Biological soil crusts in Québec's boreal forest to improve restoration outcomes

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1 BACKGROUND

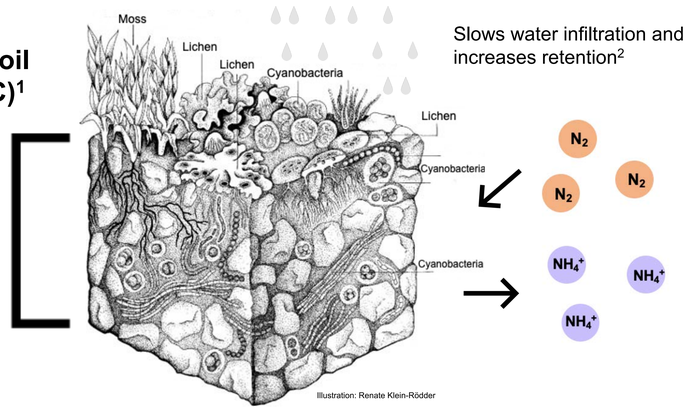
Unrestored mine tailings

Conventionally rehabilitated mine tailings

How can we get there?
…
Imitation of natural successional processes as a part of restoration to reach the reference ecosystem?

Reference ecosystem

Biological Soil Crusts (BSC)[1]



Soil stabilization[3]

Slows water infiltration and increases retention[2]

2 RESEARCH QUESTIONS

a What species of **lichen** and **bryophytes** are establishing as part of the biological soil crust on abandoned borrow pits?

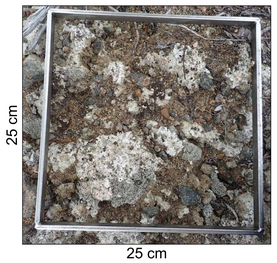
b What **abiotic variables** are governing the distribution of these biological soil crust communities?

c What **bacterial communities** associated with biological soil crusts are establishing on an abandoned mine tailings? Do these bacterial communities have **nitrogen fixing** capabilities?

3 METHODS

a b Characterization of BSC on abandoned borrow pits

- Study areas: Parc national des Grands-Jardins and along La Route du Nord
- Percent cover of BSC organisms in twenty quadrats per 100 m^2 plot
- Abiotic variables: slope and aspect, presence of frost heaving, elevation, and surrounding forest type; collected composite soil samples



c Characterization of soil bacteria associated with BSC on an abandoned mine tailings

- Study areas: Preissac Mine Sites

Site	BSC community type	No. of 1m² plots	Soil samples per type
Preissac Mine Site B (Unrestored)	Bare soil	5	25
	Cyanobacteria-dominated	5	25
	Bryophyte-dominated	5	25
	Lichen-dominated	5	25
Preissac Mine Site A (Rehabilitated in 1992)	Conventionally rehabilitated	5	25

In the lab

Identification of lichen and bryophyte species using microscopy, chemical spot tests, and thin layer chromatography

Physicochemical soil analyses

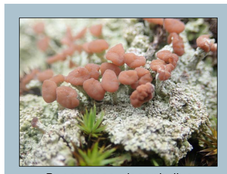
16S rDNA gene sequencing to characterize bacterial species composition and diversity

nifH gene sequencing to assess the presence of diazotrophic bacterial species

4 PRELIMINARY RESULTS

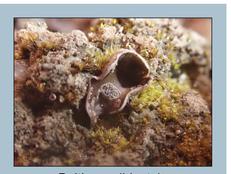
- Over 37 lichen species and 11 bryophyte species present across borrow pits
- Species composition similar between regional sites but differs between plots
- All species part of the boreal flora and many well known as being early successional pioneer species with adaptations to withstand dry conditions

LICHEN



Baeomyces placophyllus

Stereocaulon tomentosum s. lat.



Peltigera didactyla

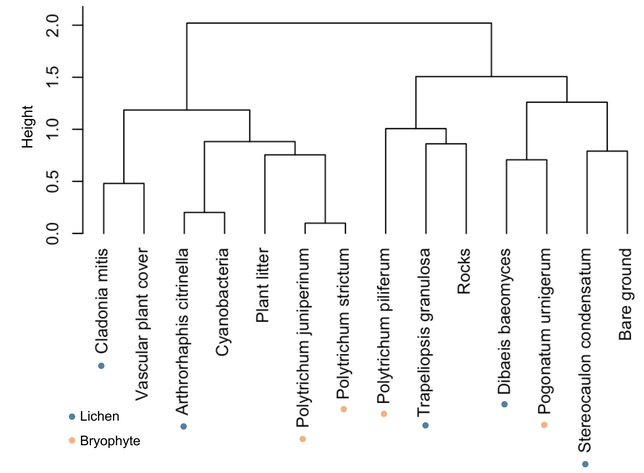
BRYOPHYTES

Polytrichum juniperinum

Racomitrium canescens subsp. *canescens*

Polytrichum piliferum

Figure 1. Cluster dendrogram of biological soil crust quadrat percent cover (common species and cover categories), using Ward's agglomeration method.



- First hierarchical division discriminates the early pioneer species, along with mineral features, from later successional biological soil crust species, the latter clustering with vascular plant cover and plant litter

5 SIGNIFICANCE

- First step in a larger project to develop a **restoration method imitating natural successional processes** for abandoned mine and borrow pit sites
- Assessment of presence of diazotrophic bacterial species will help **elucidate the functional traits** of biological soil crusts
- Allow for the **formulation of preliminary recommendations to test restoration techniques** for northern mines
- Increase knowledge on the **distribution** of terricolous **lichen and bryophyte species in Québec**
- Fill in knowledge gap on Québec's biological soil crusts

6 NEXT STEPS

a b Characterization of BSC on abandoned borrow pits

- Investigate BSC species associations
- Evaluate how much of the variation in community composition is due to physicochemical soil parameters

c Characterization of soil bacteria associated with BSC on an abandoned mine tailings

- Compare community composition between BSC community types
- Assess whether BSC community type influences community composition
- Evaluate how much of the variation in community composition is due to physicochemical soil metrics

REFERENCES