Developing and Monitoring the Efficacy of Functional Restoration of Linear Features for Boreal Woodland Caribou: 2015 Progress Report

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EXECUTIVE SUMMARY

Environment Canada and the British Columbia Ministry of Environment have identified that habitat restoration is required to sustain woodland caribou populations in northeast British Columbia. However, woodland caribou habitats require decades to recover to pre-disturbance conditions. Functional restoration is therefore needed as an interim strategy to mitigate impacts while caribou habitats recover. The functional restoration of linear disturbances may benefit woodland caribou by reducing predator movement rates and enforcing spatial separation between caribou and predators.

The overarching goals of our research program are to develop a non-invasive (1) mitigation strategy that facilitates the functional restoration of linear disturbances at scales relevant to caribou demography, and (2) monitoring design to measure the merit of mitigation strategies based on animal response data. The study follows a before after control impact design that measures how predators use a caribou range in both space and time. This entails monitoring the spatiotemporal patterns of large mammal use across an entire caribou range for 1 year under both disturbance and undisturbed conditions, deploying functional restoration treatments on linear feature disturbances, and then monitoring the rates of animal use following treatment deployment.

During 2015, we developed a sampling design and deployed 85 motion-sensing monitoring cameras to monitor large mammal use on disturbed (linear features) and undisturbed (game trails) conditions. Motion-sensing cameras have been shown to be an effective monitoring tool for large boreal mammals across multiple seasons and can survey population level responses for multiple species.

Rates of habitat use are currently being collected for large mammal species that interact in this ecosystem (e.g., humans, wolves, bears, caribou, moose, and deer) at camera monitoring sites. Data collection will continue through 2016. Results from our program will facilitate a Habitat Restoration Pilot Program by providing animal use data that can be used to guide the design of restoration treatments (i.e., placement and prescription) and subsequently measure to what extent restoration treatments reduce the effects of linear features on caribou and interacting species.

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We are grateful to Paula Bentham and Brian Coupal with Golder Associates Ltd., who provided linear feature inventory data from the Parker Caribou Range collected as part of a Habitat Restoration Pilot Program (BCIP-2016-04 and BCIP-2016-16). We also thank Craig DeMars and Stan Boutin with the University of Alberta for providing woodland caribou and wolf collar locations from a research study assessing spatial factors affecting the predation risk of caribou calves. Both datasets were used to confirm that the sampling design and subsequent camera deployment considered the range of variation within the Parker Caribou Range.

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1 INTRODUCTION

Human disturbances have been observed to negatively impact boreal woodland caribou via two primary processes related to predators. First, disturbances can improve habitat conditions for moose and deer. The resulting prey population growth can increase the number of predators with consequences on caribou mortality (i.e., apparent competition; Holt 1977). Second, linear disturbances can increase the encounter rate between caribou and their predators by facilitating predator movement and reducing spatial separation (DeCesare 2012). Environment Canada and the British Columbia Ministry of Environment have identified that habitat restoration is required to sustain woodland caribou populations in northeast British Columbia. However, woodland caribou habitats require decades to recover to pre-disturbance conditions. Wilson (2015) identifies that functional restoration is needed as an interim strategy to mitigate impacts while caribou habitats recover. Wilson defines functional restoration as the outcome of a management action that mitigates a risk from ecosystem disturbances.

Caribou tend to have low overlap with their predators. However, linear disturbances can reduce spatial separation and increase predator search efficiency (DeCesare 2012) inflating the encounter rate between predators and woodland caribou (Whittington et al. 2011; McKenzie et al. 2012). Studies show that predation is the most common source of known mortality in adult woodland caribou (McLoughlin et al. 2003), and predation rates are influenced by encounter probabilities and population size (Messier 1994; Hebblewhite et al. 2005). Thus, mitigations that reduce encounter rates by reducing predator movement rates or enforcing spatial separation between caribou and predators must, necessarily, reduce predation given constant population size. We completed a pilot study showing that log-blocking treatments applied on linear disturbances can reduce use by wolves at small spatial scales (Keim et al. 2014). However, it is unclear if such actions disrupt the functional response between predators and caribou at scales relevant to caribou demography (Wilson 2015).

Habitat restoration implementation plans are currently being developed in the Parker Caribou Range as part of a pilot program designed to improve caribou habitat (Golder 2015; BCIP-2016-04 and BCIP-2016-16). The pilot program is inventorying vegetation conditions on linear features with the goal of implementing active restoration methods where treatments could improve caribou habitat or decrease predator use. Our research program is designed to test whether mitigation treatments can restore functional caribou habitat in the Parker Caribou Range at scales relevant to caribou demography. Results from our program will facilitate the Habitat Restoration Pilot Program by providing animal use data that can be used to guide the design of restoration treatments (i.e., placement and prescription) and subsequently measure to what extent restoration treatments reduce the effects of linear features on caribou and interacting species.

