Diversity of saproxylic fungi and wood decay

Hedi Kebli

Supervision : Pascal Drouin, Suzanne Brais and Gavin Kernaghan

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Ecological functions of deadwood

Key role by maintaining diversity and supporting many ecological process essential to the ecosystem functioning

- Carbon and nutrient cycling
- Regenerative substrate
- Diversity (insects, birds, mosses and fungi)

⟶ Habitat and source of energy and nutrient

Why do we study fungi on deadwood?

Fungi are major wood decomposers (lignin and cellulose)

Pholiota sp.

Bisporella citrina
(yellow fairy cup)

- Nutrient exchange
- OM recycled
- Finland : 4000-5000 saproxylic species and 40% of threatened species are saproxylics

Pionneer fungal species composition influence establishment of later fungal colonizers and decompositions rate.

Partial harvesting

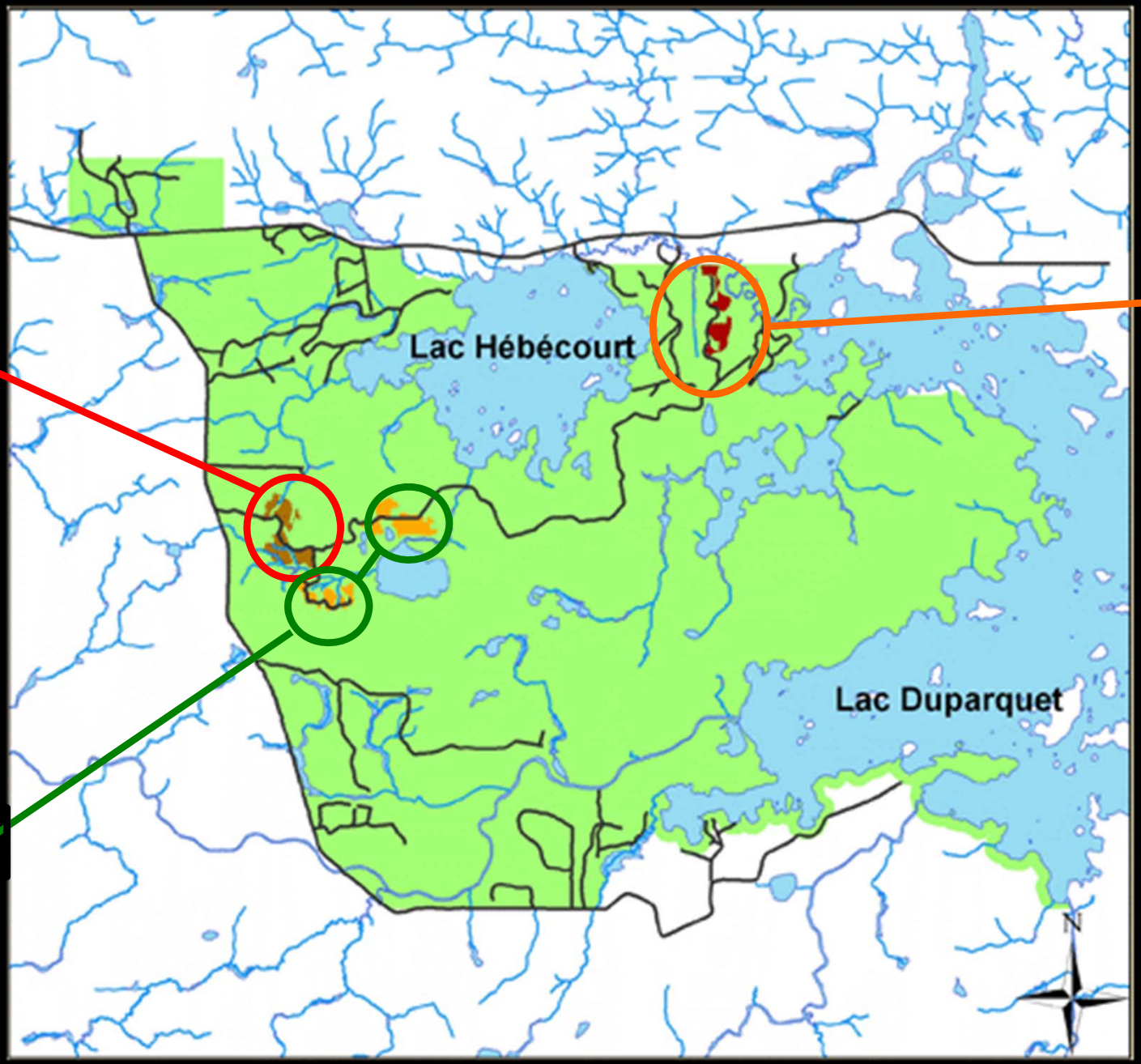
- Goals include
  - Increasing diversity in tree species and size classes
  - Growth shade-tolerant species
  - Altering rotation length
  - Maintenance of ecosystem functions
- Con
  - Reduce CWD
  - Reducing diversity of saproxylic fungi

