

# Spruce budworm outbreaks impact the survival and space use of boreal caribou



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## Introduction

Boreal populations of woodland caribou (*Rangifer tarandus caribou*) are threatened in Canada. Most recovery plans focus on the protection and restoration of their critical habitat. While the impact of fires and human activities on caribou populations have been largely documented, little information exists on how the impact that pest insects can have on conifer forests influences the distribution of caribou and their interaction with gray wolves (*Canis lupus*).

## Objectives

Determine how a spruce budworm (SBW, *Choristoneura fumiferana*) outbreak influences habitat selection and ranging behaviour of boreal caribou and gray wolves in the fall.

## Methodology

- 145 boreal caribou and 16 gray wolves were monitored with GPS collars in the Côte-Nord region of Québec between 2005 and 2018, i.e., before and during a spruce budworm outbreak (Fig. 1).
- Habitat selection was assessed by contrasting land cover features at observed and random locations.
- Individual home-ranges were estimated from 95<sup>th</sup> percentile kernels.
- SBW outbreak severity was quantified based on the annual extent of tree defoliation.

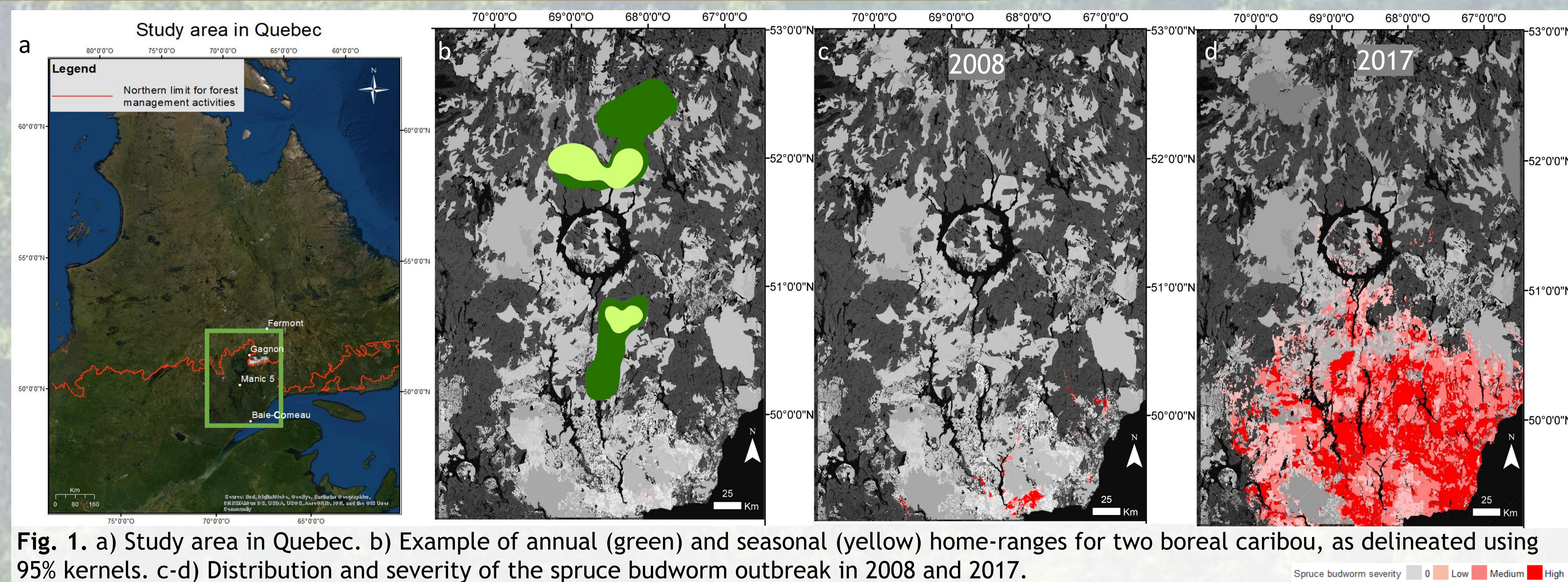
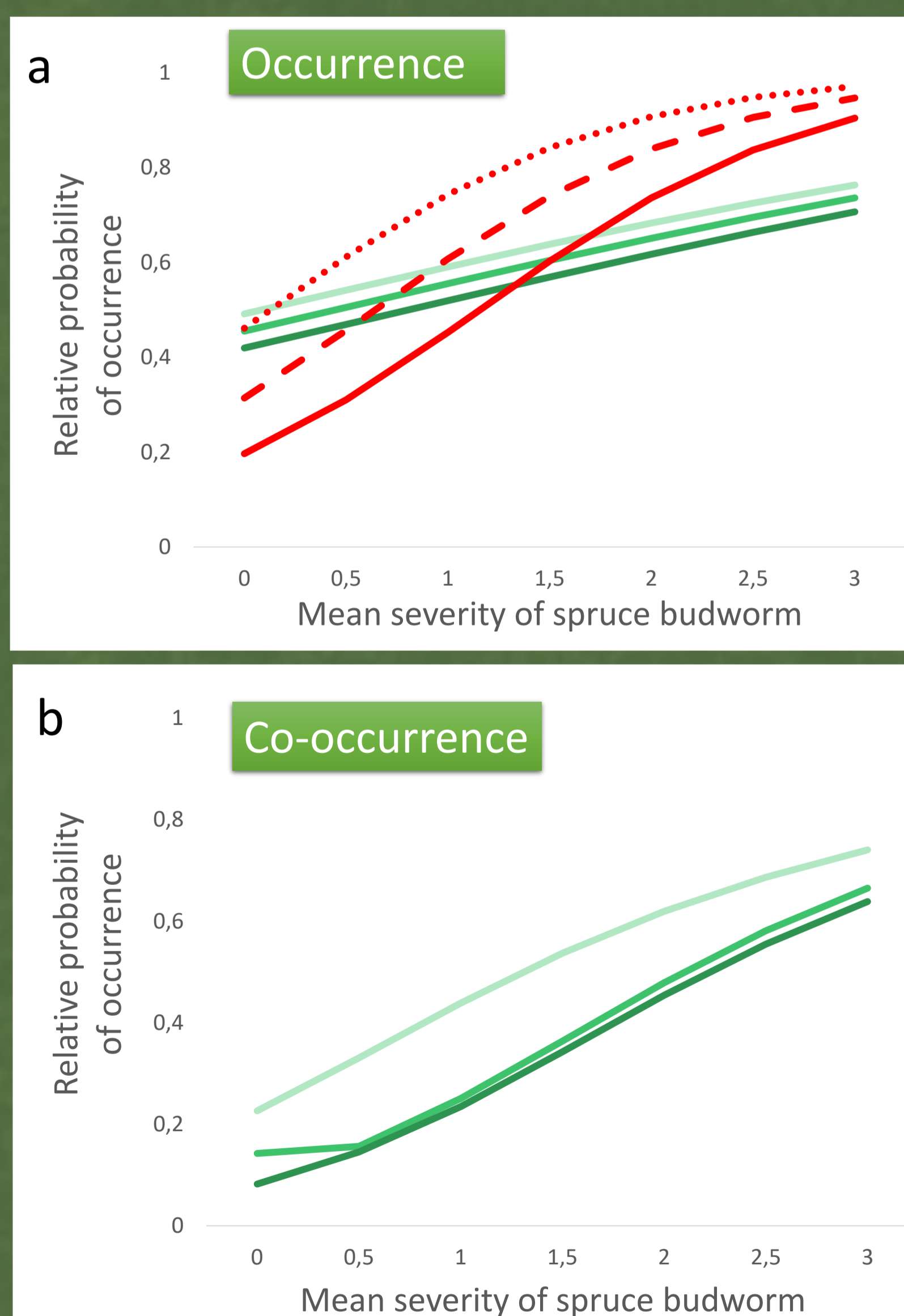


Fig. 1. a) Study area in Quebec. b) Example of annual (green) and seasonal (yellow) home-ranges for two boreal caribou, as delineated using 95% kernels. c-d) Distribution and severity of the spruce budworm outbreak in 2008 and 2017.

