

# Understanding complex interactions in forest ecosystems: climate and insect outbreaks

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## Introduction

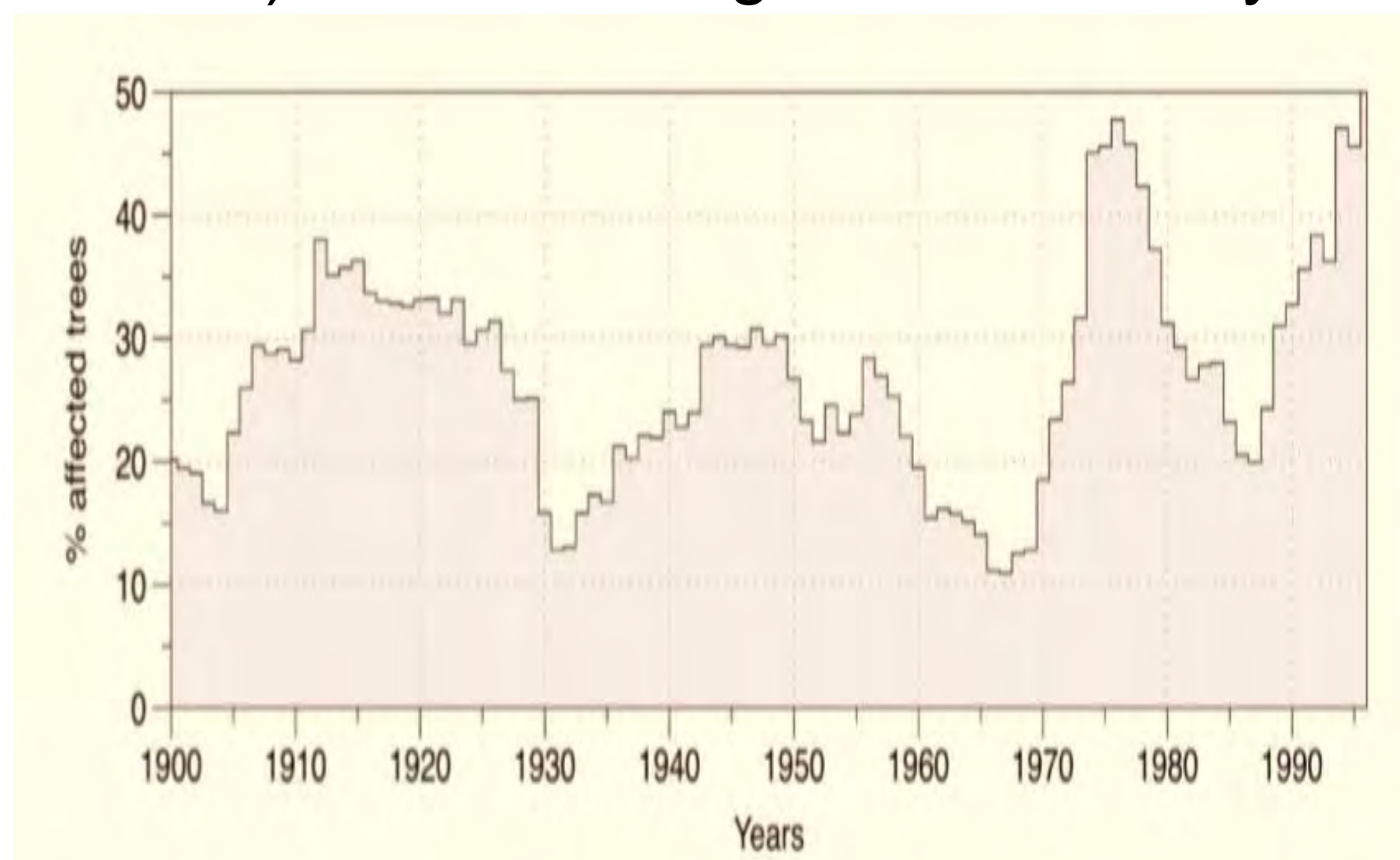
- Natural disturbances are major drivers in forest ecosystems, affecting the structure and function.
- Climate change affect the vulnerability of host species to defoliation
- Spruce budworm (SBW) (*Choristoneura fumiferana*), is the main defoliator in the Eastern Canadian forest



