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Deadwood diversity and their decay-class dynamics in the northwestern boreal black spruce forests of Quebec

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Context

In unmanaged boreal forests snags and deadwood are important components of stand structure

Deadwood and snags are significant for biodiversity

Many organisms are often confined to certain qualities of deadwood

Mushrooms

Lichen
(Peltigera)

Black-backed
Woodpecker

Flying squirrel

White-spotted
Sawyer

Objectives

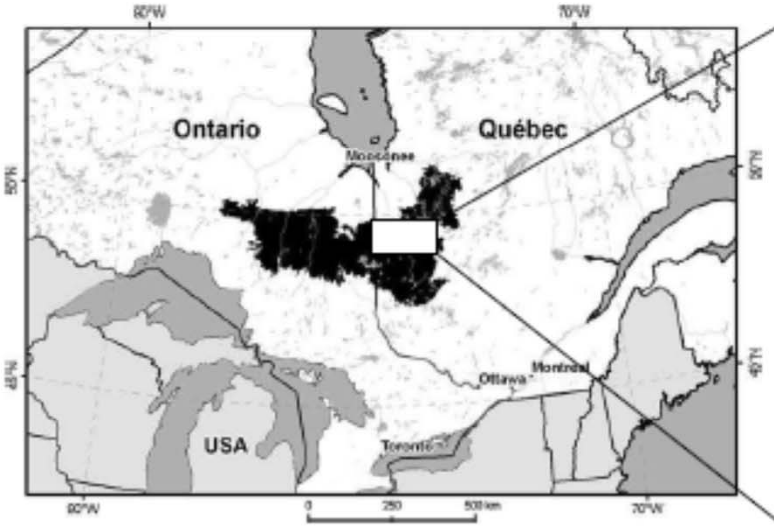
(1) Describe structural attributes of deadwood in mature, overmature and old-growth spruce stands

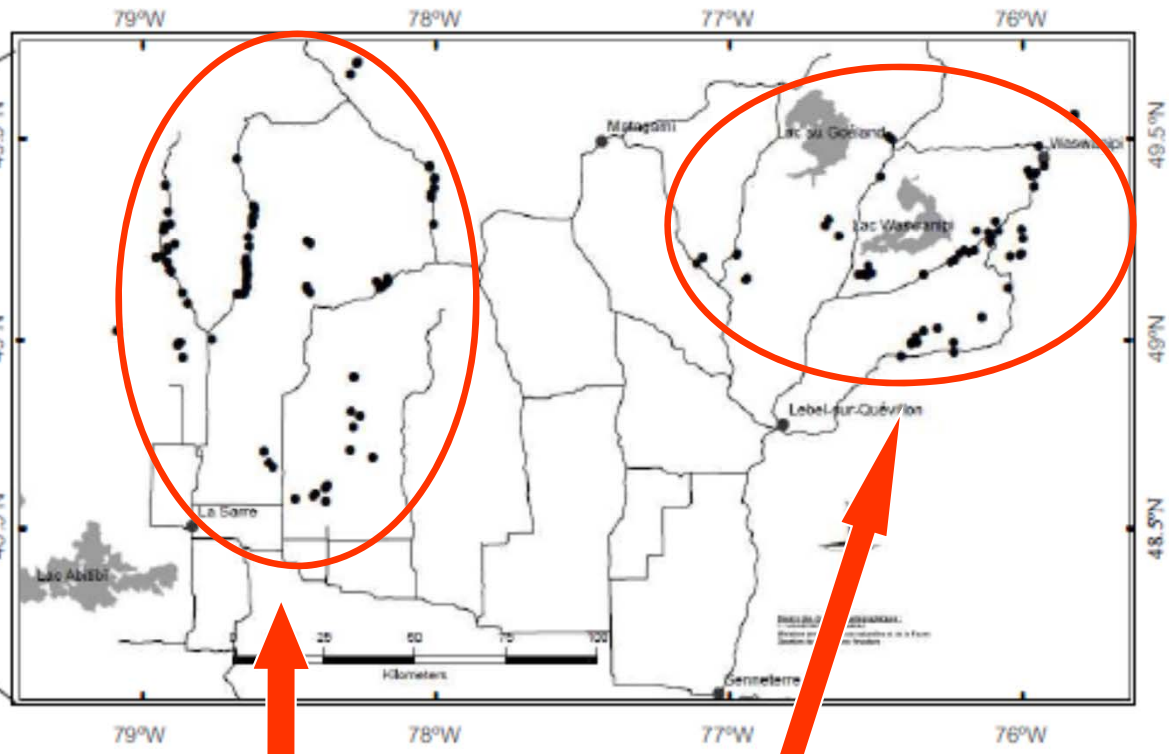
(2) Determine the influence of time since fire on the abundance of snags in mature, overmature and old-growth spruce forests

(3) Describe the variability of the diameter structure of snags and deadwood and in their degree of decomposition

Methods

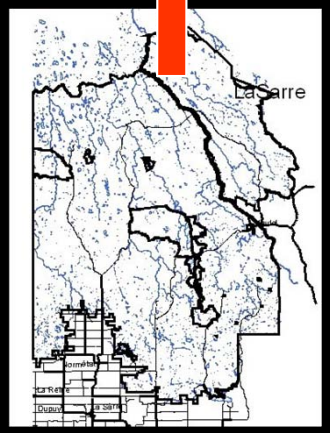
Study area





Location of the study area and the Clay Belt of eastern Canada

Two forest management units with a total area estimated around15000 km²



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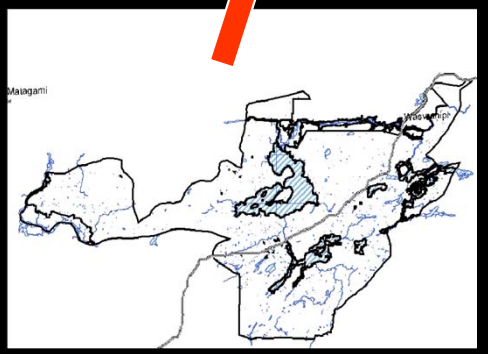