Objective of the study

- How forest management (disturbance) impacts diversity and activity of pionneer saproxylic fungal communities in stands of different successional status and composition.

Image: Wikipedia

Study area



1760 (mixed post budworm outbreak)

1910 (mixed aspen)

1923 (aspen)

Stand	Bloc	Treatments
Aspen, 1923	Bloc 1 Bloc 2 Bloc 3	Uncut control Partical cut (1/3, 2/3) Control burn
Mixed aspen, 1910	Bloc 1 Bloc 2 Bloc 3	Uncut control Partical cut (gap harvesting, regular harvesting)
Mixed post budworm outbreak, 1760	Bloc 1 Bloc 2 Bloc 3	Uncut control

Incubation

Balsam fir(240 blocks) and
trembling aspen (240 blocks)

Collected in spring and fall for 30 months

Methodology : other variables

Respiration

Species richness

Shannon diversity

Cellulose and Lignin

Carbon and nitrogen

Wood density

Trembling aspen, paper birch, coniferous basal area

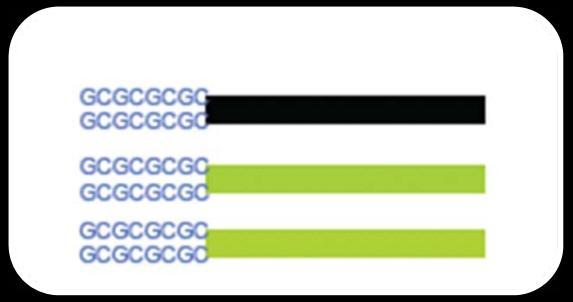
Deadwood volume

Time of incubation

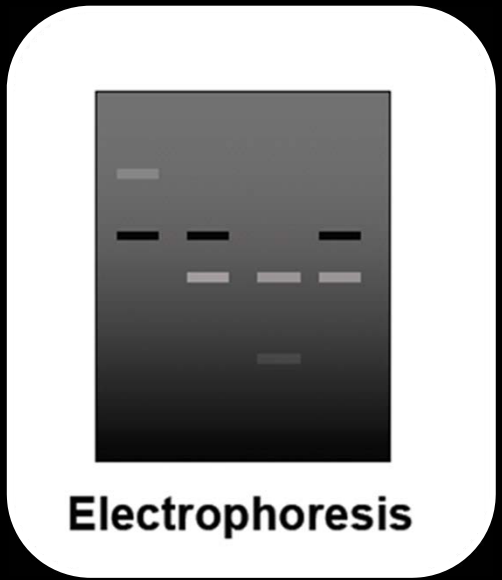
Disturbance intensity

Methodology: Molecular analyses

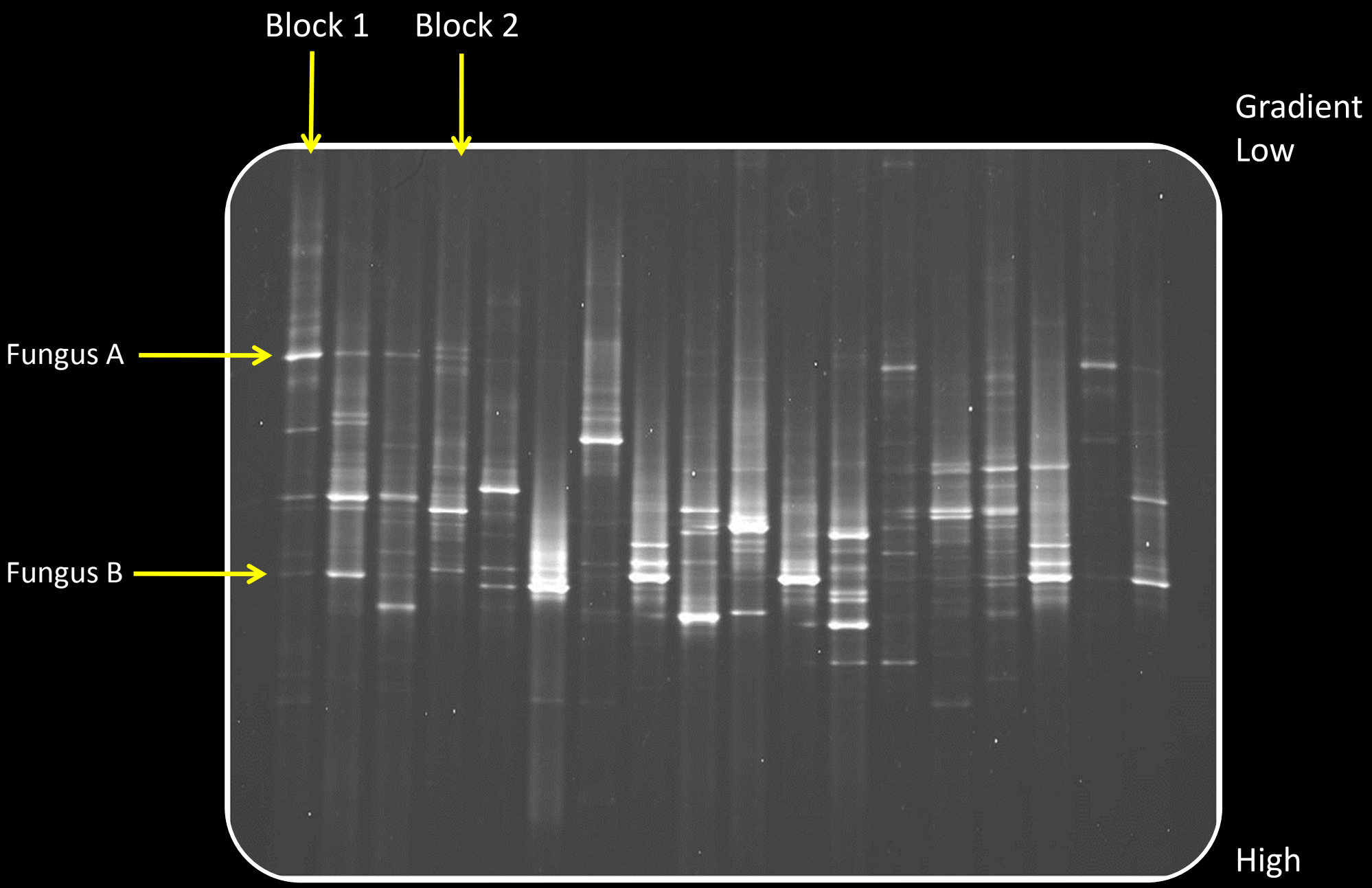
DNA extraction



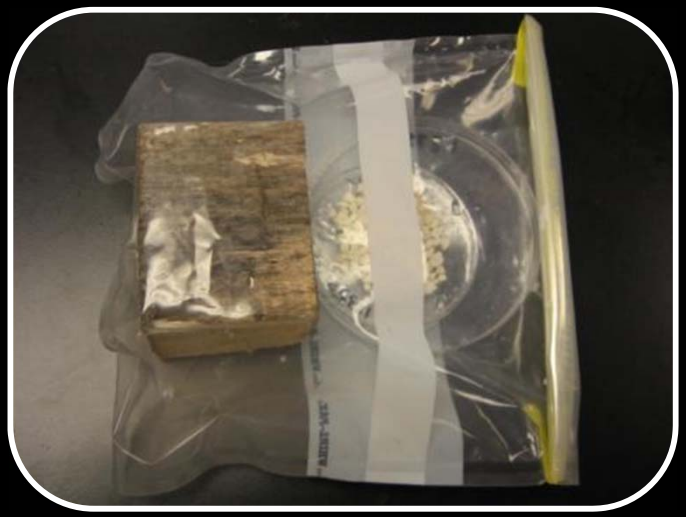
PCR amplification (Fungi)



