Project Profile

Project Name:	Adaptive Management of woodland caribou under current and future change to climate and human footprint
Project Number:	BCIP-2016-13
Proponent:	Alberta Biodiversity Monitoring Institute
Funding Envelope:	Boreal Caribou
Timeframe:	October 15, 2015 to March 31, 2017

Project objectives

Our primary objective is to identify primary mechanisms through which climate and human development affect caribou, and quantify the strengths of these effects. In this proposal, we focus on creating the necessary climate-related data sets, specifically reconstruction of icing events, winter severity, and fire history across Western Canada. We anticipate that the entire project will span multiple years, but that the climate data sets will be complete within a year, allowing other stakeholders and researchers to quickly benefit from these products.

Project description

The role of climate in woodland caribou declines is poorly understood, yet may play an important role in past and future population trends of this endangered species. Currently, habitat alteration and subsequent changes to prey communities and predation rates are the primary mechanisms implicated in woodland caribou declines, yet there are several direct and indirect climate mechanisms that could also be driving declines. This project will clarify and quantify the effects of climate and human development on caribou population dynamics. It will also allow for improved study design in caribou research, and improved recovery planning and triage. It will produce new data sets for the caribou research and recovery community, and may suggest novel recovery strategies based on climate mechanisms identified.

Project background

Changes to predator-prey dynamics are known to negatively impact woodland caribou and have been linked to increased human footprint on the landscape. Yet behind this well-known conservation narrative, climate may be affecting caribou far more strongly than previously thought, because the signal of climate is in part masked by that of industrial development (Figure 1). Both human footprint and climate have concentrated impacts in southern latitudes, yet research has focused primarily on

human footprint rather than climate as a primary mechanism driving caribou declines. However, the reality is likely a combination of climate and human footprint effects.

Climate could affect caribou through several mechanisms simultaneously. Winter weather can have direct negative impacts on caribou nutrition through icing events that hinder foraging, or early spring melt that accelerates plant phenology, reducing plant nutrition during calving 1–3. Winter weather could also indirectly impact caribou by affecting deer and wolf dynamics, with warmer winters increasing deer distribution and abundance 4, spurring growth and expansion of wolf populations 5. Conversely, occasional sever winters may drive transient declines in deer availability, potentially causing wolves to consume more caribou following such severe winters 6. Finally, warmer and drier summers are increasing fire frequency in the boreal forest 7, negatively impacting the old-growth winter habitat of caribou.

As costly, high-stakes mitigation and recovery actions are considered and implemented, it is important to disentangle the effects of climate and human development. Without such clarity, recovery efforts in climate-compromised areas may fail, while recovery opportunities in favourable climate areas may be overlooked. In addition, caribou research efforts may be less effective if climate is not considered in study design. Our project will clarify the roles of climate and human development in woodland caribou population dynamics using long-term data on climate, human development, fire, wolf and alternative prey abundance and distribution, and caribou demography across western Canada. Using these long-term data, we will test hypotheses regarding climate and human development mechanisms driving caribou population dynamics. We will create novel climate data sets including spatially-explicit time-series of icing events, winter severity index, and fire occurrence. Such climate-related data sets would be valuable to the broader caribou research community as climate is increasingly recognized as an important factor for caribou.

Project approach

The project will be carried out using the following approach:

Study Areas:

We will develop GIS coverage for climate and fire history variables over western Canada, including Alberta, Saskatchewan, British Columbia, Northwest Territories, and Yukon Territory.

Methods:

We will empirically test multiple mechanisms through which climate and industrialization jointly impact caribou demographics. Support for these pathways will be evaluated using structured equation models (SEMs) to test relationships among this complex, potentially collinear network of variables. Competing SEMs will be tested, and a best model will be constructed using multi-model inference and model averaging based on information theory. Caribou demographic data will consist of survival and recruitment for boreal caribou in western Canada since the mid 1990s, including herds with contrasting growth and industrialization histories. Data sources will be matched spatially to each caribou herd's

range. Climate data will include time series of winter severity (i.e., snow depth and temperature data) and summer warmth, and freezing-rain and freeze-thaw events derived from remote sensing data. In addition, large-scale climate indices will be examined for predictive power; predator and alternative prey data will include deer and moose relative abundance and occurrence from hunter and aerial surveys, and wolf and caribou resource selection patterns. Finally, habitat layers will be used to characterize changes in vegetation classes and linear features due to shifting land use and post-fire succession over time.

Project deliverables

We will produce the following deliverables to update project status and accomplishments:

1. A 20-year record of winter severity index (an important predictor of deer distribution), icing events, and fire history and subsequent forest succession across western Canada. Access to these climate-driven data sets for the broader caribou research and recovery community within approximately 1 year.
2. Final report describing the results of the analysis, which will enhance research, planning and recovery of caribou.