2 FUNCTIONAL RESTORATION PROGRAM OBJECTIVES

The overarching goals of this research program are to develop a non-invasive (1) mitigation strategy that facilitates the functional restoration of linear disturbances at scales relevant to caribou demography, and (2) monitoring design to measure the merit of mitigation strategies based on animal response data. The program consists of two phases that aim to recover and monitor functional woodland caribou habitat across portions of the Parker Caribou Range.

- Phase 1 consists of developing and implementing a science-based sampling design to monitor animal use within the Parker Caribou Range for 1 year using motion-sensing cameras. The program is aimed at collecting habitat use data continuously across seasons on humans and large mammal species that interact in this ecosystem (e.g., humans, wolves, bears, caribou, moose, and deer).
- Phase 2 consists of monitoring animal use once restoration treatments are deployed, and is designed to answer ‘how well does the treatment mitigate predator use?’ and ‘are predators leaving the treatment area?’ These questions are key to measuring how successful functional restoration is at reducing predator use and predator-caribou overlap.

The study will follow a before-after control impact design that measures how predators use a caribou range in both space and time. This entails monitoring the spatiotemporal patterns of large mammal use across an entire caribou range for 1 year under both disturbance and undisturbed conditions, deploying functional restoration treatments on linear feature disturbances, and then monitoring the rates of animal use following treatment deployment. The benefits of this design are that it (1) accounts for how caribou and their predators use linear features depending on line conditions, habitat, and season, (2) accounts for within-range variation related to time, (3) limits among-range variation such as population size, which has the potential to confound multi-range results, and thus (4) provides a benchmark from which to estimate mitigation efficacy.

A schematic showing how predator use is hypothesized to change across time, mitigation treatment, and feature type is provided on Figure 1. Success will be measured if the rate of predator use (1) on linear features is lower in the treatment area than in similar control areas; (2) on linear features in the treatment area approaches the rate of use on game trails; and (3) on game trails within the treatment area remains constant or declines.

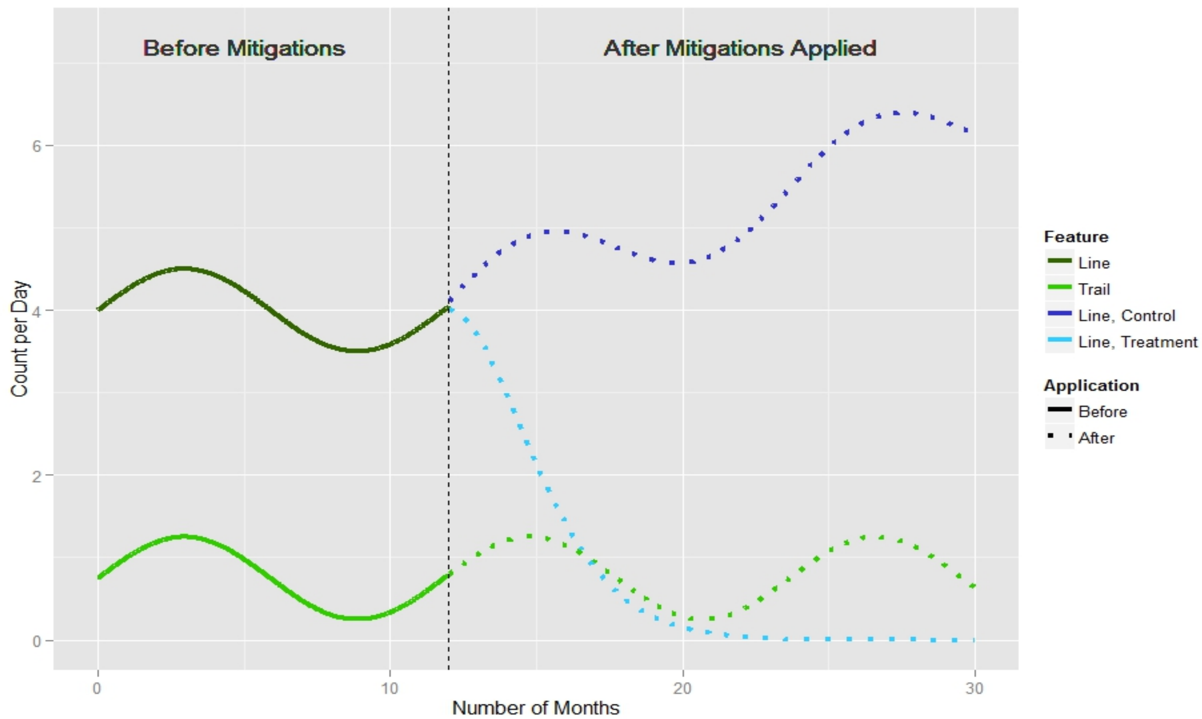


FIGURE 1 Predicted response of predator use within the Parker Caribou Range before mitigations (Phase 1) and after mitigations (Phase 2) on linear features (Line) and animal trails (Trail)