Methodology : DGGE



Methodology: fungal activity analyses



Respiration analyses

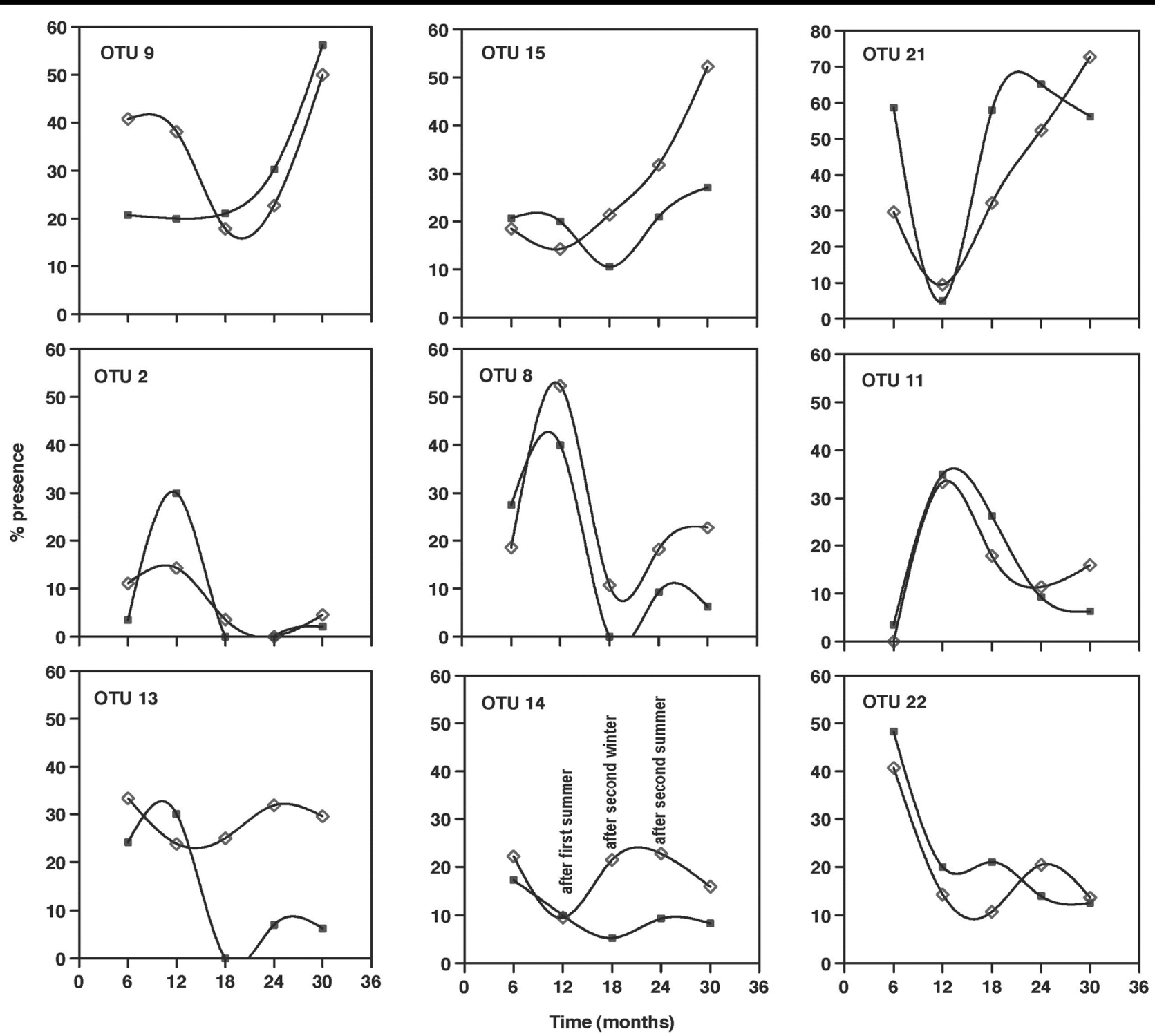
Statistical analysis

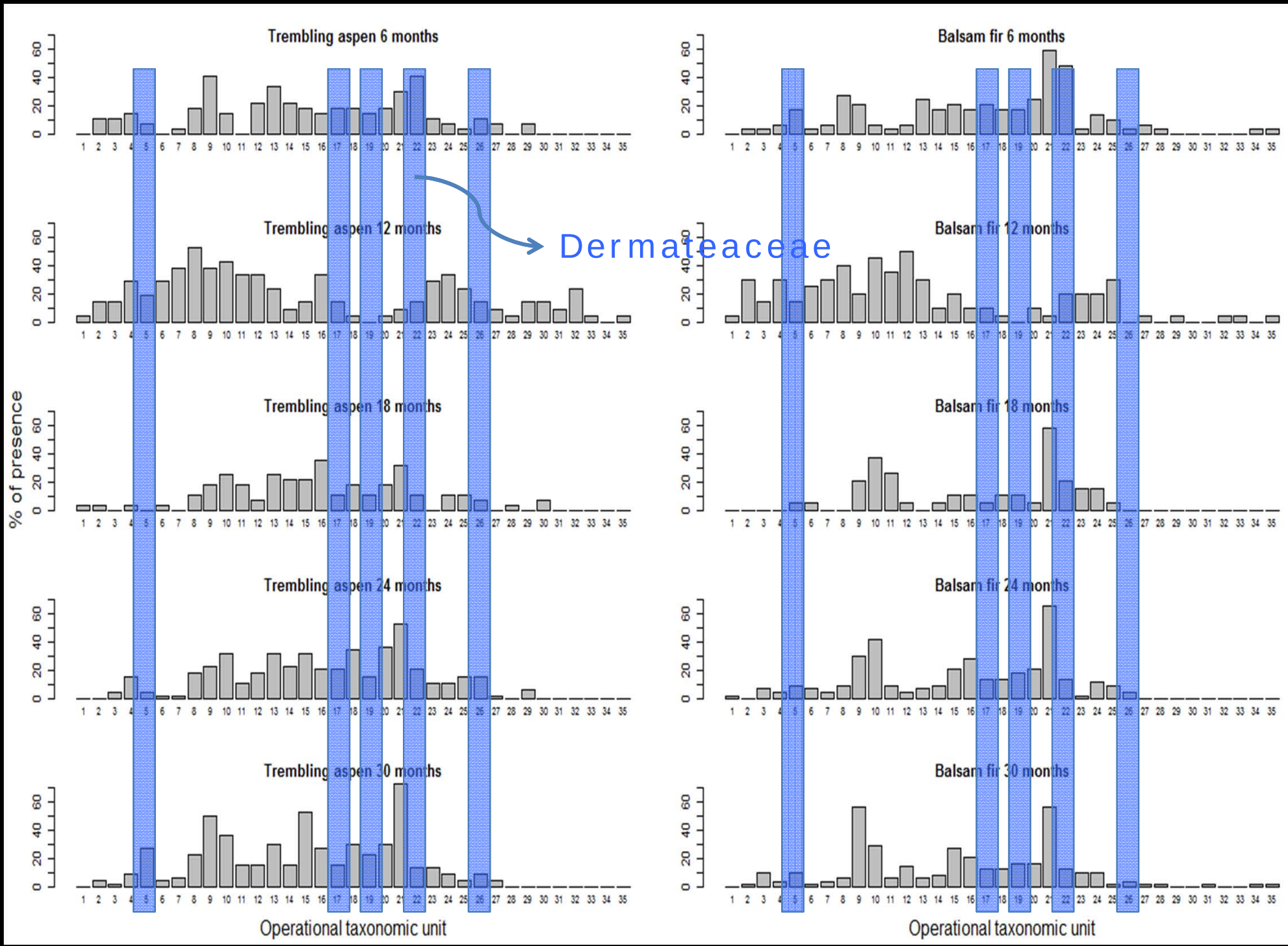
- Linear mixed-model for diversity, species richness, respiration and decomposition variables (model averaging)

- In some models, H' and *S* were used as explanatory rather than response variables.

