

# How big is the footprint? Quantifying offsite effects of mines on boreal plant communities

Xiangbo Yin<sup>1</sup> (yinx01@uqat.ca), Rémi Boisvert<sup>1</sup>, Christine Martineau<sup>2</sup> and Nicole Fenton<sup>1</sup>

<sup>1</sup>Université du Québec en Abitibi-Témiscamingue (UQAT), Rouyn-Noranda, QC, Canada.

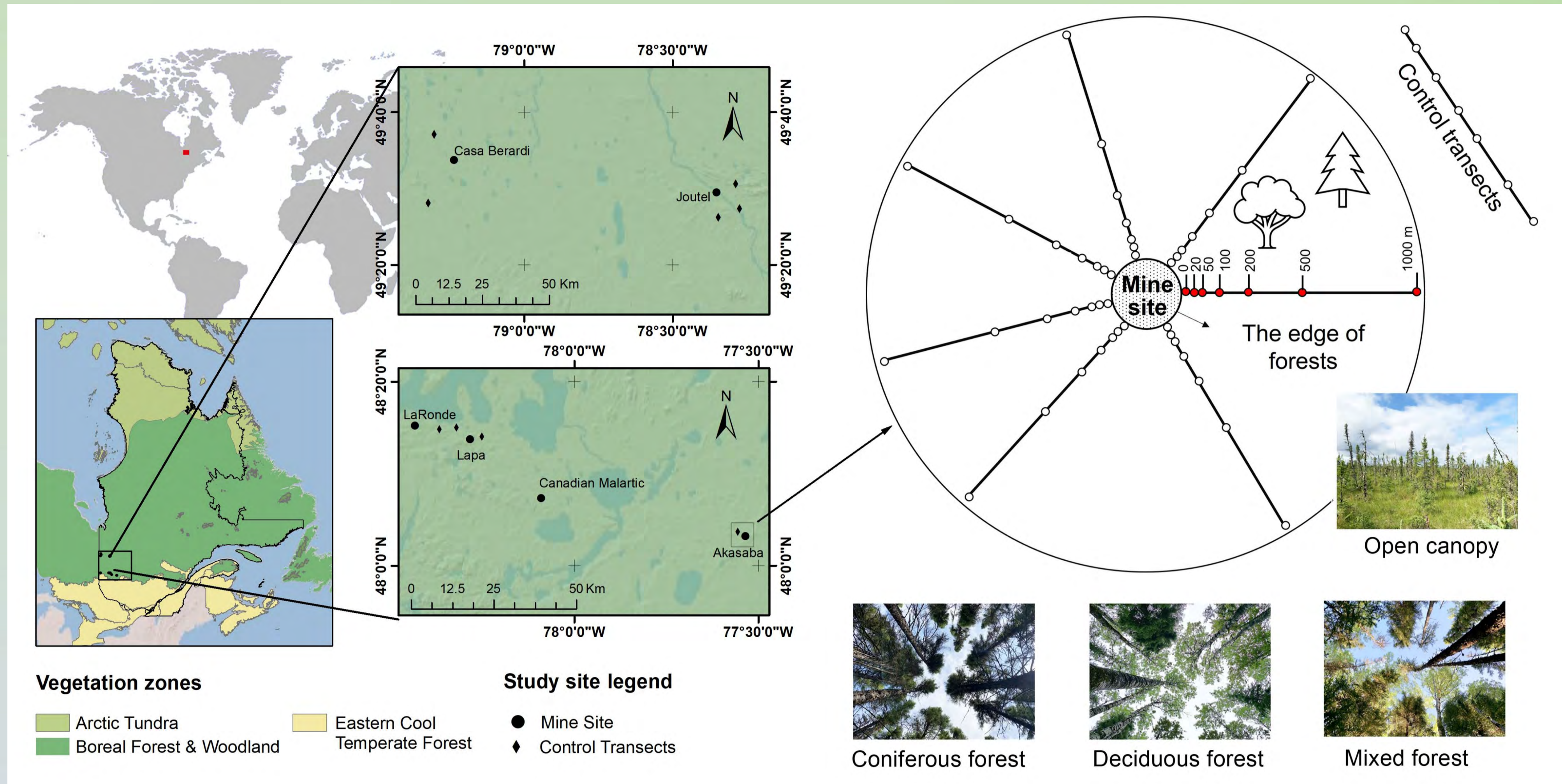
<sup>2</sup>Laurentian Forestry Centre, Québec City, Québec, Canada.