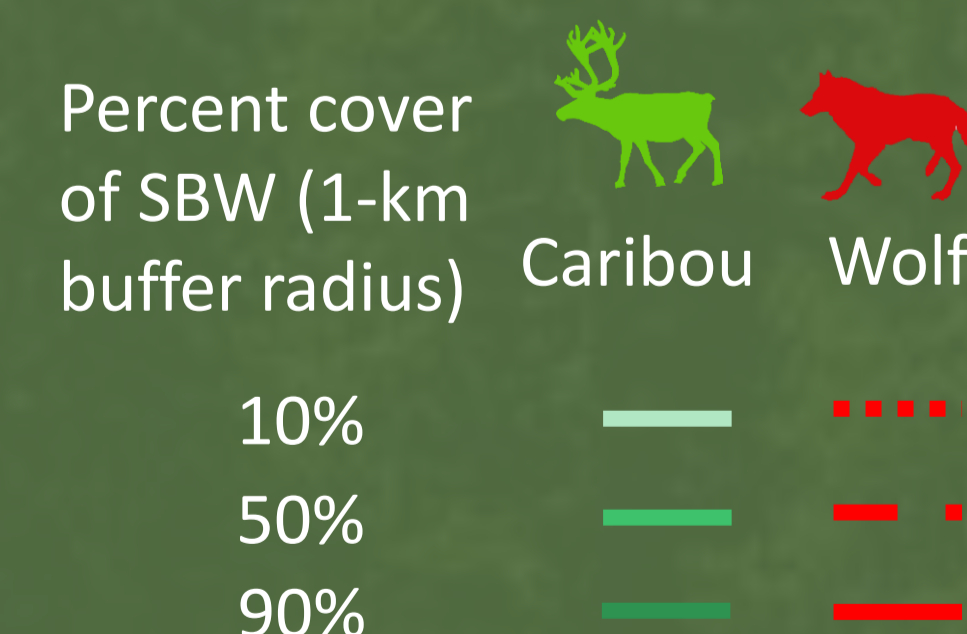
## Results : SBW outbreak impacts habitat selection



### Caribou and wolves respond to the spruce budworm outbreak in the fall

- They both had a relatively high probability of occurrence in forests infected by SBW (Fig. 2a). The probability of occurrence was the lowest for areas largely impacted by the outbreak.
- They selected sites with high mean severity of SBW (Fig. 2a)

The similarity in the response of caribou and wolves to the infestation was such that the insect increased their relative probability of co-occurrence (Fig. 2b).



## Results : SBW outbreak impacts ranging behaviour

### Caribou respond to the spruce budworm outbreak and latitude

- Caribou had larger home-ranges in the north than in the south (Fig. 3a).
- Caribou expanded their home-ranges as the SBW covered an increasing large proportion of the landscape (Fig. 3b).
- The reaction of caribou to the cover of the SBW infestation did not vary with latitude (model c received more empirical support than model d, below).

### Model selection using AIC

| ID | Model structure                   | $\Delta AIC$ |
|----|-----------------------------------|--------------|
| a  | Latitude                          | 3.50         |
| b  | Proportion of SBW                 | 27.36        |
| c  | Proportion of SBW + Latitude      | 0.00         |
| d  | Model c + Prop. of SBW x Latitude | 2.41         |