Hypothesis

1. Harvesting intensity
2. Effect of time
3. Interaction between intensity and time
4. Stand successionnal stage
5. Total deadwood volume
6. Global model 1 (1-5)
7. Diversity
8. Global model 2 (global 1 + diversity)


OTU 9
OTU 15
OTU 21
OTU 2
OTU 8
OTU 11
OTU 13
OTU 14
OTU 22
% presence
Time (months)
after first summer
after second winter
after second summer


Trembling aspen 6 months
Trembling aspen 12 months
Trembling aspen 18 months
Trembling aspen 24 months
Trembling aspen 30 months
Balsam fir 6 months
Balsam fir 12 months
Balsam fir 18 months
Balsam fir 24 months
Balsam fir 30 months
Dermateaceae
% of presence
Operational taxonomic unit
Operational taxonomic unit

Model analysis (AIC)

Models	Diversity	Respiration	Decomposition	C/N
Harvesting intensity			Balsam	
Effect of time				
Interaction between intensity and time				Aspen
Stand successionnal stage				
Total deadwood volume				
Global model 1				
Diversity			Balsam	Balsam
Global model 2				

Results : diversity

We found a total of 35 different OTUs with a maximum of 14 OTU per block (12 months in cut stands for trembling aspen wood blocks)

Time

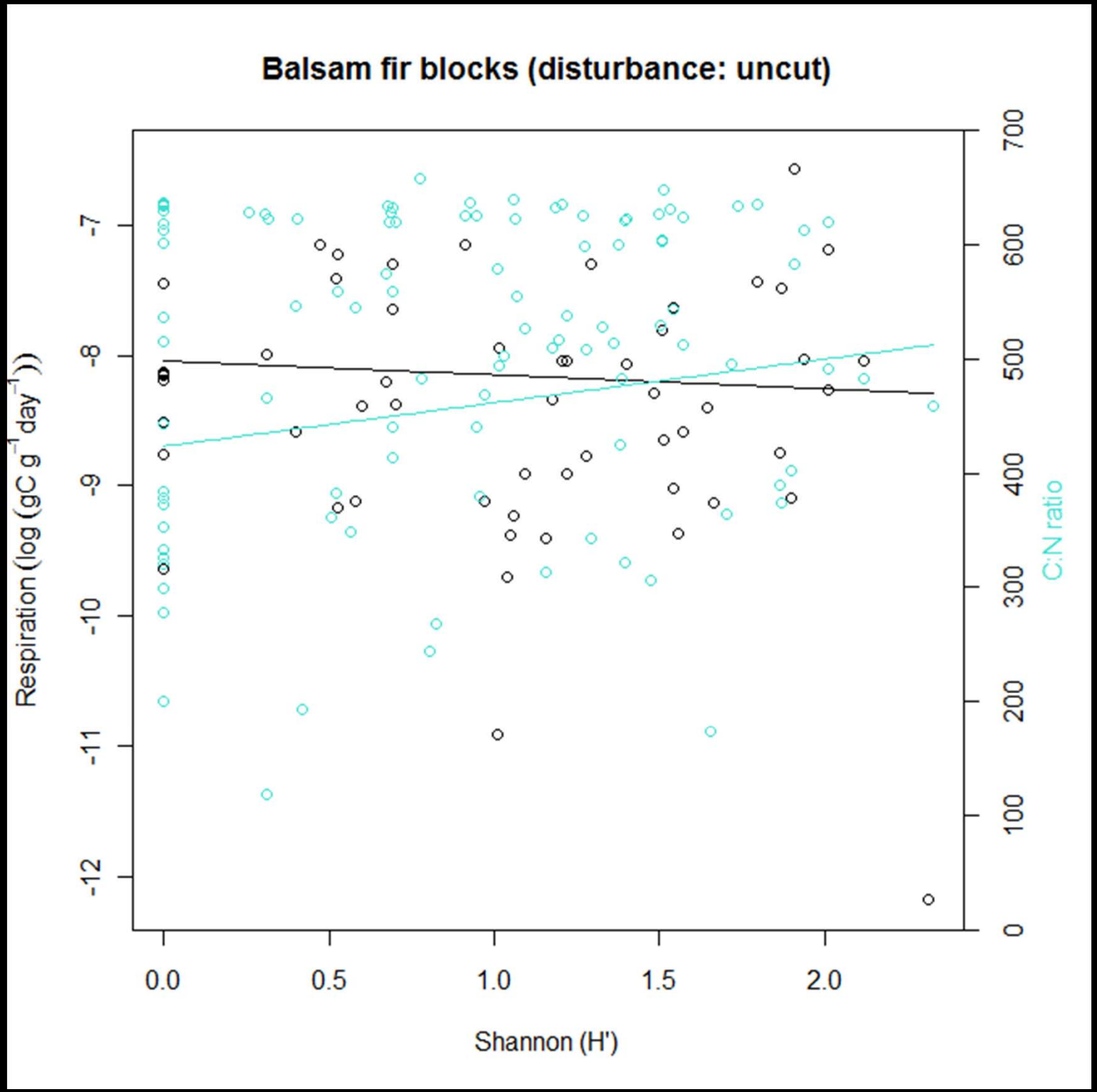
	Shannon index	Species richness
Balsam fir	2.4% / 6 months	2% / 6 months
Trembling aspen	Ø	Ø