## Introduction

The continuous supply of minerals and metals from mining facilitates social and economic development in the world. However, it is also one of the main anthropogenic disturbances on biodiversity and ecological services, especially in boreal forests. Little is known about offsite effects of mines on surrounding plants. To address this research gap, six gold mines from different stages of mining lifecycle were selected in Québec boreal forest.

## Methods



## Results

### 1 Offsite effects of mines affected plant composition

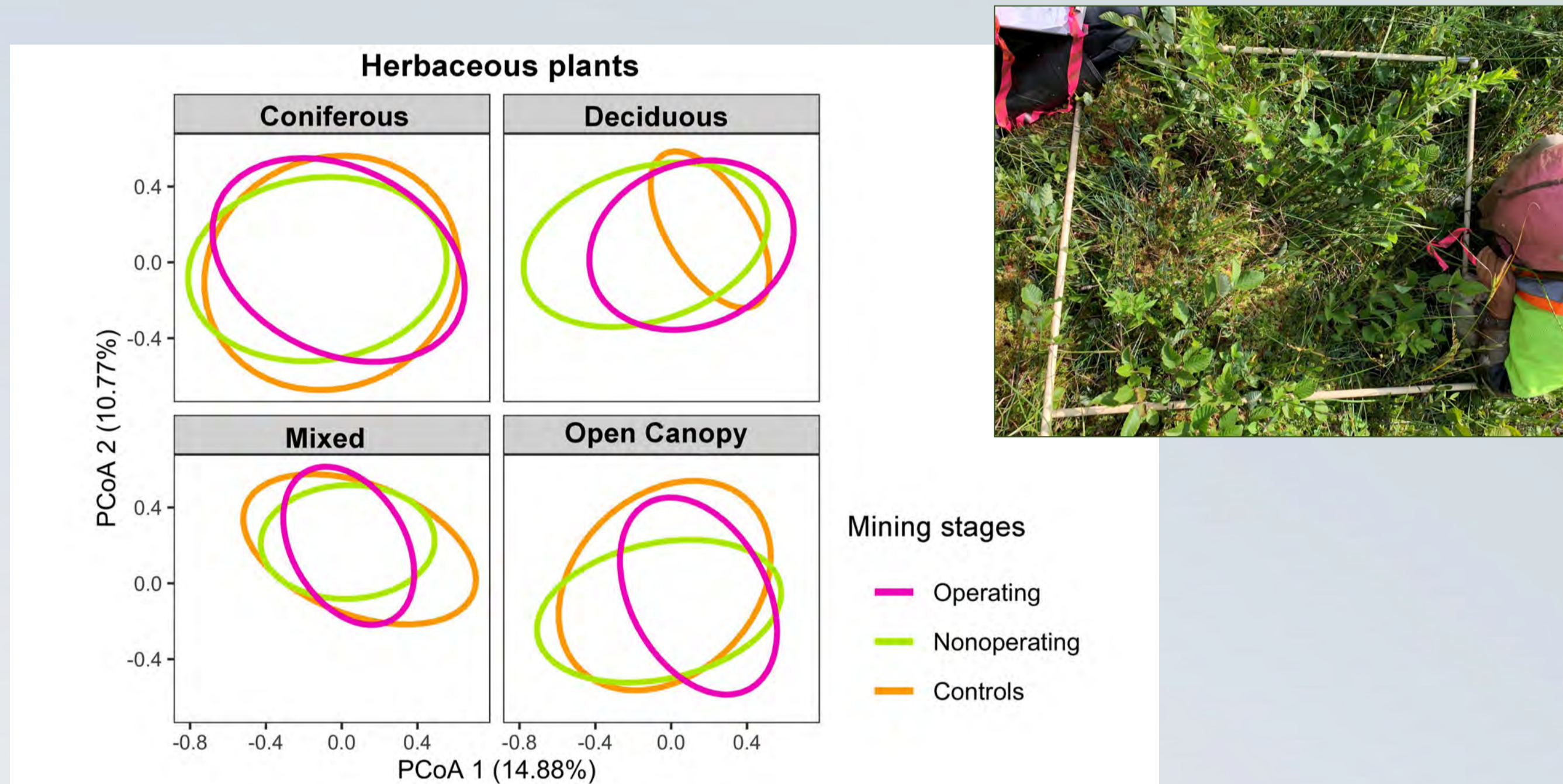


Fig.1 Ordination diagrams and PERMANOVA results of effects of forest types and mining stages on understory composition near mine sites at community levels. Principal co-ordinates analysis (PCoA) for woody (A) and herbaceous plants (B) using Bray-Curtis distance.