Photo by: Lavoie & Montoro Girona

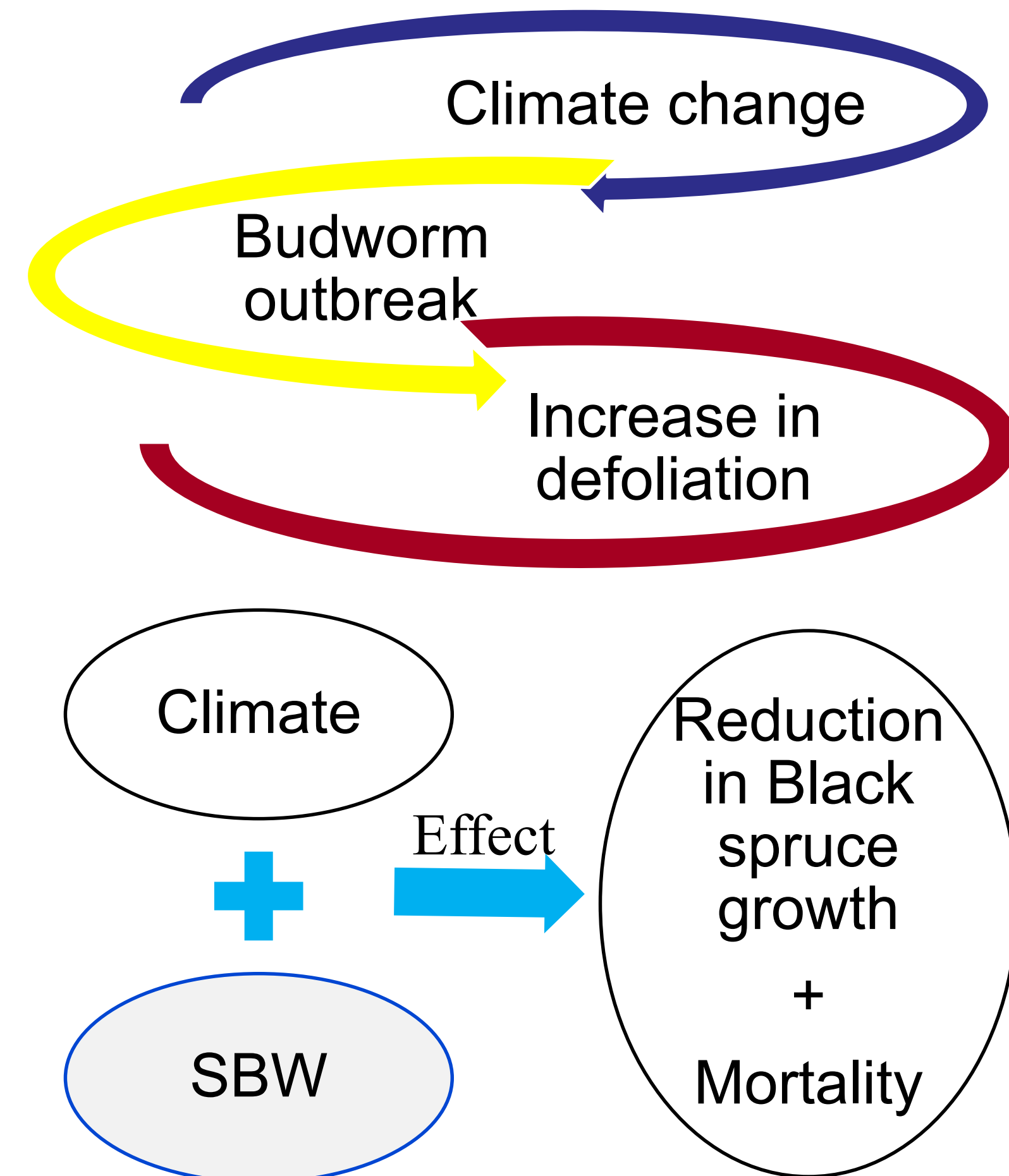
Effect of budworm attack on black spruce