Results : respiration

Time

Balsam fir — 2% / 6 months

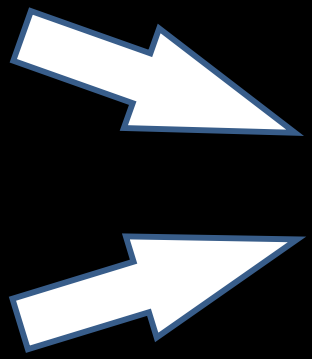
Trembling aspen — 2.5% / 6 months


Balsam fir blocks (disturbance: uncut)
Respiration (log (gC g^{-1} day^{-1}))
-7
-8
-9
-10
-11
-12
C:N ratio
700
600
500
400
300
200
100
0
0.0
0.5
1.0
1.5
2.0
Shannon (H')

Results : decomposition rate

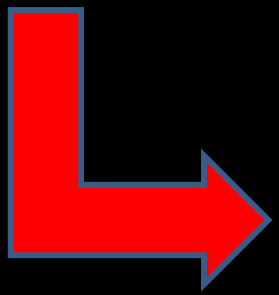
Density Ø

LCI Ø



Balsam fir

Trembling aspen

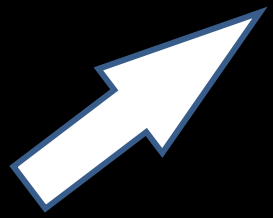


Low decomposition (aromatic compounds)