### 2 Influenced distance by mines at community level

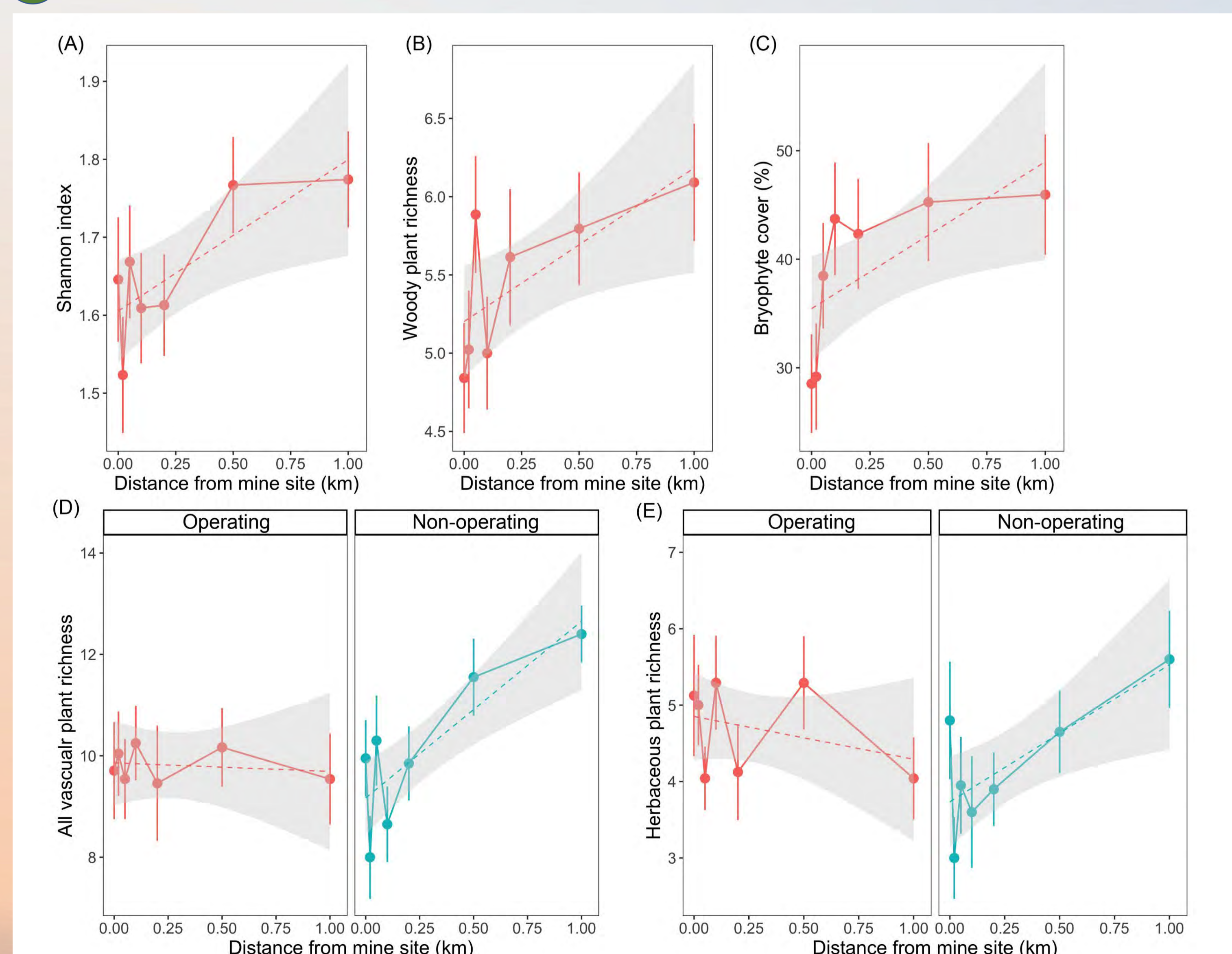


Fig.2 Effects of distance from mine sites on understory diversity. Only significant effects based on the results of (generalized) linear mixed models are shown; points represent the mean for all samples; bars represent SE. We assessed the Shannon and Simpson indices for all vascular species, richness and cover of all vascular, woody, herbaceous plants and the cover of lichen and bryophytes.