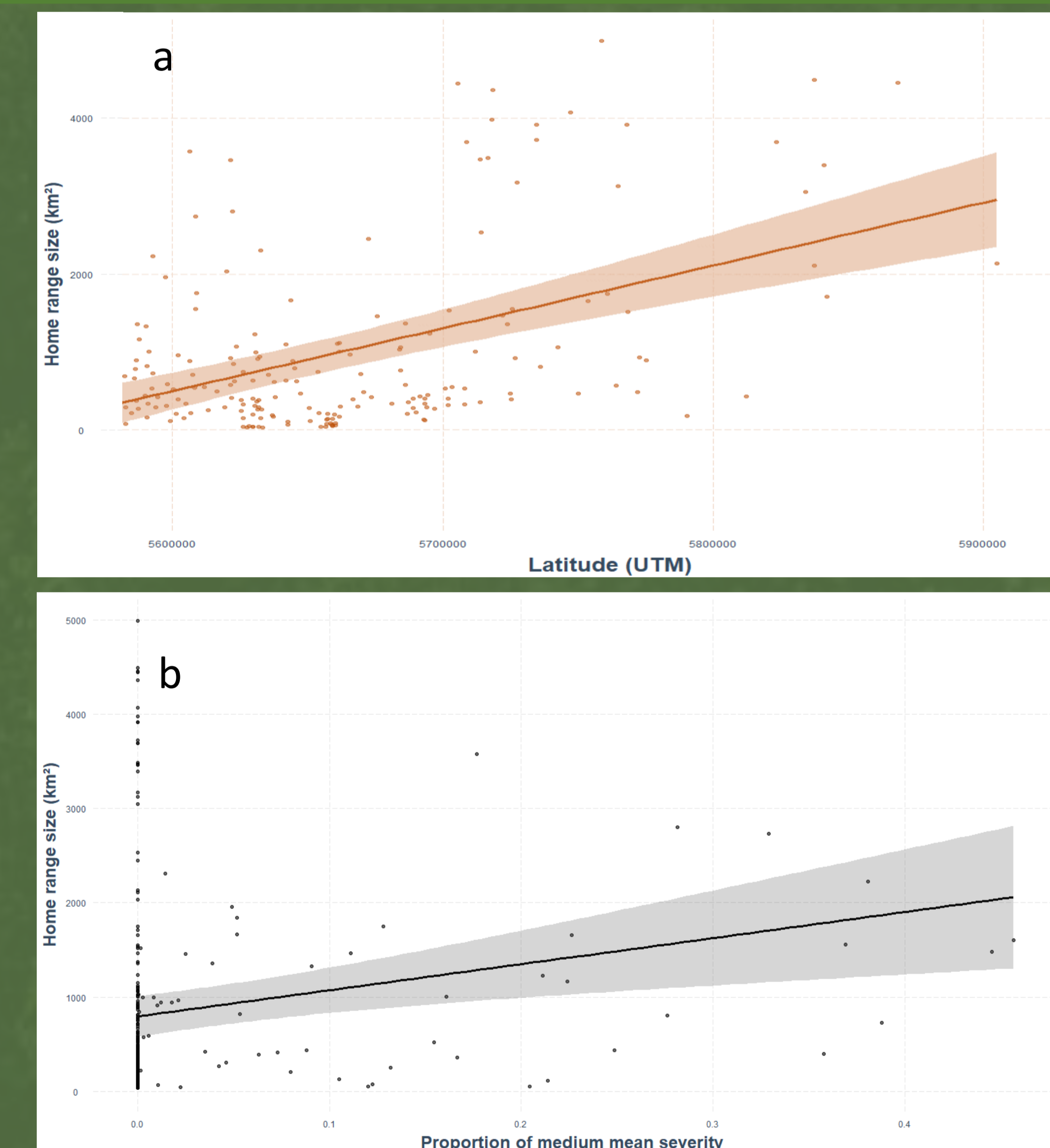


Fig. 3. Relationship between home-range size of boreal caribou and a) the latitude or b) the proportion of the home-range covered by the SBW infestation in the fall.

## Discussion

- The SBW outbreak impacted boreal caribou by influencing their selection of forest stands and the size of their home-ranges, depending on the severity and the proportion of their home-ranges impacted by the outbreak.
- The SBW outbreak increased the probability of co-occurrence between boreal caribou and gray wolves.
- As insect outbreaks become increasingly prevalent in northern boreal forest following climate change, the impact of SBW on the food web involving boreal caribou will become a factor of increasing importance for caribou conservation.

## Ongoing analyses

The next steps will be to evaluate how SBW outbreaks modify the vegetation over time. We will also evaluate the proposed boreal caribou recovery strategy in the context of global changes by assessing the cumulative impacts of forest harvesting and climate-induced changes on wildfires and spruce budworm outbreaks.