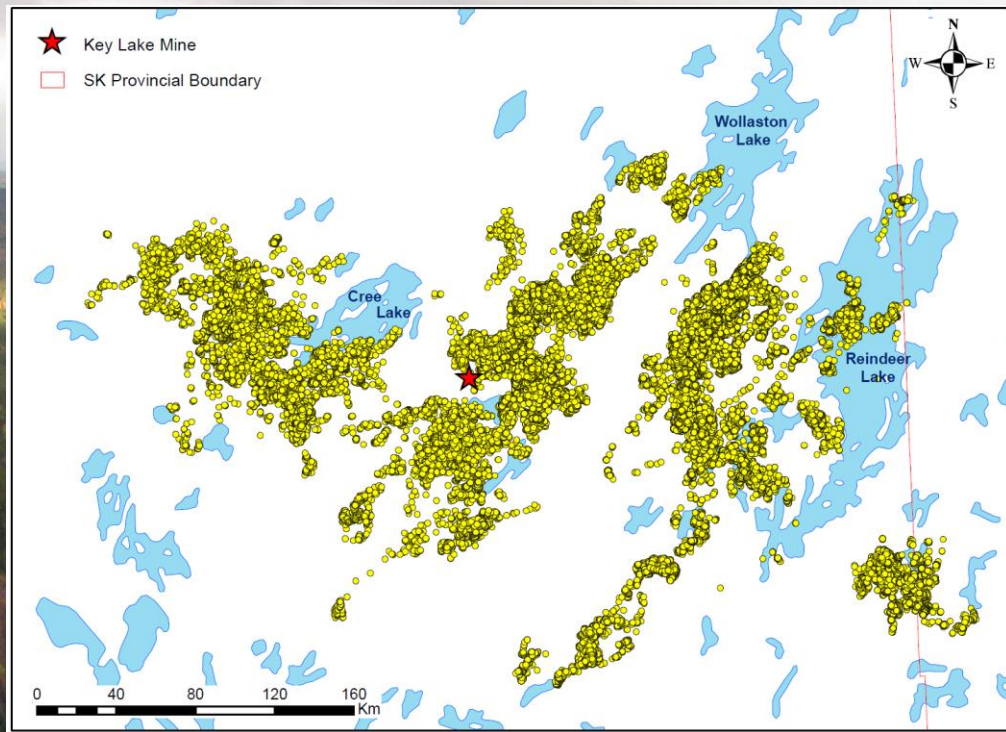
Research Themes

1. Caribou habitat
2. Population dynamics and behaviour

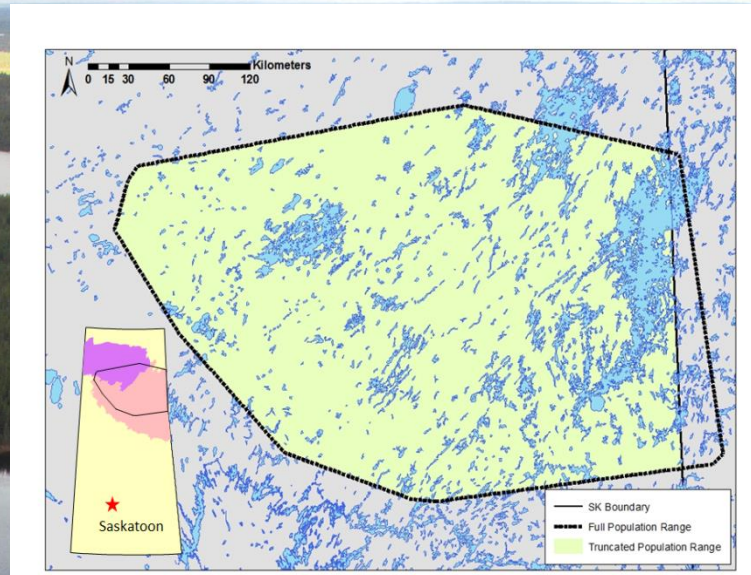
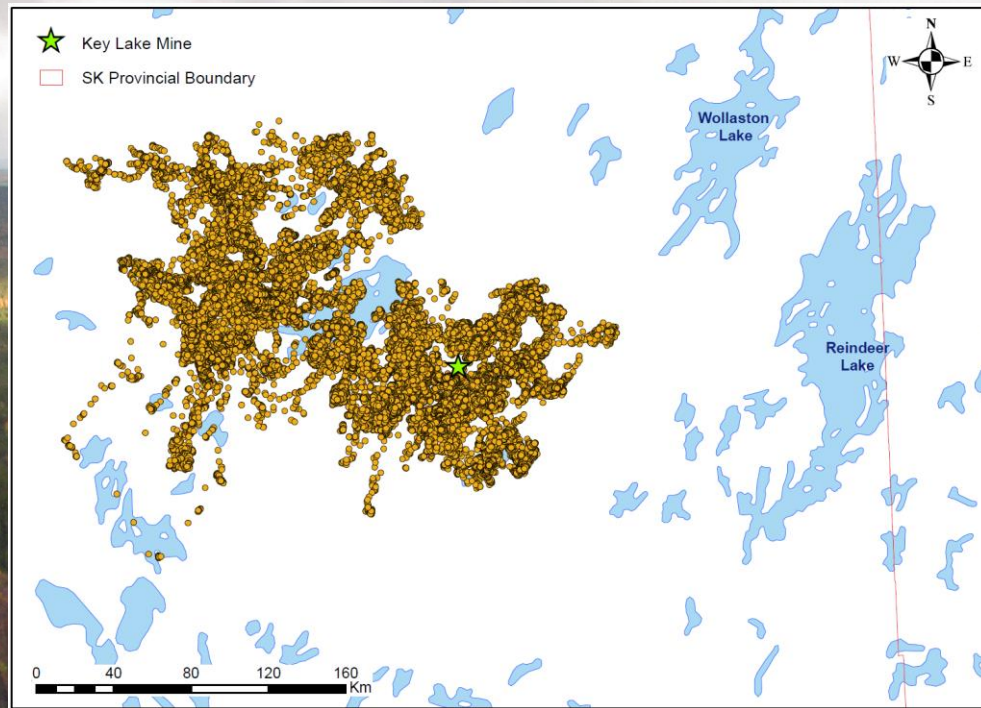


Population trend, status,
probability of occurrence, critical habitat

Study Area: Locations of Collared Caribou



Study Area: Partner Collar Data



Population Size



- Average density of caribou across 16 surveys conducted since 2018
 - 36.9 caribou/1000 km² (95% CI: 26.7–47.2 caribou/1000 km²)
 - This is high for woodland caribou, roughly twice the density as found in Alberta
 - Minimum density based on sightability test using collared caribou on grid