## Acknowledgements

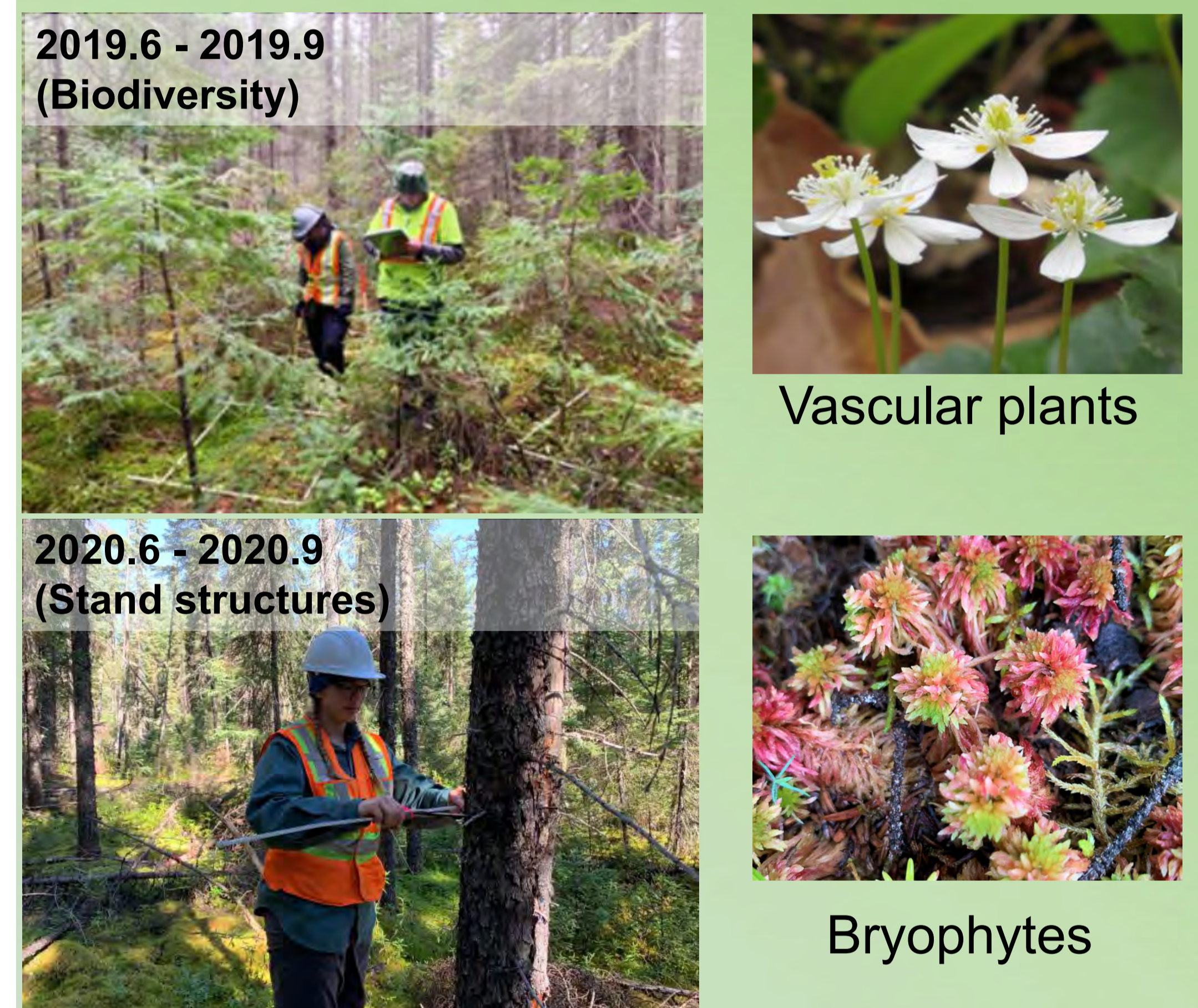
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## Objectives:

- 1) Determine offsite effects of mines on plant diversity in boreal forest;
- 2) Evaluate the roles of forest types and mining stages in determining the offsite effects;
- 3) Evaluate which vegetation groups could be used as reliable indicators to monitor the offsite effects of mines in boreal forest.