- Increase in the severity (% of affected trees) of SBW during the last century



- Expansion, to the north, and increase of frequency and severity
- Changing climate scenarios

## Hypothesis



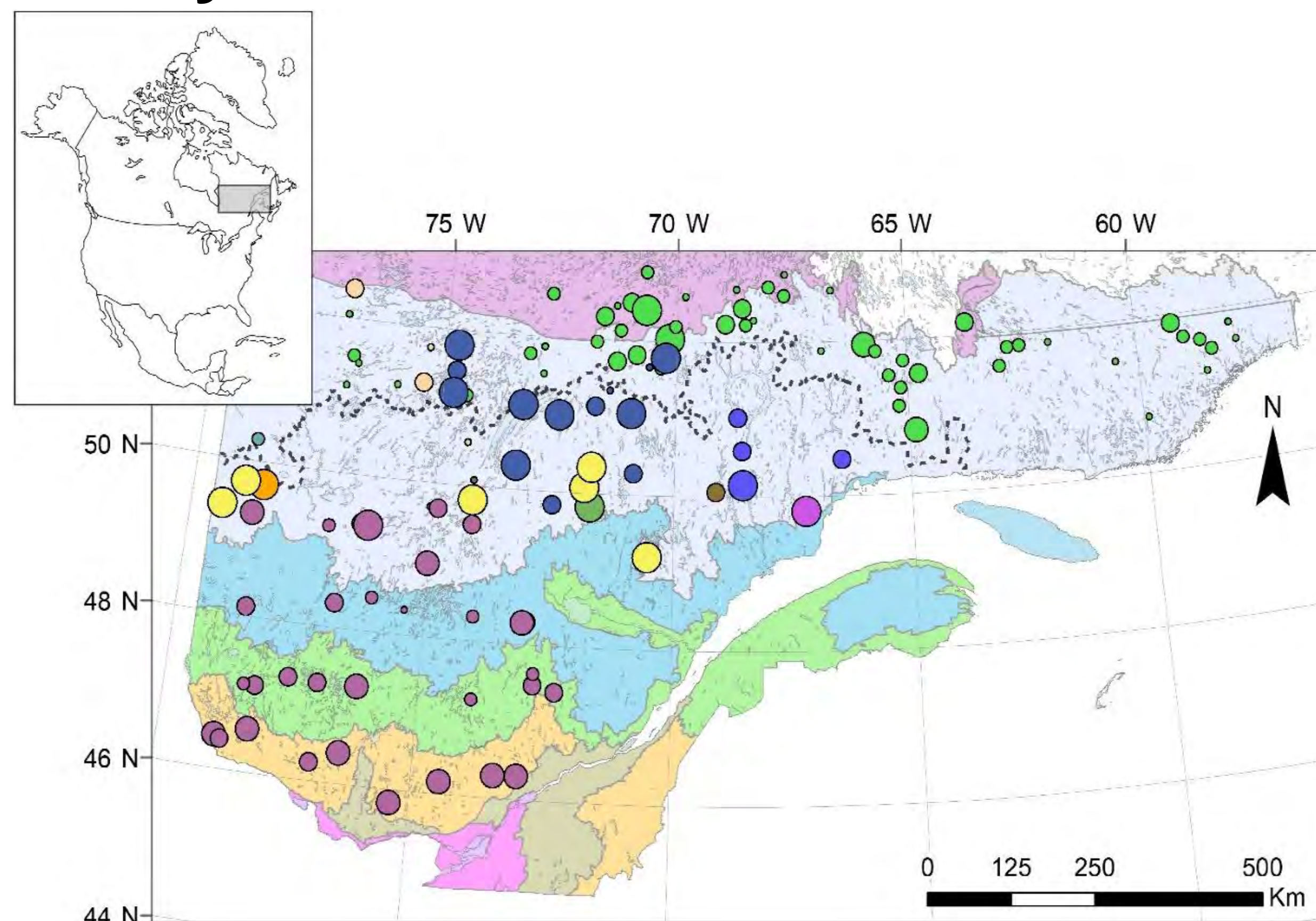
- Climate change affects the severity of black spruce epidemics due to the better synchronization of bud / budworm emergence