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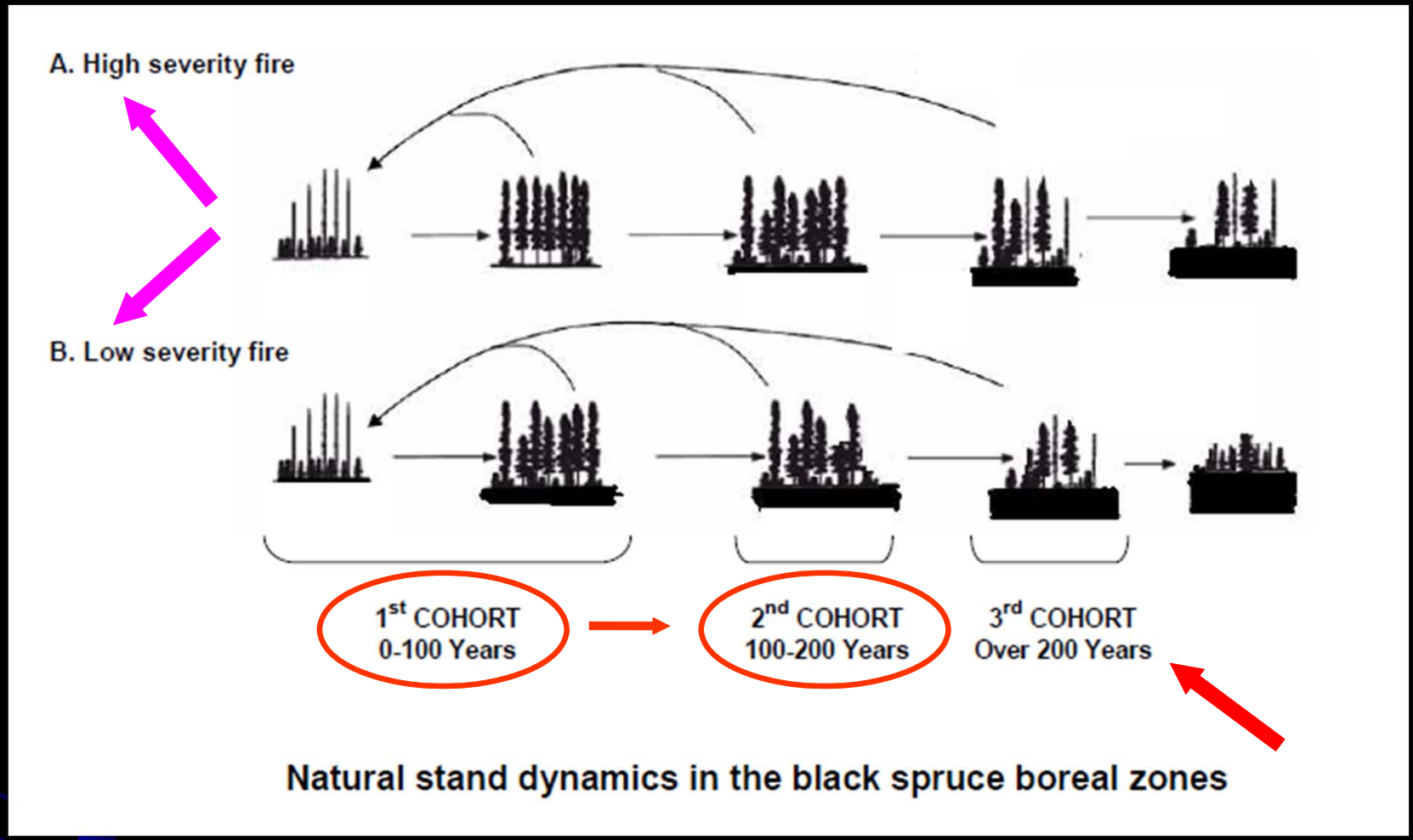


Natural stand dynamics in the black spruce boreal zones

- The first cohort begins dying off around 100 years since fire
- The third cohort includes all age classes over 200 years
- We refer to fire severity as the effects of fire on the organic matter accumulated above the mineral soil

Sampling

129 pure black spruce stands, based on maps derived from forest inventories, were sampled. The number of each type of stands is representative of their occurrences in the area.