## Fieldwork:



### 3 Influenced distance by mines at species level

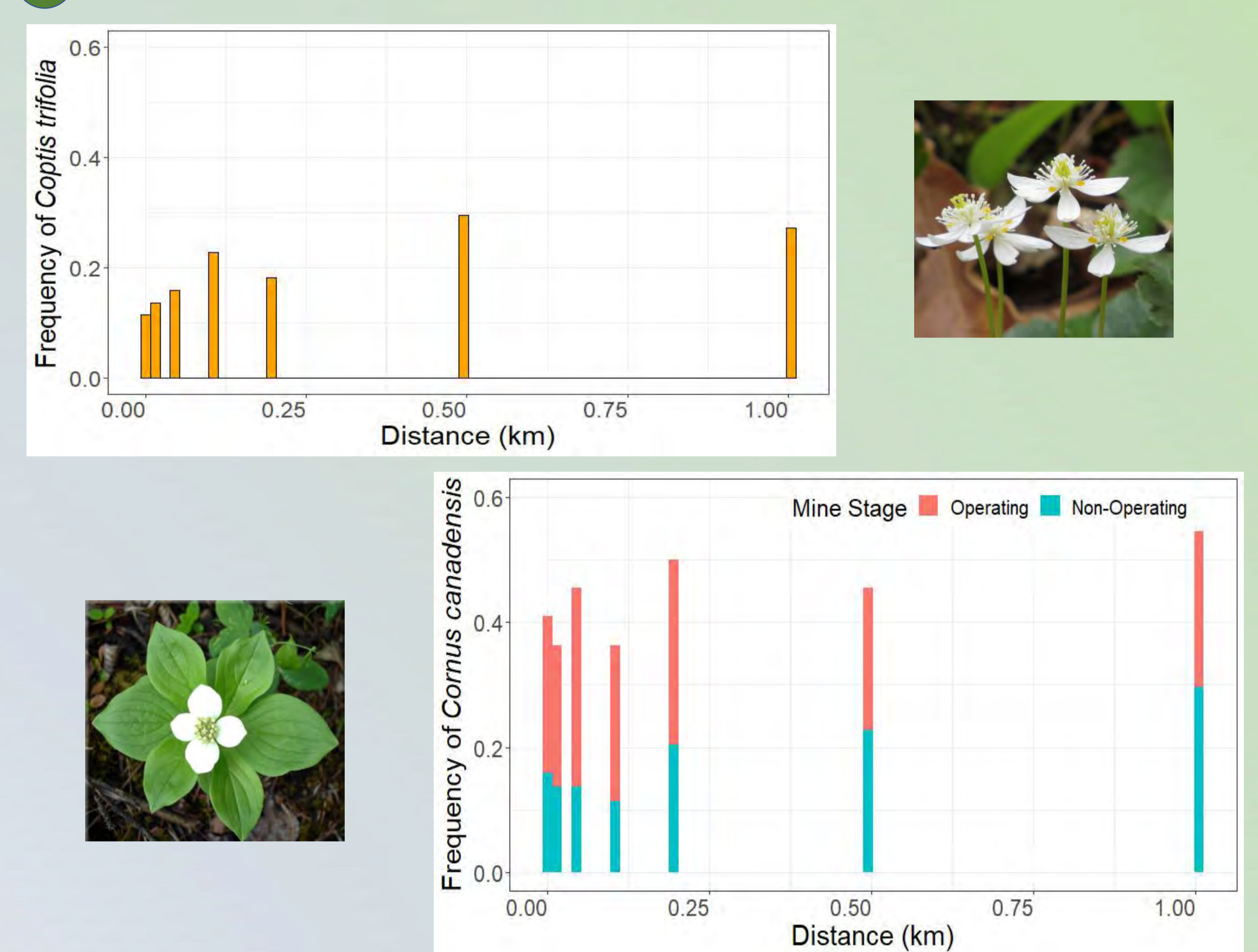


Fig.3 Effects of distance from mine sites on understory species. Only significant effects based on the results of linear mixed models are shown. We assessed the frequency and the abundance of five common boreal understory species (*Coptis trifolia*, *Cornus canadensis*, *Linnaea borealis*, *Lysimachia borealis*, and *Maianthemum canadense*).

## Conclusions

1. Our study confirmed the presence of offsite effects of mine sites on plant communities.
2. Forest types, mining stages and their interaction were important drivers of the offsite effects.
3. Bryophyte cover was a sensitive indicator of the offsite effects, based on this indicator, footprint was established at approximately 0.1 km away from mine sites

**Implication:** Given the high stability of conifers in maintaining plant composition, a buffer zone with conifer plantation near operating mine sites is proposed to offset potential adverse offsite effects on understory diversity in boreal forests.

## Publications:

Boisvert, Rémi; Yin, Xiangbo; Fenton, Nicole. Offsite effects of mining on the frequency and abundance of five herbaceous species in western Québec (Canada). *Botany*, 99 (7): 449-455.

Yin, Xiangbo; Christine Martineau; Fenton, Nicole\*. How big is the footprint? Quantifying offsite effects of mines on boreal plant communities. *Journal of applied ecology* (submitted).