## Objectives

- Identify the influence of different climate scenarios on the dynamics of spread and severity of epidemics
- Evaluate the trend and the impact of climate on SBW outbreaks during the last century
- Calibrate & redo the spatiotemporal patterns

## Methods

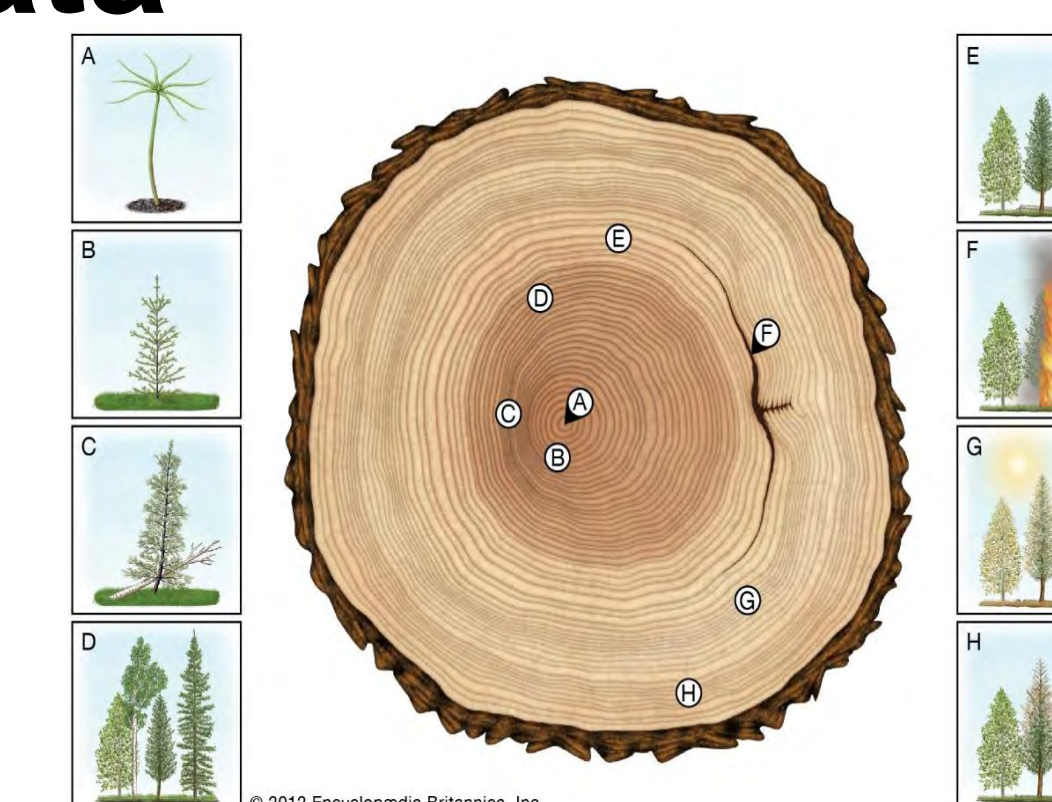
### Study area



Location of study sites in Quebec. The different colors correspond to the various original datasets