% Crown closure (class)	61-80 (B)		41-60 (C)		D 25-40 (D)	
Height (m) (class)	12-17 (3)	7-12 (4)	12-17 (3)	7-12 (4)	12-17 (3)	7-12 (4)
Nclass	25	14	40	15	22	13
Nclass /Ntot=129	19	11	31	12	17	10
% surface area class/ total surface area	19	13	28	16	16	8

Variables

Structural attributes

- *LTBA* = Live tree basal area (m^2/ha)

- *SNAG* = SNAG abundance (SNAGS/ha)

- *CWD* = Coarse woody debris abundance (CWD/ha)

- *CWDV* = Coarse woody debris volume (CWDV/ha)

- *CANOPY* = Canopy closure classes (CANB, CANC, CAND)

- STRUCTURE = Age structure (Even, Uneven)

- HEIGHT = Height classes (3, 4)

Independent variables

- *COHORTS* = Age classes (Cohort1, Cohort2, Cohort3)

- *FIRE SEVERITY* = (FIS severe; FIPS low severity)

- *OM* = Organic matter thickness (0-30 cm, 30-60 cm, 60-100 cm and more)

- *SOIL TEXTURE* = Clay *vs* Organic

- *SLOPE* = Slope classes (A, B, C)

- VP = Van post classes of organic matter decomposition (VP2, VP4)

RESULTS

Redundancy Analysis allows studying the relationship between the two tables of variables (*Structural attributes and independent variables)*