Population Size



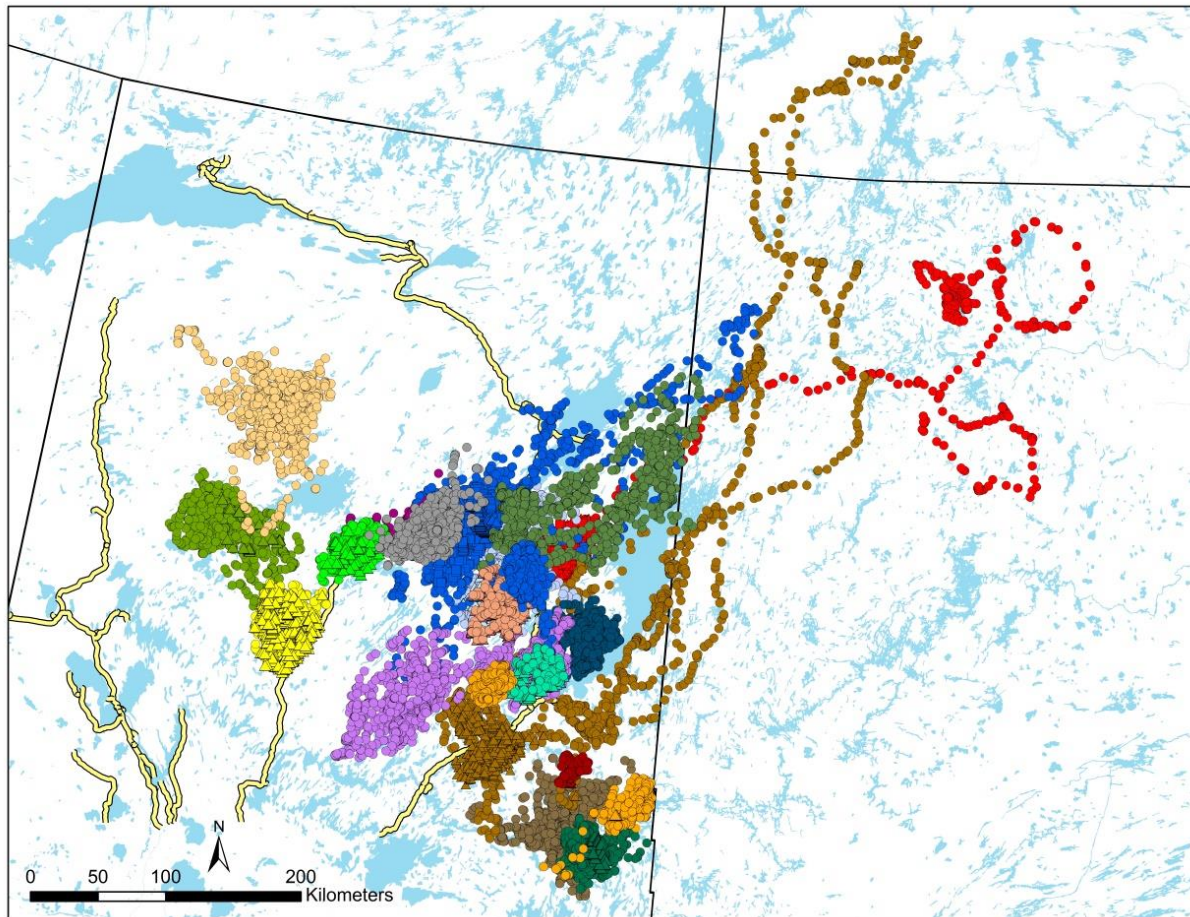
- Extrapolating density to population size
 - Min. 3380 caribou (95% CI: 2436–4304 caribou) in area where collared caribou occurred (91,238 km²)
 - Est. 5000 in whole of the SK1 unit

Moose Densities



- Among the lowest in boreal forests of North America where wolves co-occur
 - 45.7 moose/1000 km² (37.8–53.6 moose/1000 km²), 13 surveys.





