Habitat or Climate: Correlates of mammal composition across the Canadian forest-tundra transition

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Abstract

Climate is warming globally and there is clear evidence that the warming is causing shifts in many species ranges. Predicting range shifts of wildlife species is thus integral in understanding climate change impacts. The first step in this process is to access the utility of climate in explaining the current distribution of species. Here we highlight the preliminary findings of our research in modeling patterns of mammal species occurrence over the forest tundra ecotone. Our analyses suggests as we move from large spatial grains to medium spatial grains there is an increasing importance of habitat and decreasing but still integral importance of climate as predictive variables. This has important consequences for predicting climate mediated range shifts.

Introduction

The forest-tundra ecotone is a marked threshold of vegetative structure and mammal species assemblage that will likely shift with impending climate change. Understanding how species are currently distributed here is thus highly relevant to predicting climate change impacts.

Our primary research objective was to quantify whether:

1. Mammal species with strong trophic interactions (eg. Predator-prey) vary synchronously across the forest-tundra, and
2. Mammal species occurrence is better predicted by vegetation or climatic variables

Methods

Data Collection:

I Walked n=79 triangles along from the Dempster highway (100m removed), YT, and recorded all mammal tracks.

Species Prevalence Index:

Using the field data I calculated the proportion of six 500m segments with species present.

Multiple Regression

Explanatory Variables:

Percent tree/shrub coverage and snow depth were measured in the field for each segment. Triangle average annual temperature interpolated from gridded climate normals, corrected for elevation via environmental lapse rate.

Response Variable:

Aggregate Boreal Mammal Prevalence

(Sum of prevalence's for five core boreal mammals: American red squirrel (*Tamiasciurrus hudsonicus*), snowshoe hare (*Lepus americanus*), moose (*Alces alces*), American marten (*Martes americana*), and Canadian lynx (*Lynx lynx*)).

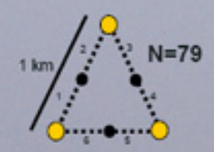

Figure 1. Stylized study triangle, along which mammal tracks were recorded. Actual triangles were plotted in GIS and navigated using GPS and compass.

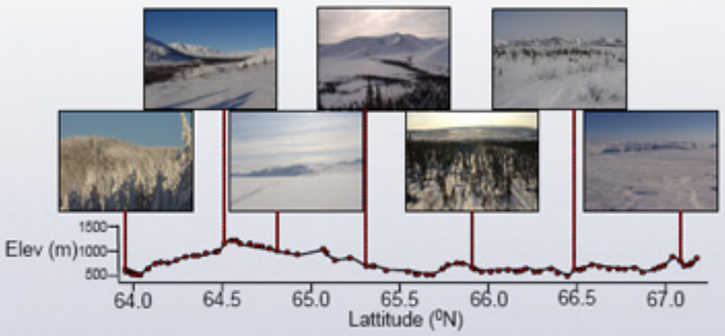

Figure 2. Schematic of the Dempster highway, YT, with representative site pictures. The road is indicated by the black line, plotted according to latitude by elevation. Red dots indicate sample triangles. Red/black lines link photographs to sites at which they were taken

Preliminary Results

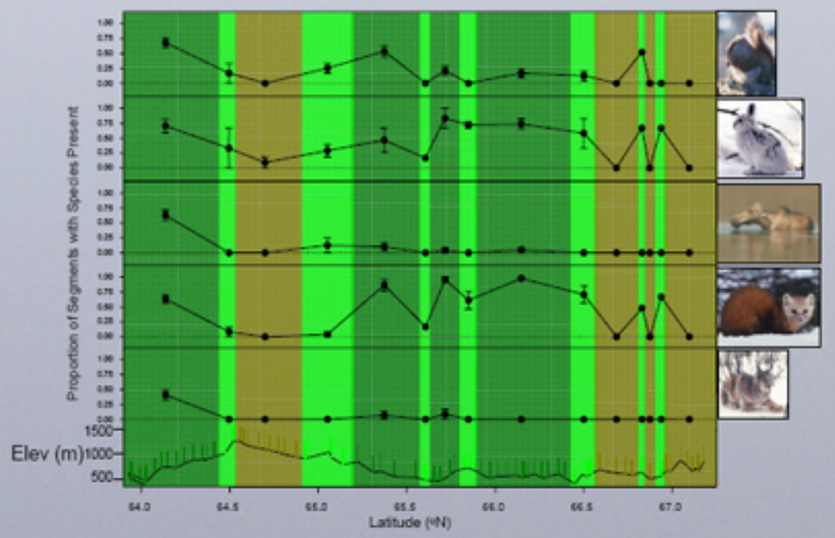

Figure 3. Schematic of the Dempster highway, YT, plotted with a summarized prevalence data for core boreal mammals, including the American red squirrel (*Tamiasciurrus hudsonicus*), snowshoe hare (*Lepus americanus*), moose (*Alces alces*), American marten (*Martes americana*), and Canadian lynx (*Lynx lynx*) respectively. The Dempster highway is indicated by the black line at the bottom, plotted according to latitude by elevation. Sample triangles are represented by bars categorized and colour coded by habitat type: dark green for forest, brown for tundra and light green for triangles containing characteristics of both. Mammal track data are averages of prevalence for all triangles within each consecutive habitat category along the Dempster highway ±SE.

Table 1. Multiple regression results for an analysis of the relation between climate/habitat variables (conifer cover, snow depth, and annual average temperature) and aggregate boreal mammal prevalence.

Explanatory Variables	Coefficent ± SE	Partial Correlation Coefficient	P
Constant	0.73 ± 0.16	-	<0.0001
Avg Ann Temp	0.11 ± 0.02	0.580	<0.0001
Conifer Cover	0.35 ± 0.09	0.443	<0.0001
Snow Depth	0.04 ± 0.001	0.437	<0.0001

$N = 67$ sites, $r^2 = 0.73$, $F_{3,63} = 55.3$, $p < 0.0001$

Preliminary Conclusions

The results show some decoupling of traditional predator-prey species with respect to prevalence and some atypical habitat associations. Our analysis thus far suggests climate is a strong predictor of mammal occurrence even at the mesoscale used. However vegetative variables also have strong explanatory power suggesting that the utility of climate envelope approaches to predicting species occurrence is scale dependant.

Future Direction

Currently I am building models of mammal occurrence based on an index of mammal abundance derived from track density. Moreover, I am analyzing a comparable small mammal dataset which I collected through trapping this summer, at the same sites as I collected the track data.

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