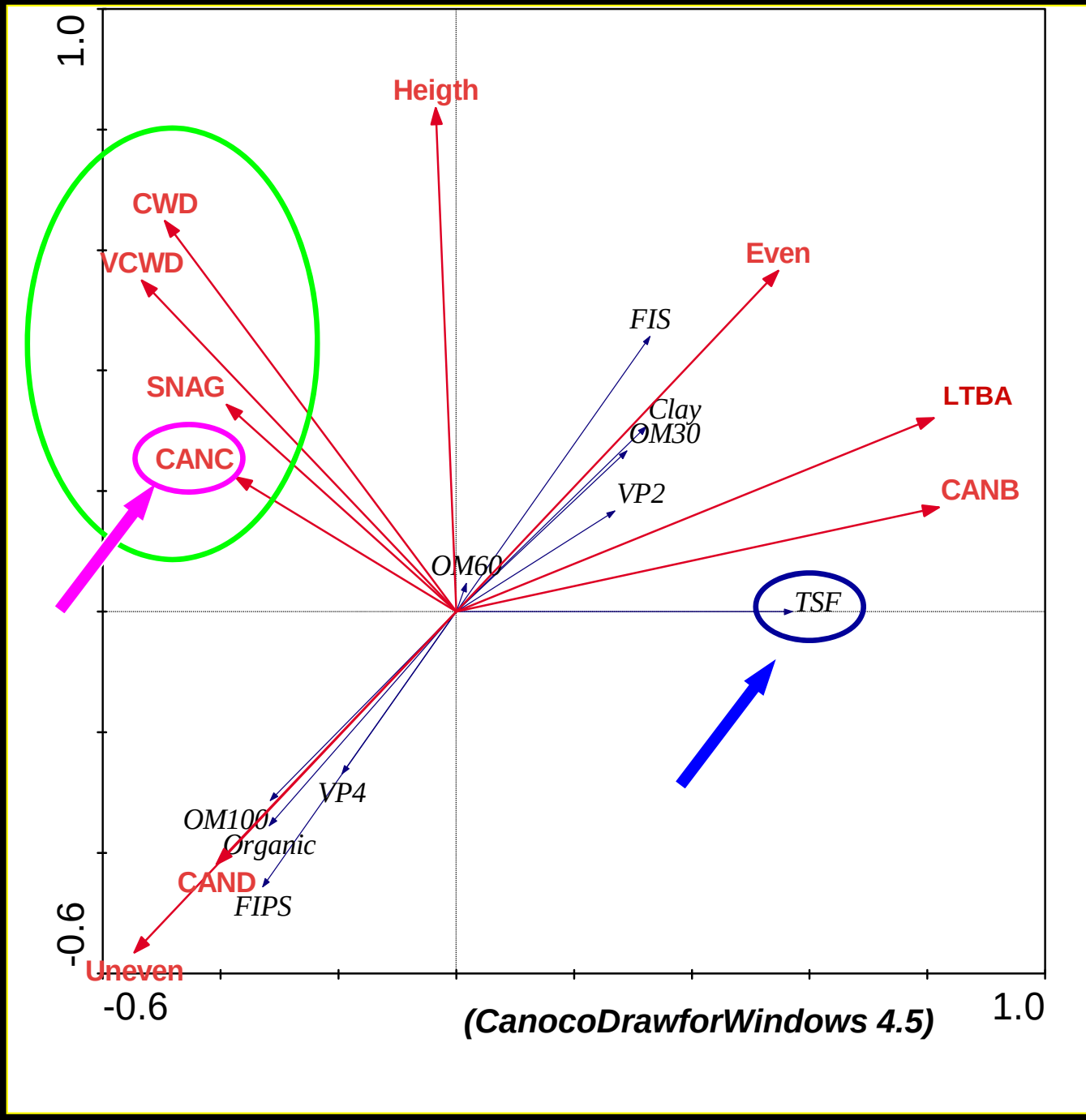
Redundancy analysis

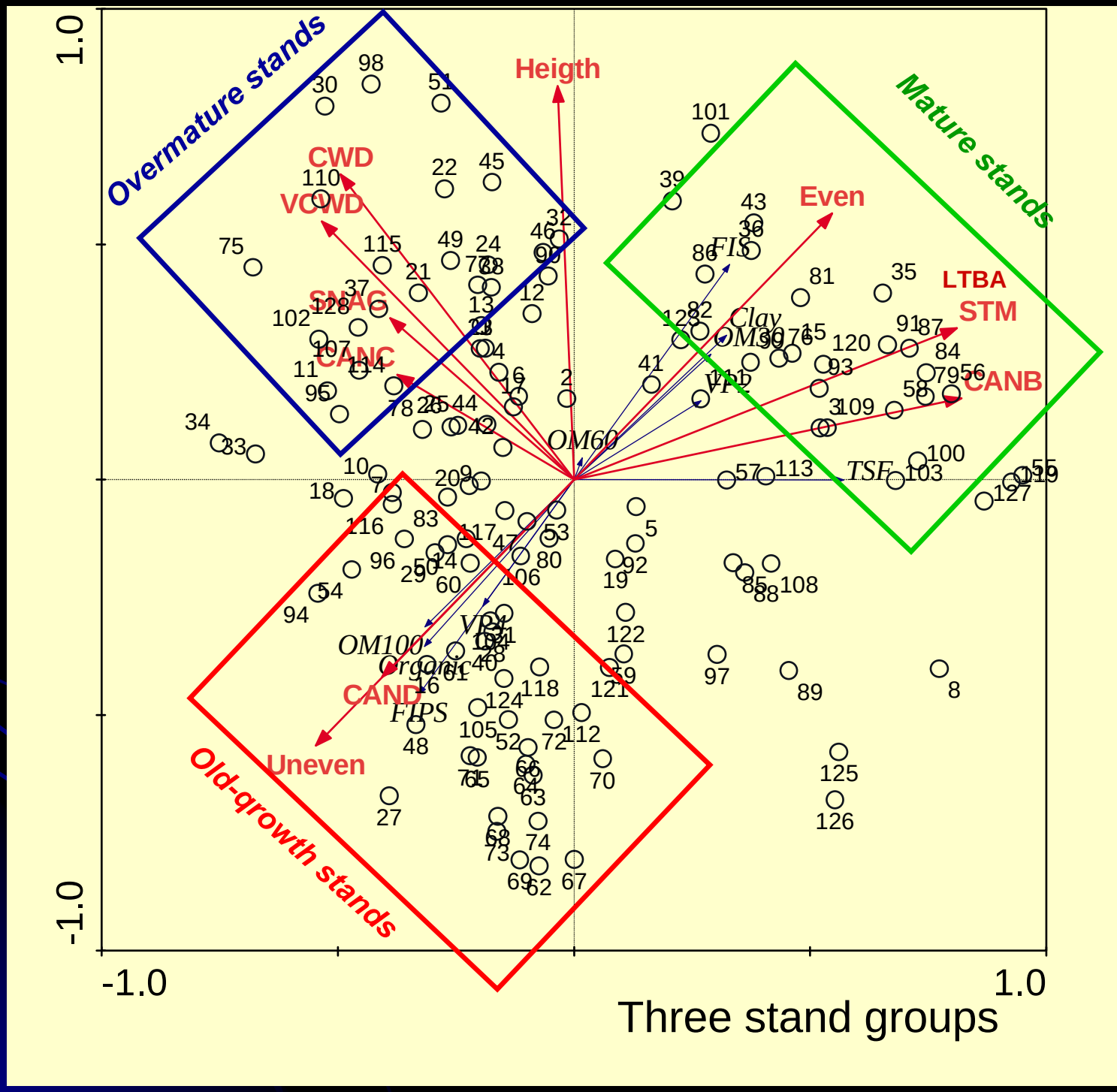
Variable vectors

Eigenvalues,
contribution to the variance

	RDA1	RDA2
Eig.value	423.001	0.2111
Accounted	0.325	0.3252

	RDA1
Clay	0.089023
Organic	-0.084007
TSF	11.492636
OM30	0.081126
OM60	0.003378
OM100	-0.084503
VP2	0.066564
VP4	-0.050349
FIS	0.091938
FIPS	-0.091938




Overmature stands
Heigth
Mature stands
CWD
VCWD
Even
LTBA
STM
SNAG
CANC
CANB
Old-growth stands
CAND
Uneven
FIPS
OM60
OM100
Organic
Clay
TSF
VPD
1.0
-1.0
-1.0
1.0
Three stand groups

Influence of some environmental variables on SNAG abundance

Abundance of snags

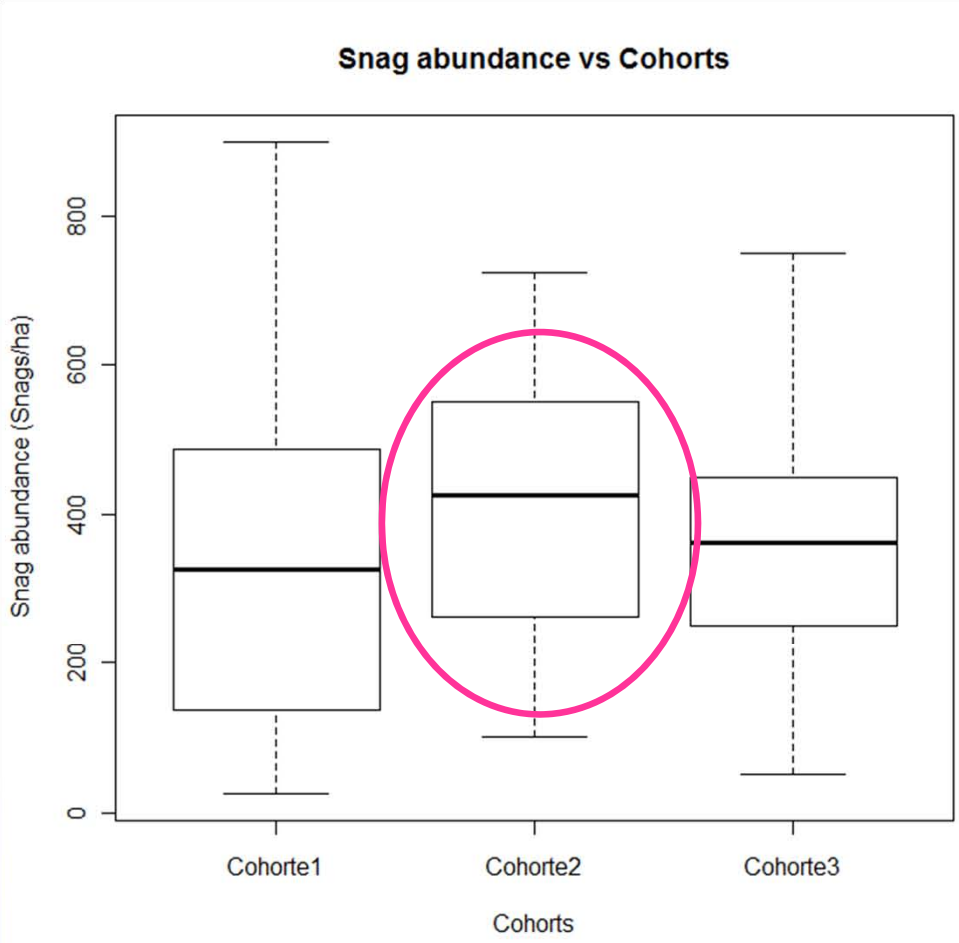
Analysis using generalized linear models (GLM’S)