Wolf Densities



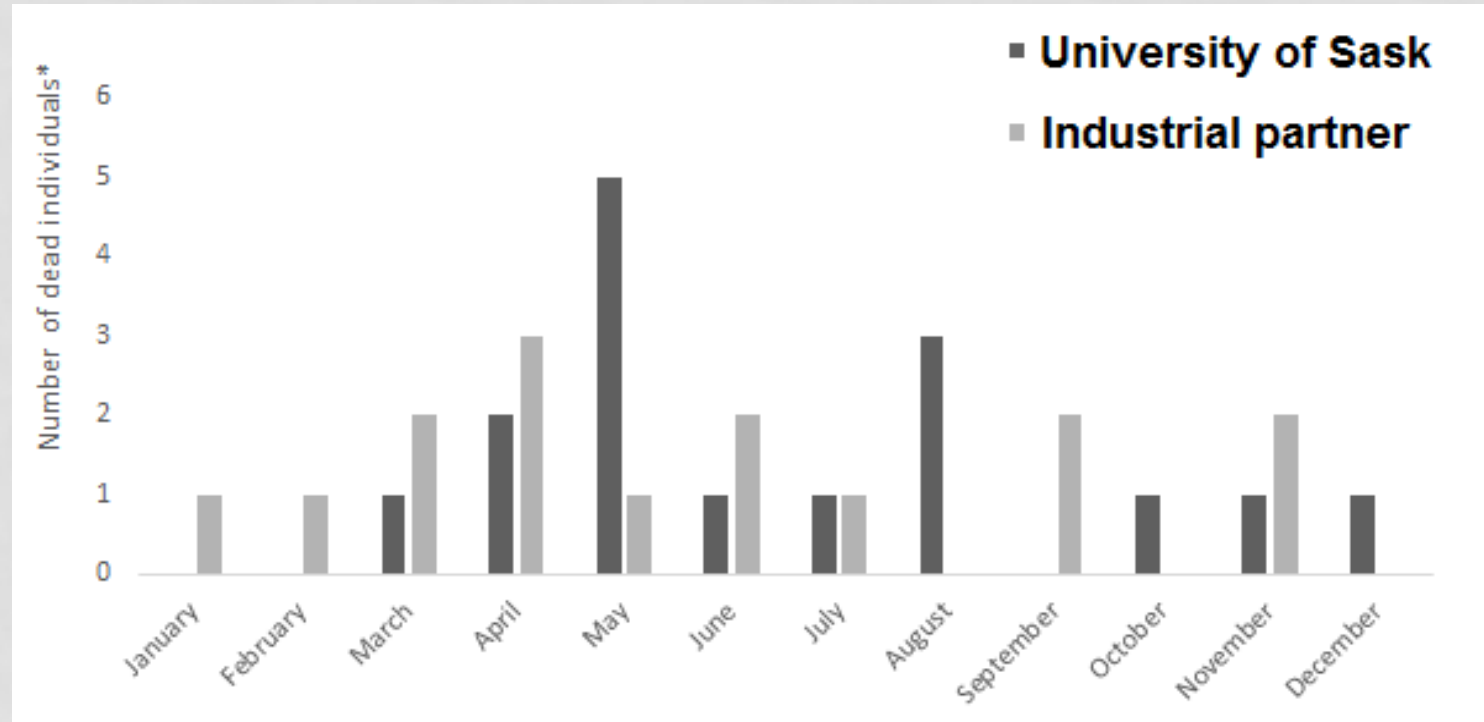
- Also estimated to be low
 - Based on known relationship between moose density and wolf density est. at <2 wolves per 1000 km^2
 - Established (non-transitory) territories are also very large
 - $3531 \pm 598 \text{ km}^2$ ($\bar{x} \pm \text{SE}$, $n = 12$ packs; 100% minimum convex polygon [MCP])
 - Pack sizes small
 - 2–9 wolves (4.6 ± 0.6 , $n = 19$ packs, lone = 4)

Caribou Survival



- Survival (out of 94 collared females as at March 15, 2014)
 - $2014-16 = 0.926$ with 95% confidence interval $\{0.883-0.964\}$ (assumes all drops are deaths)
 - Rate applies to U of S sample, which covers the SK1 range

Mortality highest in snow-free season



Caribou Pregnancy Rates



- Pregnancy rates from blood samples of collared caribou are high-normal
 - Across two years of captures (2013 and 2014) averaged 0.897 (95% CI: 0.834–0.951)

Caribou Recruitment



- Recruitment (calves/100 cows)
 - Averaged 0.211 (0.883-0.964) from 2014-16 (50:50 sex ratio assumed)
 - Applies across the SK1 range (U of S sample)

2014-16 Population Growth



- 2014 to 2015, $\lambda = 1.002$ [0.926–1.069]
- 2015 to 2016, $\lambda = 1.047$ [0.977–1.107]
 - Mean annual increase of 2.4% per year, i.e., $\lambda = 1.024$ [0.973–1.071]
 - U of S sample, applies throughout all SK1 range
 - Industrial partner data more variable and local, but same trend (highest population growth in 2015-2016)
 - Conclusion: stable to slightly increasing population