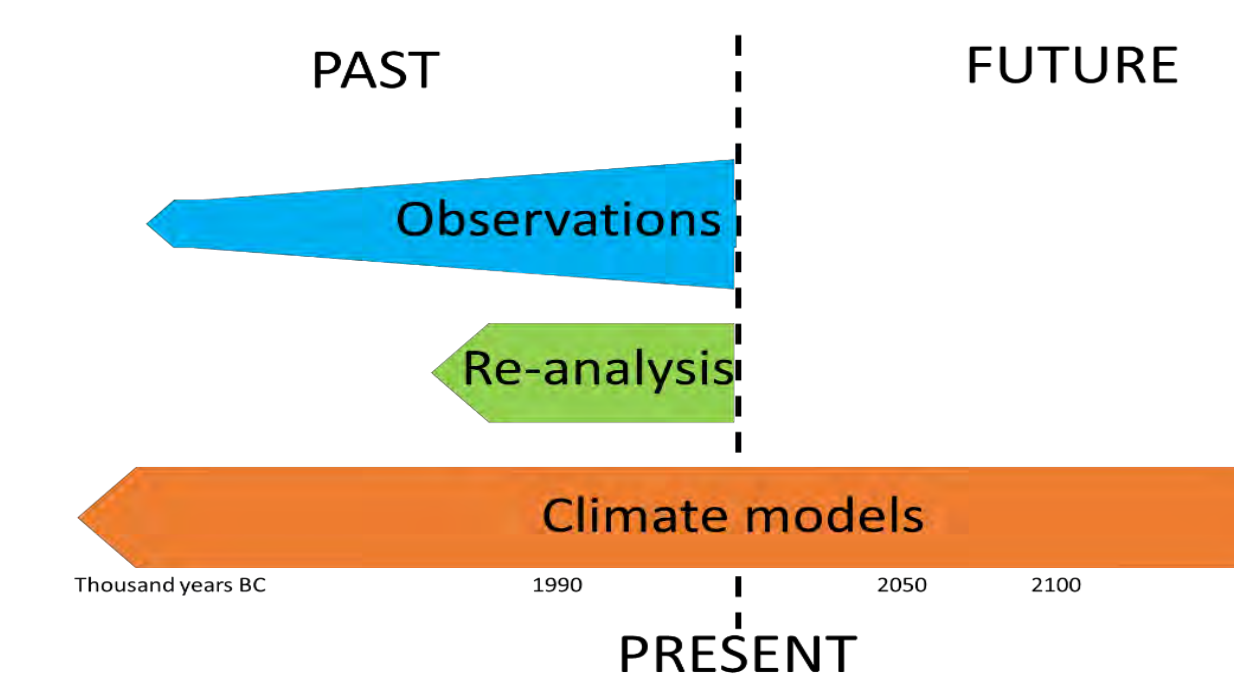
### Dendroecological data

- Dendrochronological time series data integrating more than 10 different projects from the Ministry
- Complementary field works



### Climatic data

- Climate datasets of the last century (WorldClim data)



### Modeling

- Climate normalized growth during absence/presence of SBW (presence recorded by MFFP through aerial surveys)
- Evaluate the effect of budworm outbreak of growth as a function of climate parameters
- “Compare the predicted climate effect on the reduction of growth during an epidemic”

## Contributions

- Evaluate the effect of climate during the outbreak period on the growth of the boreal stands over the years
- Extract the rate and the extent of impact of the defoliating insect, and its interaction with climate, on the boreal stands
- Help understand ecological shifts at a spatiotemporal scale
- The results of this project will help on future climate to predict a general trend in the range and severity of future outbreaks

### References

- Lavoie, J.; Montoro Girona, M.; Morin, H. Vulnerability of Conifer Regeneration to Spruce Budworm Outbreaks in the Eastern Canadian Boreal Forest. *Forests* 2019, 10, 850.
- Montoro Girona, M.; Navarro, L.; Morin, H. A Secret Hidden in the Sediments: Lepidoptera Scales. *Front. Ecol. Evol.* 2018, 6, 1-5.
- Navarro, L.; Morin, H.; Bergeron, Y.; Girona, M.M. Changes in spatiotemporal patterns of 20th century spruce budworm outbreaks in eastern Canadian boreal forests. *Plant Sci.* 2018, 9, 1905-1920.