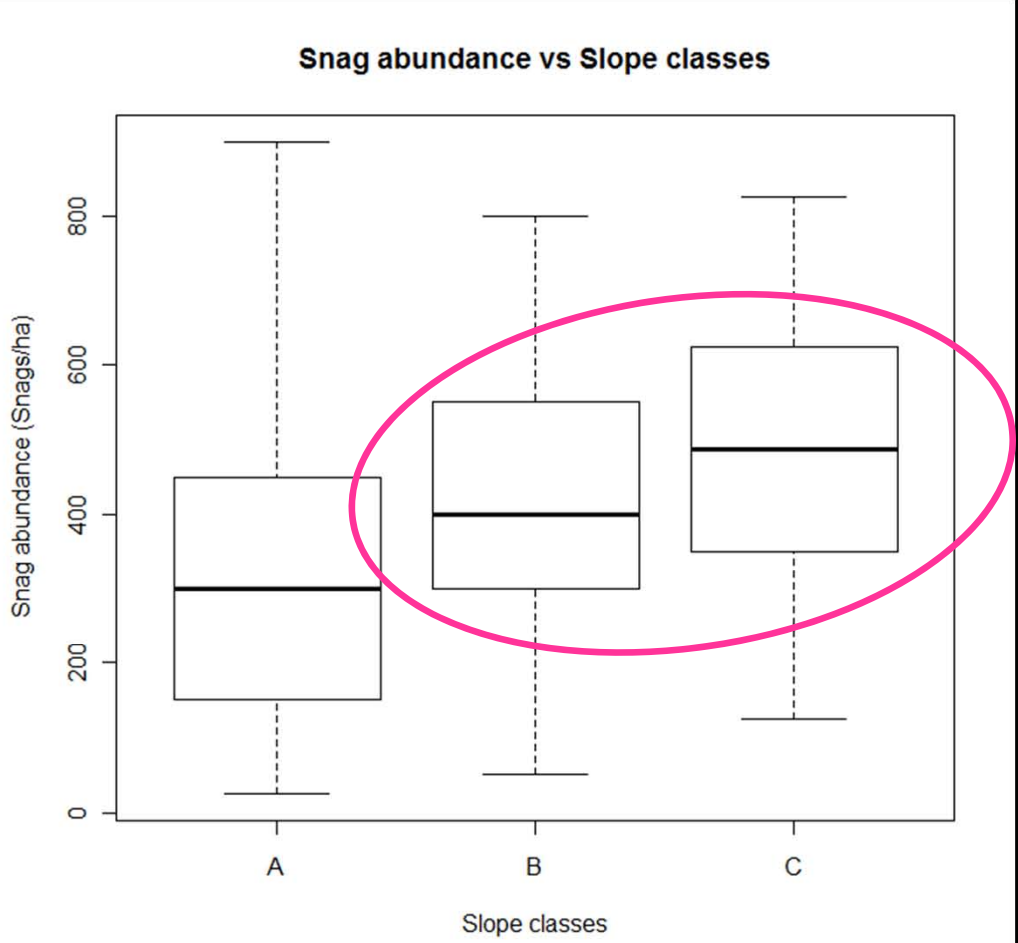
GLMs with model selection

I proceeded with negative binomial distribution GLMs with model selection

I set 15 candidate models

And the best model that explains the variability of snag abundance includes both TSF (cohorts) and fire severity