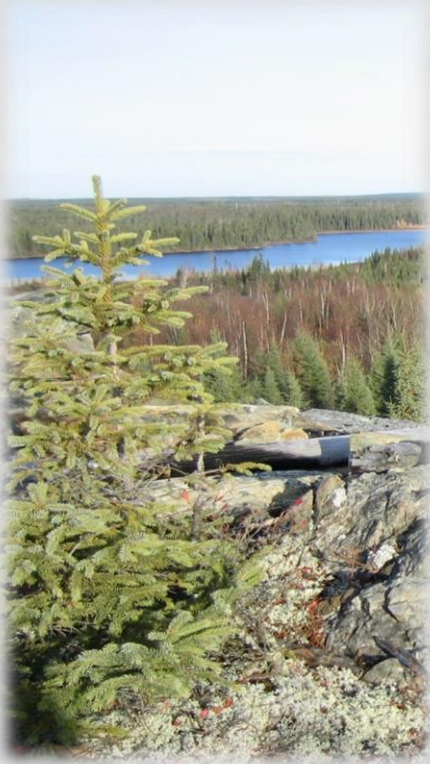
Population Viability Analysis



- Projections based on all inputs, age-sex structured population model
 - Chance population might decline to 10% decline over the next 20 years?
 - we observed that 24% of simulations resulted in this outcome (76% did not);
 - Chance of a 10% population increase from current size?
 - 57% of resulted in this outcome (43% did not).
 - Conclusion of stable to slightly increasing population

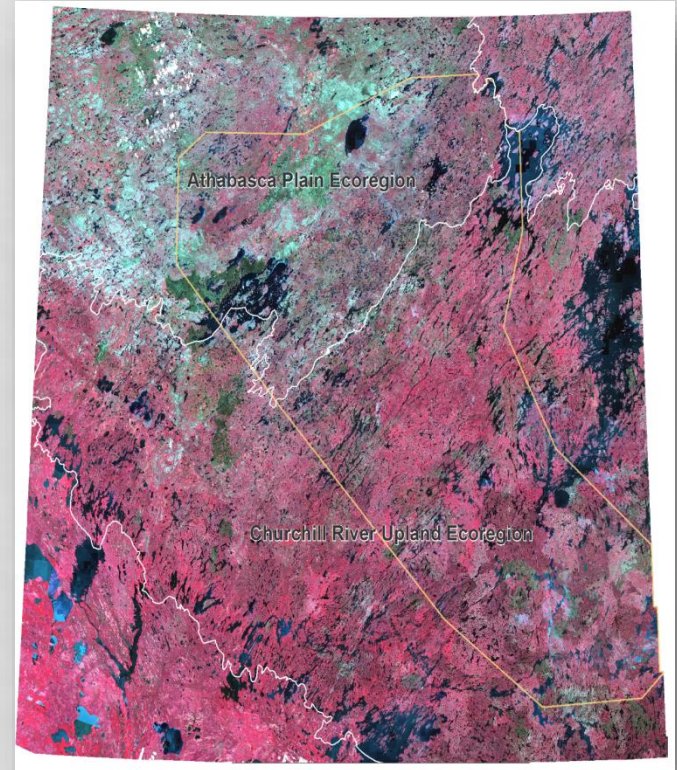
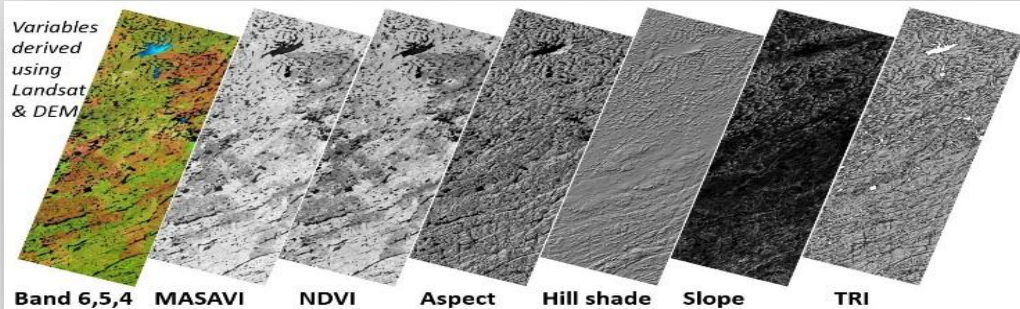
Vegetation Sampling