High mineralization rate

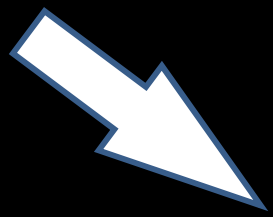
Results : effect of disturbance

Balsam fir density

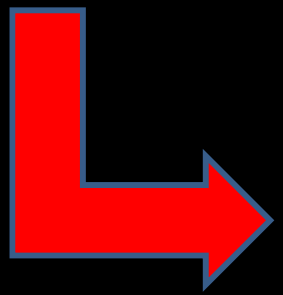


In burned vs uncut

Trembling aspen C:N ratio

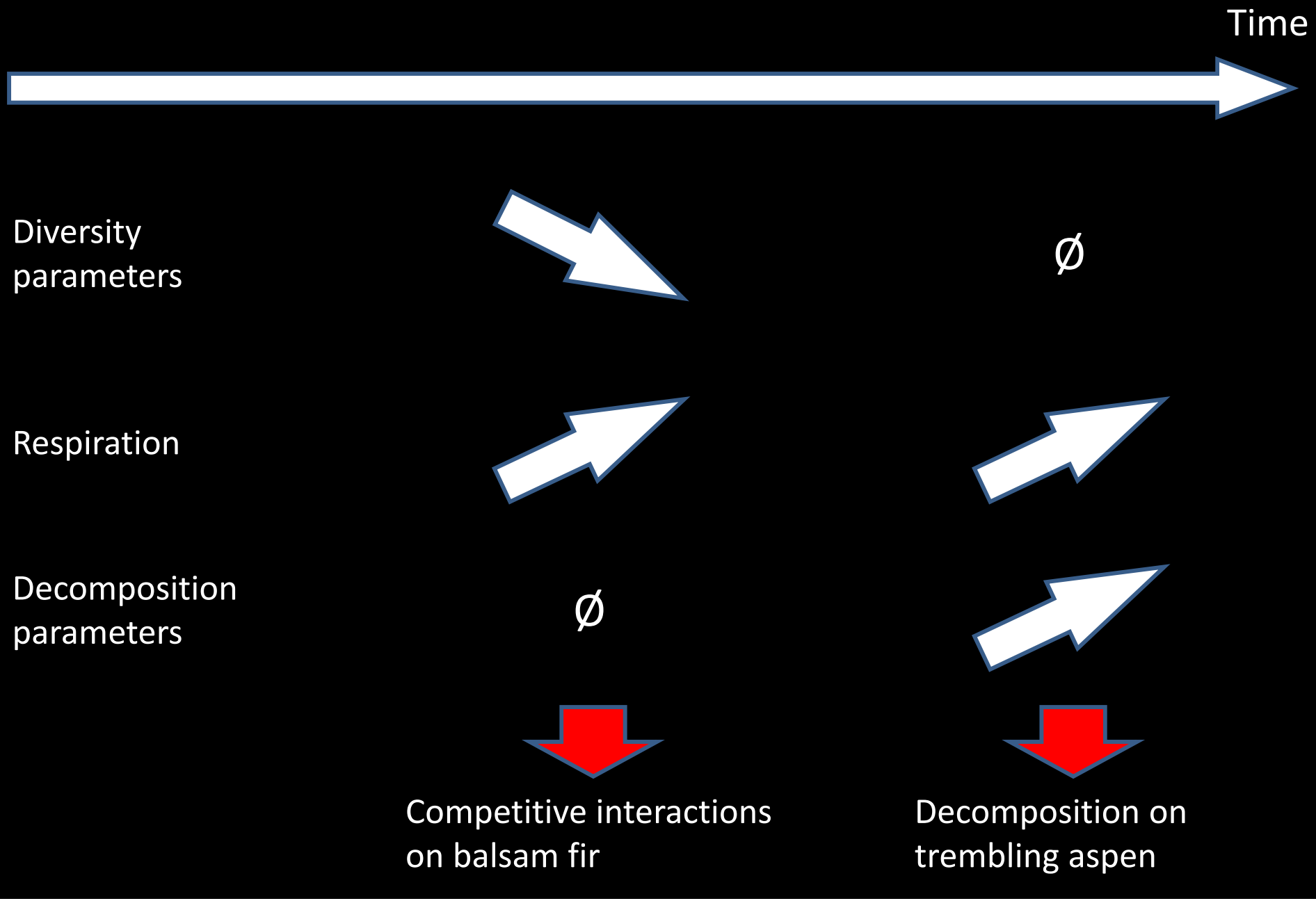


Faster in disturbed stands



Disturbance enhance decomposition of trembling aspen but slow down balsam fir decomposition.

Competition Vs Decomposition



Conclusion

- Richness and diversity of early fungal colonizers were not affected by stand disturbance or substrate quality but respiration was.
- Differences in decomposition rate between aspen and balsam fir may be linked to competition between fungal species under different conditions of resources availability.
- Respiration increased with time in both wood species but this may reflect two different processes: decreased competition in balsam fir wood and increased mineralisation in aspen wood.
- Forest dynamics in the boreal mixed woods (including highly disturbed stands) may sustain a continuous supply of deadwood from a diversity of tree species and foster pioneer generalist fungi assemblage in a position to colonize rapidly and indiscriminately fresh fallen wood.

Photo: Manuella Strukelj-Humphery

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