The proposed study is in alignment with the implementation objectives from the Boreal Caribou Implementation Plan for British Columbia (BCIP; B.C. MoE 2011). Anticipated benefits to caribou include mitigations that can restore landscape function in caribou ranges while linear features naturally revegetate [BCIP implementation objectives #1 and 2]; an approach to monitor the efficacy of functional restoration practices at managing predators and their overlap with caribou [BCIP implementation objective #5]; and improved understanding of the ecological relationships between predators, linear features and prey. Understanding these ecological relationships is important because the high cost of restoration treatments may prohibit widespread application. Targeting restoration efforts where they can most benefit caribou (i.e., placement and prescription) may reduce unneeded effort and thus optimize boreal woodland caribou conservation efforts. If successful, this program will provide non-invasive, cost-effective methods to recover boreal woodland caribou by reducing the magnitude of effects from industrial footprints in caribou ranges.

3 PROJECT ACTIVITIES AND STATUS

Phase 1 was initiated in October 2015. The objectives during program initiation were to develop the sampling design, and purchase and deploy motion-sensing monitoring cameras to monitor large mammal use on disturbed (linear features) and undisturbed (game trails) conditions. Motion-sensing cameras have been shown to be an effective monitoring tool for large boreal mammals across multiple seasons (Keim et al. 2014; Burton et al. 2015). Cameras can survey population level responses, collect data on multiple species, and monitor animal use rates at fixed locations across time (e.g., treatment and control areas).

3.1 Sampling Design

Camera monitoring sites were selected within the Parker Caribou Range using a random design. This statistical approach is used to obtain an unbiased sample (i.e., group of monitoring locations) from a population of potential sampling sites. Monitoring sites were identified as follows:

1) Potential monitoring sites were generated randomly across the caribou range with a minimum spacing of 2 km between any two points. Our sampling frame thus became the set of random points and not the continuous space across the Parker Range. This created a finite population framework that simplifies the design while facilitating rigorous statistical analyses.

2) Camera monitoring sites were randomly selected (n=85) from the sampling frame. Individual sites were then randomly assigned to being deployed on a linear feature (n=55) or on a wildlife game trail (n=30).

3) We then confirmed that the statistical distributions of camera monitoring sites were unbiased with respect to the population of potential sites. This was completed by comparing GIS-based measurements of terrain, wildfire history, and forest composition. These ecosystem characteristics can influence the habitat use patterns of boreal wildlife species and could therefore influence future analyses.

4) Finally, we confirmed that camera monitoring sites included areas that have historically been used by GPS collared caribou and wolves (DeMars and Boutin 2014). Historical wildlife observations might not represent current use but does increase our confidence that the sampling design includes areas that are likely to be used by these two species.

3.2 Cameras and Camera Deployment

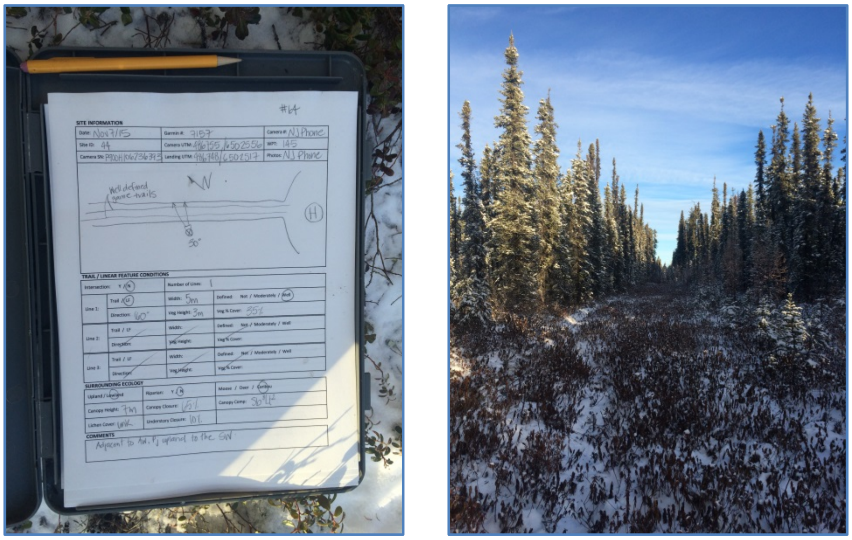
PC900 Hyperfire Professional Covert IR cameras, and associated hardware, were acquired from Reconyx in Wisconsin, USA in October 2015. These motion-sensing cameras capture high-definition images using a combination of color (daytime) and monochrome infrared (nighttime) photos. Each camera is powered using 12 AA size lithium batteries, allowing the camera to remain operational for 6 to 12 months in varying operating temperatures. Images are stored on a programmable SD memory card. Upon receipt, cameras were programmed to capture five consecutive photographs for each motion trigger event. In addition, each camera was programmed to collect one daily time lapse photograph to confirm camera operation and provide information on daily snow conditions at each camera monitoring site.