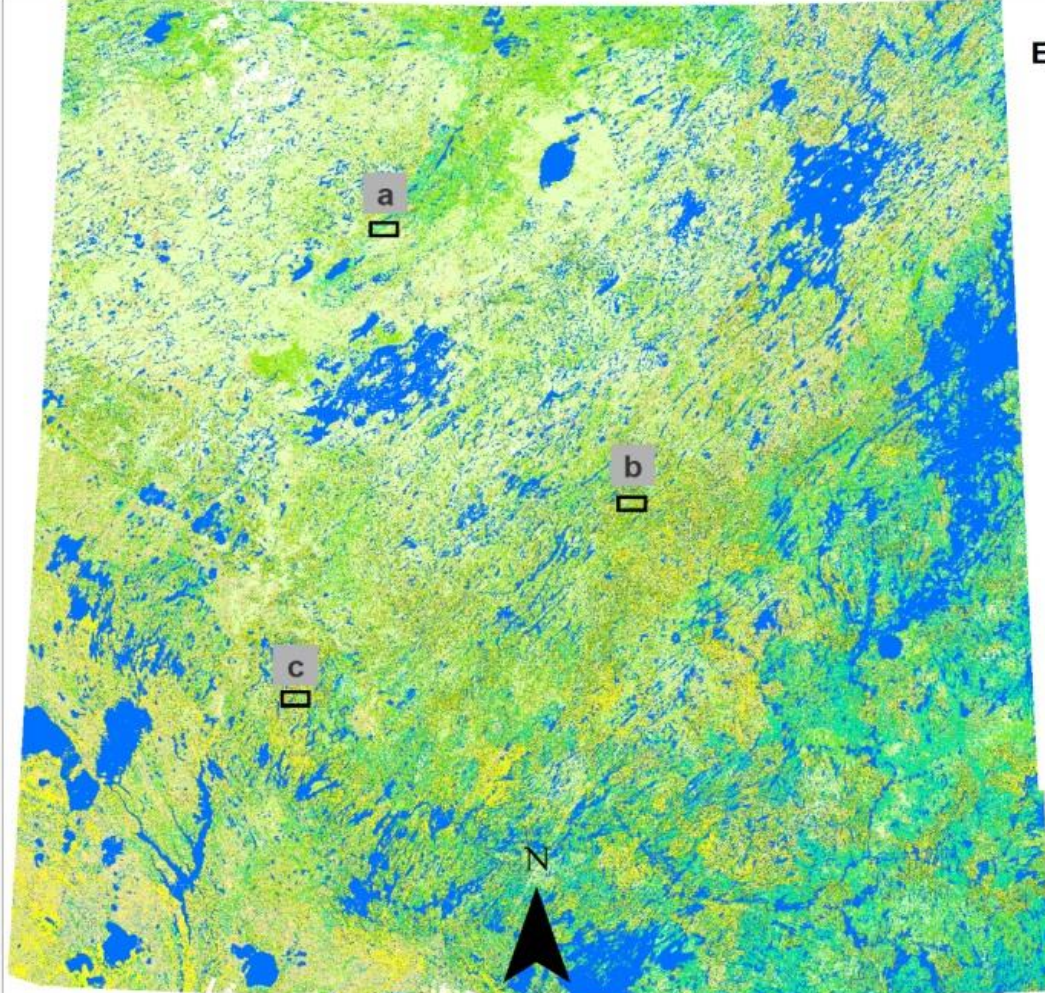
- 92 sites sampled 2014
- 114 sites sampled in 2015
- 2016 last year of sampling (106 sites)