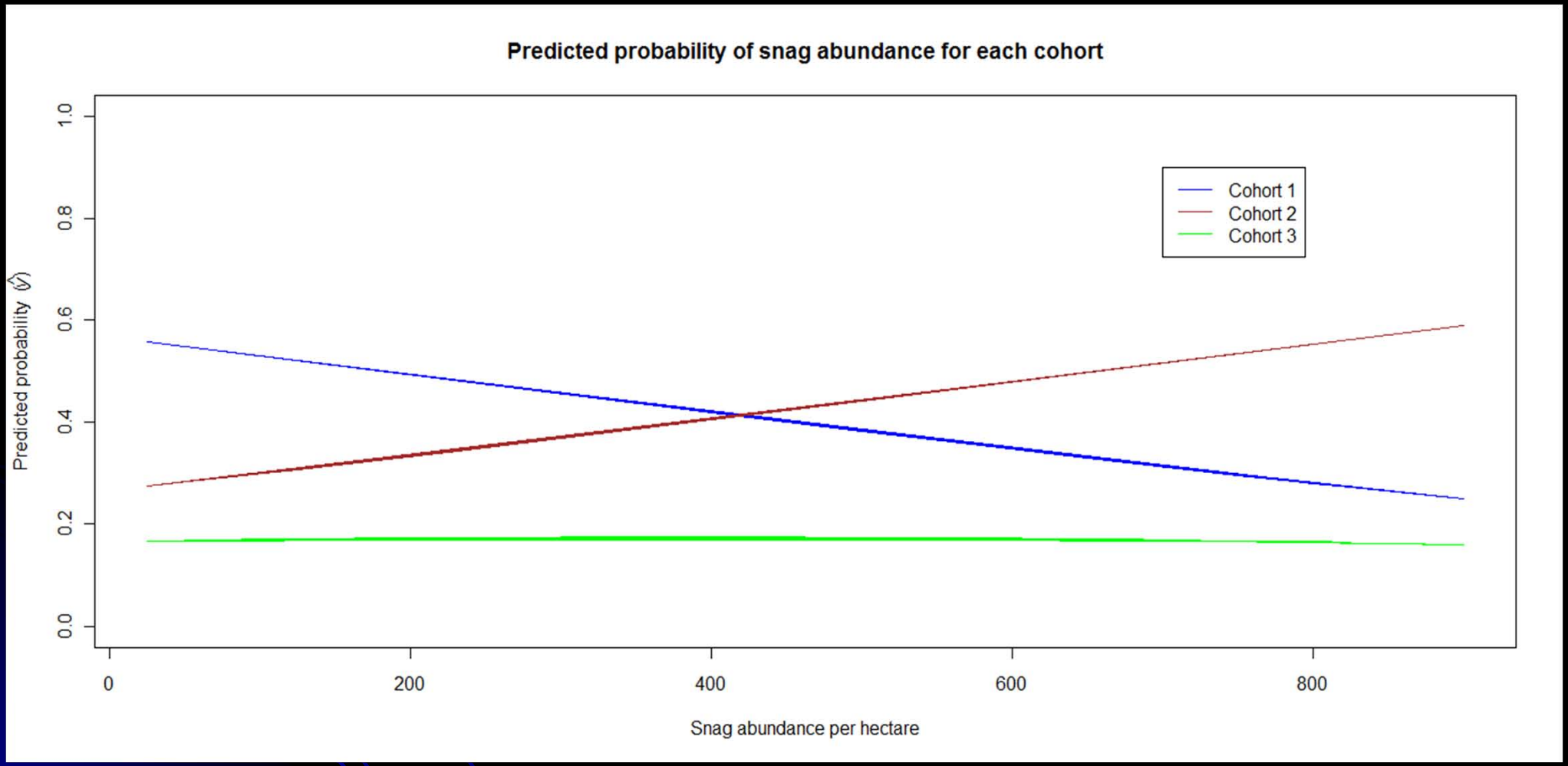




Snag density is significantly higher in stands of the second cohort

Snag abundance is significantly higher on well-drained boreal black spruce sites than on poorly drained sites