In November 2015, we deployed motion-sensing cameras at 85 camera monitoring sites in accordance with the sampling design. Each camera monitoring site was surveyed by helicopter to evaluate access. Suitable landing locations were selected based on safety, proximity to camera monitoring sites, and future access limitations. When suitable landing locations could not be found near the sites identified in the sampling design, camera monitoring sites were moved to the closest location with similar forest composition and nearby helicopter access.

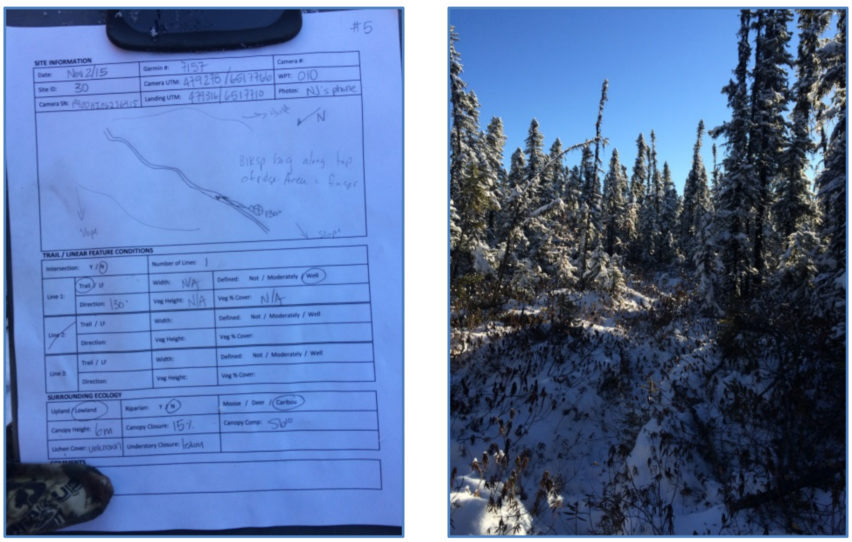
At each monitoring site, vegetation and brush were cleared to reduce the likelihood of false triggers. The camera was positioned and walk-tested to ensure coverage of the entire game trail or linear feature being monitored. The field of view was assessed using the front-facing camera view of a cell phone (Photograph 1). Once armed, each camera was placed in its steel security enclosure, which was bolted to a tree, and secured with a cut-proof padlock. We then collected information about the surrounding ecosystem (e.g., forest composition) and the game trail or linear feature (e.g., width, vegetation cover, and game trail definition) at each site to support future analyses of animal use. Finally, we photographed the site, recorded its location, and drew a diagram of the camera monitoring site (Photographs 2 and 3).

Photograph 1 Installation Photographs

Photograph 2 Example of Linear Feature



Photograph 3 Example of Game Trail



4 ONGOING RESEARCH

Rates of habitat use are currently being collected for large mammal species that interact in this ecosystem (e.g., humans, wolves, bears, caribou, moose, and deer) at camera monitoring sites. Results from our program will facilitate the Habitat Restoration Pilot Program by providing animal use data that can be used to guide the design of restoration treatments (i.e., placement and prescription) and subsequently measure to what extent restoration treatments reduce the effects of linear features on caribou and interacting species. Moving forward, the next research steps are as follows:

Monitor Animal Use Patterns (2016)

- Maintain data collection at camera monitoring sites and inventory observations in a database.
- Assess the joint-distribution of wildlife use across time and space during the first year to determine baseline use and evaluate how species interactions are influenced by vegetation conditions on game trails and linear features.
- Present results from the first year to the REMB to help guide the Habitat Restoration Pilot Program, and advise the REMB regarding restoration treatments and related sampling efforts.

Test the Efficacy of Functional Habitat Recovery (2017)

- Maintain data collection at camera monitoring sites and inventory observations in a database, following the deployment of restoration treatments.
- Assess the joint-distribution of wildlife use across time and space during the first 2 years to determine how species restoration treatments have influenced use by predators, prey, and humans.

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