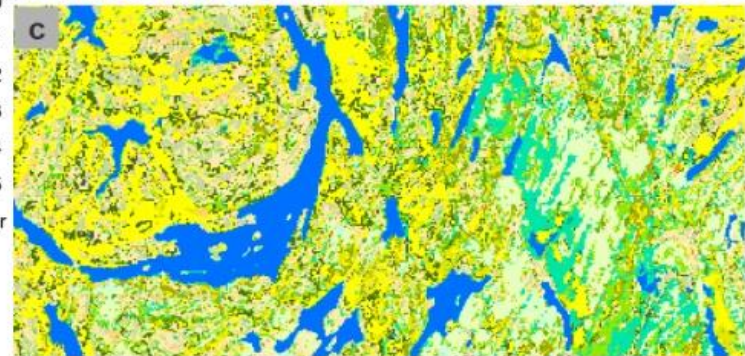
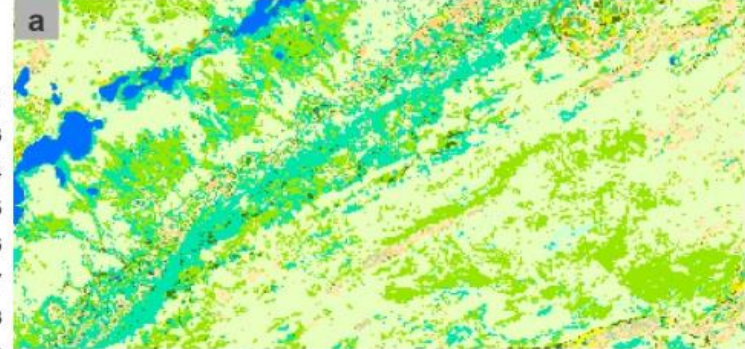
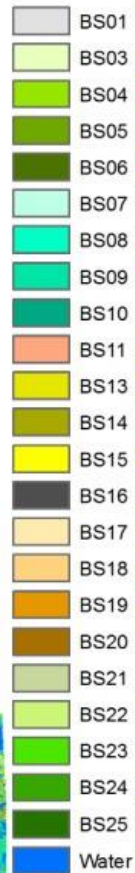
Habitat Remote Sensing

- Development continues with initial map product in early 2016
- Adding 2016 field data to the analysis now (312 total sites)
- Comparison of overall and class-level accuracies





Ecosites



Habitat Selection Analysis

- Multi-scale, multi-season analysis based on collared caribou locations
 - Caribou focused on 4 main associations:
 - Mature (>40 yr) pine forests
 - Mature black spruce
 - Black-spruce bog (almost all mature)
 - Open muskeg
- Land area of these components comprises 50.1% of study area

Late winter habitat selection (example)