Multinomial analysis : Influence of time since last fire on snag abundance

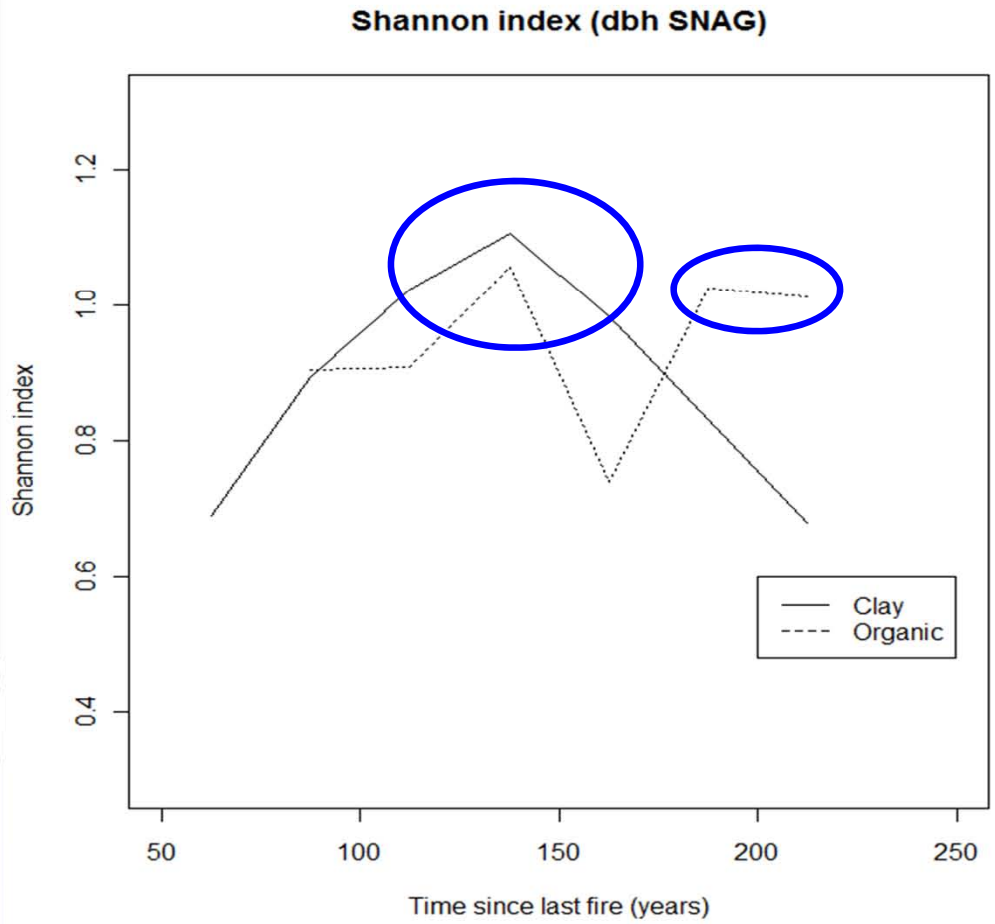


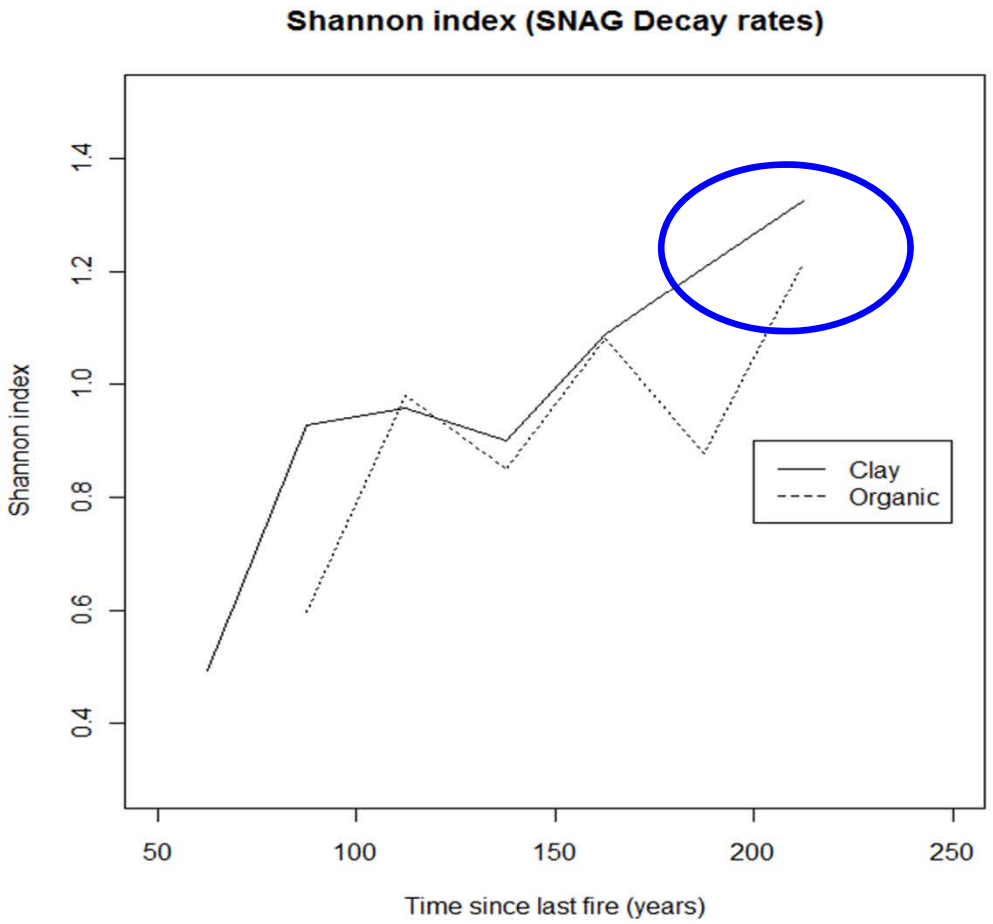
It is more likely to have a low density of snags in first cohort stands

