Response of Woodland Caribou to Roads, Trails, Campgrounds, and Levels of Human Activity in Jasper National Park

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Extended Abstract: Woodland caribou (*Rangifer tarandus caribou*) populations are declining in many areas of North America and are now classified as Threatened in Canada (COSEWIC 2002). In southern Jasper National Park, woodland caribou populations have declined by almost 50% since 1988 even though these caribou are not subject to industrial activity. Causes of this decline may include predation, poor quality habitat, habitat degradation from recreational activity, and increased predation risk due to wolves using ploughed roads and packed trails in winter. In this paper, we examine how 10 GPS-collared woodland caribou responded to roads, trails, campgrounds, and levels of human activity during summer 2003. Our specific questions were

1. In summer, do woodland caribou avoid roads, trails, and campgrounds?
2. If woodland caribou avoid these features, do levels of human activity affect the intensity of avoidance?
3. Do levels of human activity affect woodland caribou displacement distance?

We identified woodland caribou habitat selection or avoidance by comparing the distribution of caribou with random locations from mid-April through mid-October. For each caribou location, we generated a random location with the same time-date stamp and ecoregion (alpine or subalpine). We conducted separate analyses for the alpine and subalpine ecoregions because caribou likely select different foods in each of these ecoregions. We categorized distance to roads, trails, and campgrounds because the effects of these features on woodland caribou likely decline nonlinearly with distance, and because categorization allows for testing and interpretation of the effects of distance and levels of human activity on caribou. We defined our distance classes using univariate regression trees, which identify change points in data. The distribution of caribou locations relative to roads, trails, and campgrounds depends on where high quality habitat occurs; therefore, we first generated resource selection function (RSF) models using topographic and vegetation covariates and then added human use covariates to those models. We accounted for autocorrelation among successive caribou locations by using logistic regression with caribou ID modeled as a random effect. We selected models using forward stepwise selection with quasi-Akaike information criterion (QAIC). We retained 10% of the data to test the RSF models.

In the alpine, woodland caribou selected for areas with high solar incidence, low elevations, and shallow slopes, distances far from streams, and areas within 500 m of treeline. Compared to areas with rock and talus (the dummy variable used for the categorical variable 'Land Cover'), caribou selected areas with shrubs and herbaceous meadows but avoided areas of snow and ice. This model ably differentiated between caribou and random locations (ROC[1] = 0.915; ROC_{test} = 0.920). The addition of distance to trail, hikers per day on the nearest trail, interaction between distance and trail use, and distance to campground further improved this model's performance. Compared to the reference category of distances > 750 m from trails, caribou selected areas 500–750 m from trails at low levels of trail use but avoided these areas at high levels of use. When there were few hikers per day, caribou neither selected nor avoided areas within 500 m of trails, but as trail use increased, they avoided areas 250–500 m from trails and strongly avoided areas < 250 m from trails. Compared to a reference category of distances > 2.0 km from campgrounds, caribou strongly avoided areas within 0.5 km of campgrounds, less strongly avoided areas 0.5–1.0 km from campgrounds, and neither selected nor avoided areas 1.0–2.0 km from campgrounds.

In the subalpine, woodland caribou selected for areas with high solar incidence, high elevations, distances far from streams, and forests < 150 years old. Compared to areas with coniferous forests (the dummy variable used for the categorical variable 'Land Cover'), caribou selected shrubs and herbaceous meadows but avoided rock. This model also ably differentiated between caribou and random locations (ROC = 0.824, ROC_{test} = 0.833). The addition of distance to trail and its interaction with number of hikers per day further improved this model. Compared to the reference category of distances > 750 m, caribou neither selected nor avoided areas 500–750 m from trails at low levels of use but avoided these areas as use increased. They avoided areas 250–500 m from trails at all levels of use. They also avoided areas within 250 m of trails at low levels of use, and avoidance increased as levels of use increased.

In summary, woodland caribou generally avoided areas within 1 km of campgrounds and up to 750 m from trails, however, displacement distances and intensity of avoidance depended on the levels of human use on the nearest trails. Approximately 25% of the alpine areas in which caribou occur in Jasper National Park are within 750 m of trails. The response of woodland caribou to human activities in this study may have important implications for other regions that receive high numbers of hikers, backcountry skiers, and snowmobilers.

References

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002. COSEWIC assessment and update status report on the woodland caribou *Rangifer tarandus caribou* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. xi + 98 pp.

[1]ROC = area under the receiving operator characteristic curve, which is used to determine how well a model differentiates use locations from random locations.