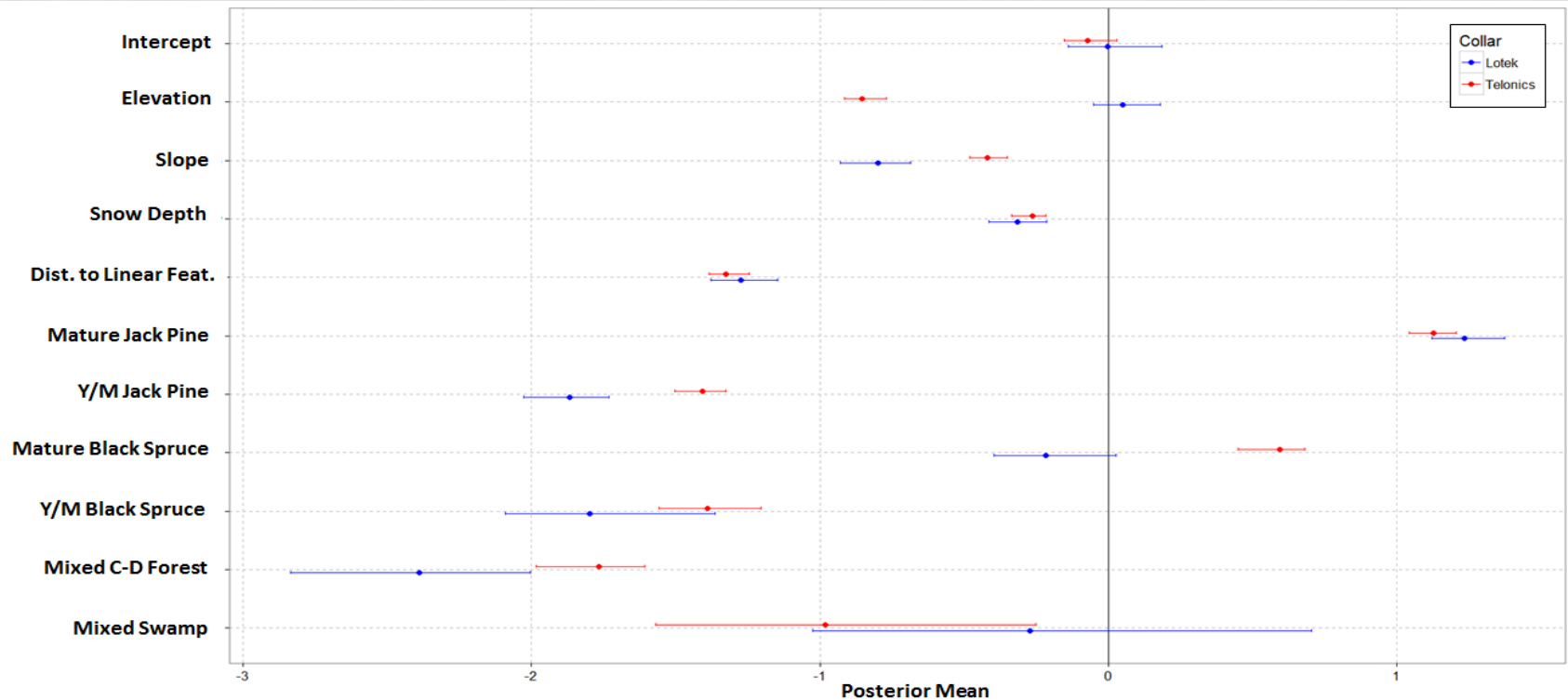


Fig. 4.31: Comparison between the top model (red) and validation model (blue) for the late winter/spring (LWS) season at the coarse spatial scale. The top model was trained using a sample of female woodland caribou fit with *Telonics*® GPS collars ($n = 17,439$ GPS locations recorded from 68 individuals over two LWS seasons) and validated using a sample of female woodland caribou fit with *Lotek*® GPS collars ($n = 6,495$ GPS locations recorded from 24 individuals over two LWS seasons). The points denote estimates of the posterior means for each covariate while the error bars on either side of the points are the 95% credible intervals (i.e., the range of values on the posterior probability distributions for each covariate that capture 95% of the probability).

Habitat Selection Analysis

- Linear features occurred at very low density
 - 0.1 km/km²; some caribou had no exposure
- Caribou were consistently predicted to occur closer than expected to linear features at broad scale, in all seasons
 - At fine scale (within home ranges) was equivocal, not as strong a predictor of occurrence

Lichen Availability

- Sample plots of lichen abundance show that preferred forage lichen availability is in excess of 6 million kg per caribou
 - Winter forage not likely limiting at this time

General Conclusions

1. Population occupies some of the most pristine habitat available to boreal woodland caribou in Canada
2. Natural fire cycle of ~100 years resulting in 50.1% of land mass supporting preferred habitat associations
3. Some of the highest densities of woodland caribou in Canada

General Conclusions

4. Wolf and alternate prey (moose) densities among the lowest in caribou range in Canada
5. Hunting pressure also very low (1 collared animal)
6. High adult female survival, mod-low recruitment, high pregnancy
 - Consistent with a large herbivore population that is experiencing density-related constraints on future growth
 - Population may be close to carrying capacity

General Conclusions

7. Population is stable to slightly increasing

“...the best available evidence suggests that the status of woodland caribou in the Saskatchewan Boreal Shield is one of a large and self-sustaining population, perhaps one of the most secure of all boreal caribou populations in Canada.”

Future Research

- Launching black bear study (pilot study was last year, 3 collared animals)
 - Also likely occur at fairly low density
- Wolf density surveys potentially for this winter
 - Interest from Alberta researchers to model how wolves exist when alternate prey are at low density and linear features are very low
- Publishing results
 - Including release of full interim report, November 2016

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Emmanuelle, Postdoctoral

Lucie, Postdoctoral

Nadine, Technician

Emily, Technician

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