It is more likely to have a high density of snags in second cohort stands

Deadwood diversity and their decay-class dynamics

Snag diameter structural diversity and their decay-class dynamics



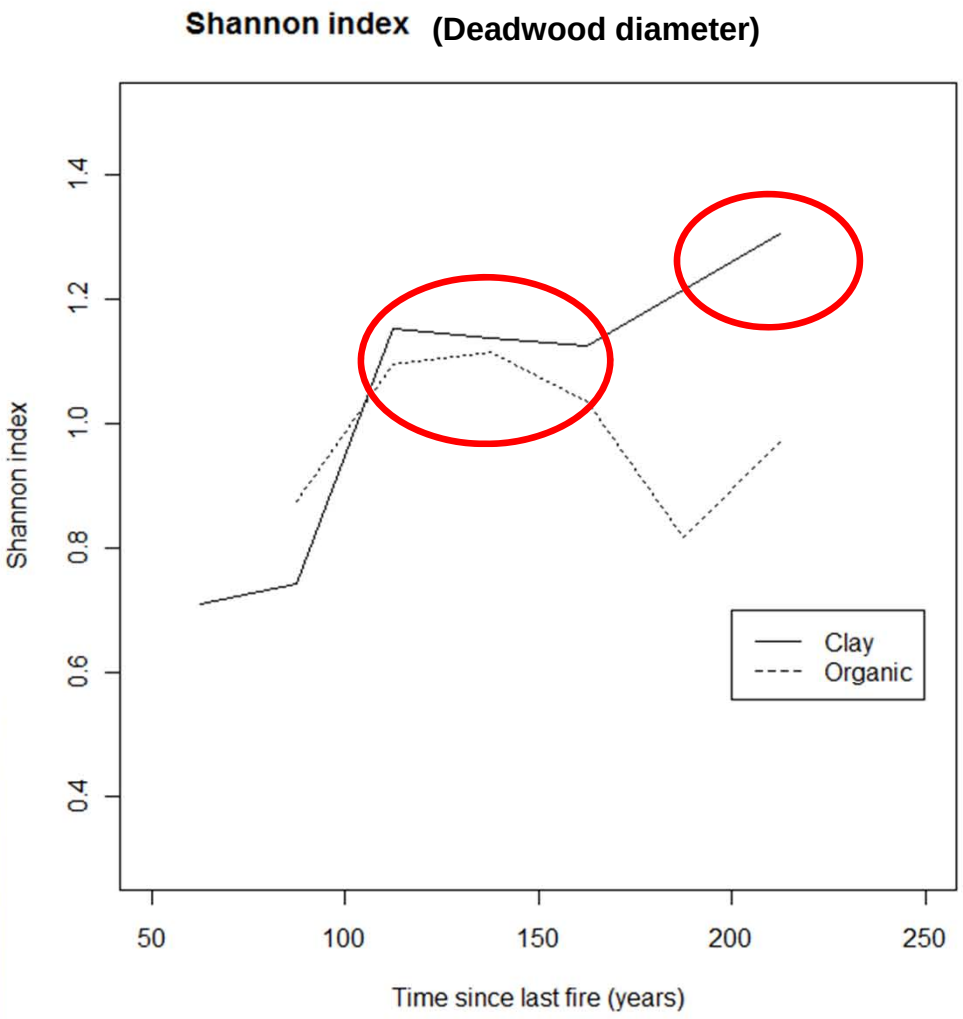


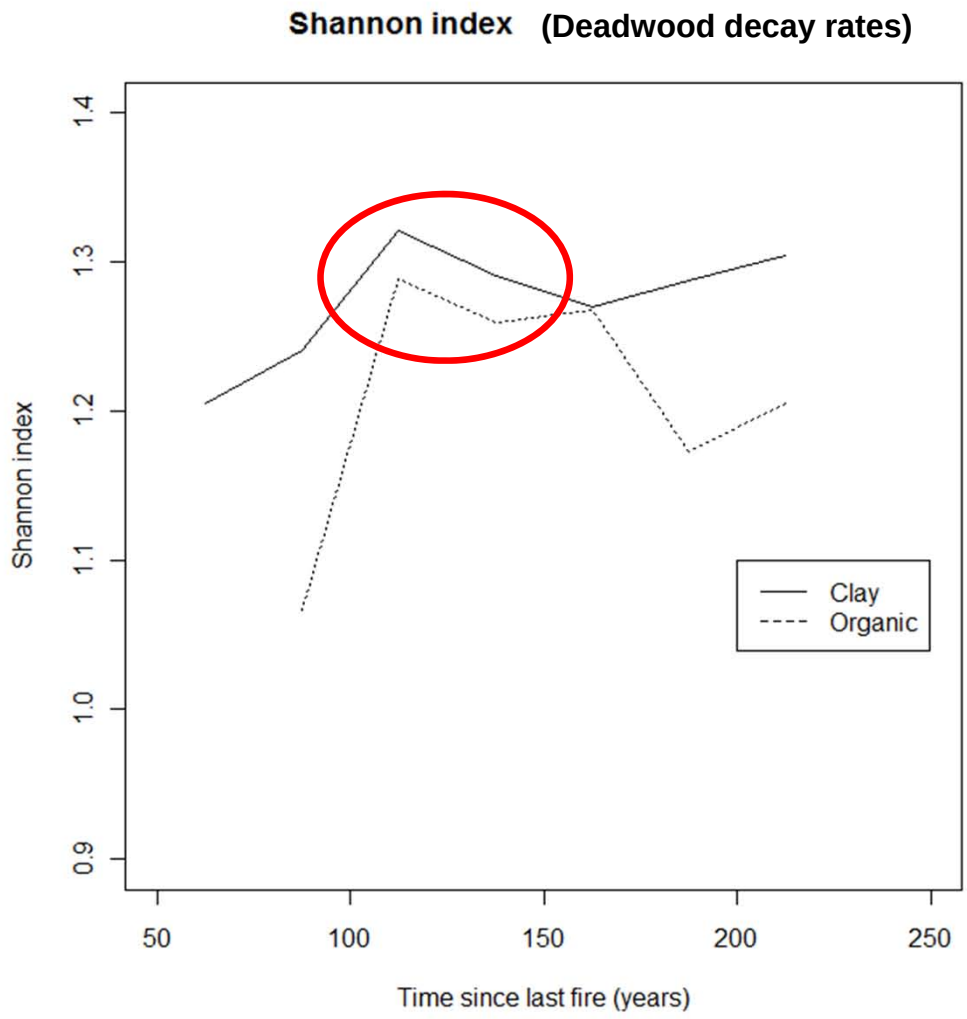
Snags in second cohort stands peak in diameter structural diversity on both organic and mineral sites.

The paludified old-growth stands have a greater diameter structural diversity of snags.

Snags in old-growth stands have the most diversified decay classes

Deadwood diversity and their decay-class dynamics





Deadwood in second cohort stands have diversified diameter classes on both organic and clay sites

However oldest stands on clay have the most diversified deadwood diameter classes

Deadwood in stands of the second cohort have the most diversified decay classes

Conclusion

Time since last fire (TSF) and stand origin were the two variables that best explained the variability in the abundance of snags

Overmature stands were also significantly richer in deadwood then the youngest and the oldest stands

They had the most diverse snags and deadwood diameter structure and the most diverse decay classes

Unmanaged overmature forests must be preserved to ensure better availability of deadwood in the landscape

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THANK YOU