WP1 Impacts on biodiversity - French site

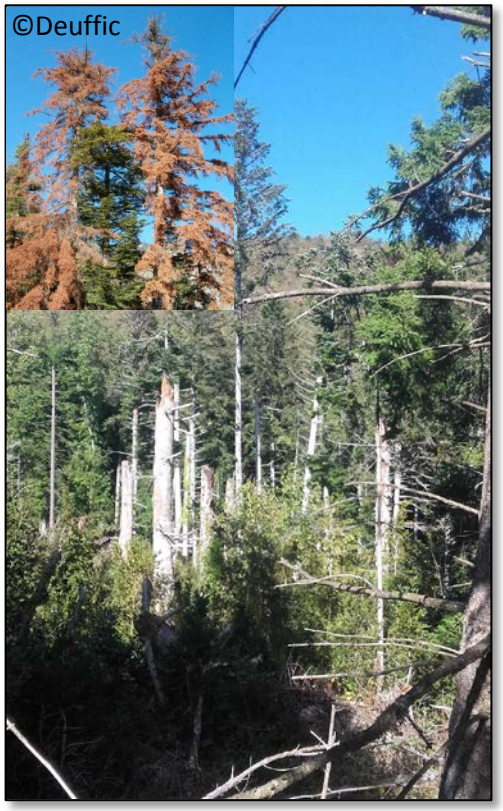
Christophe Bouget, Laurent Larrieu, Laurent Burnel, Carlos Lopez-Vaamonde, Carl Moliard, Jerome Molina, Guillem Parmain, Grégory Sajdak, Lucas Sire, Jerome Willm

Ecological and socioeconomic impacts of climate-induced tree diebacks in highland forests

CLIMTREE

WP1 Impacts on biodiversity - **French site**

BOUGET, Christophe
LARRIEU, Laurent
BURNEL, Laurent
LOPEZ-VAAMONDE, Carlos
MOLIARD, Carl
MOLINA, Jerome
PARMAIN, Guillem
SAJDAK, Grégory
SIRE, Lucas
WILLM, Jerome



Belmont Forum Collaborative Research Action / Call for Proposals on Mountains as Sentinels of Change

3rd meeting. Bavaria 27/08/2019

How do forest insects respond to resource pulses induced by forest dieback is a « fundamental ecological question »

100 YEARS Journal of Ecology
British Ecological Society

Journal of Ecology 2013, **101**, 58–67 doi: 10.1111/1365-2745.12025

FORUM

Identification of 100 fundamental ecological questions

William J. Sutherland[1], Robert P. Freckleton[2], H. Charles J. Godfray[3], Steven R. Beissinger[4], Tim Benton[5], Duncan D. Cameron[2], Yohay Carmel[6], David A. Coomes[7], Tim Coulson[8], Mark C. Emmerson[9], Rosemary S. Hails[10], Graeme C. Hays[11], Dave J. Hodgson[12], Michael J. Hutchings[13], David Johnson[14], Julia P. G. Jones[15], Matt J. Keeling[16], Hanna Kokko[17], William E. Kunin[18], Xavier Lambin[14], Owen T. Lewis[3], Yadvinder Malhi[19], Nova Mieszkowska[20], E. J. Milner-Gulland[21], Ken Norris[22], Albert B. Phillimore[23], Drew W. Purves[24], Jane M. Reid[14], Daniel C. Reuman[21,25], Ken Thompson[2], Justin M. J. Travis[14], Lindsay A. Turnbull[26], David A. Wardle[27] and Thorsten Wiegand[28]

54 How do resource pulses affect resource use and interactions between organisms?

Ecological Monographs, 80(1), 2010, pp. 125–151

A meta-analysis of resource pulse–consumer interactions

Louie H. Yang,[1,2,3,6] Kyle F. Edwards,[3] Jarrett E. Byrnes,[2,3] Justin L. Bastow,[3,4] Amber N. Wright,[3] and Kenneth O. Spence[5]

Ecology, 89(3), 2008, pp. 621–634

WHAT CAN WE LEARN FROM RESOURCE PULSES?

Louie H. Yang,[1,3] Justin L. Bastow,[1] Kenneth O. Spence,[2] and Amber N. Wright[1]

Ecological issues in the ClimTree project

In declining silver fir forests, how did insect communities respond to:

A the local fir dieback intensity?

B the regional fir dieback level ?

C Salvage logging in declining fir stands ?

Sampling design and methods

A balanced sampling design

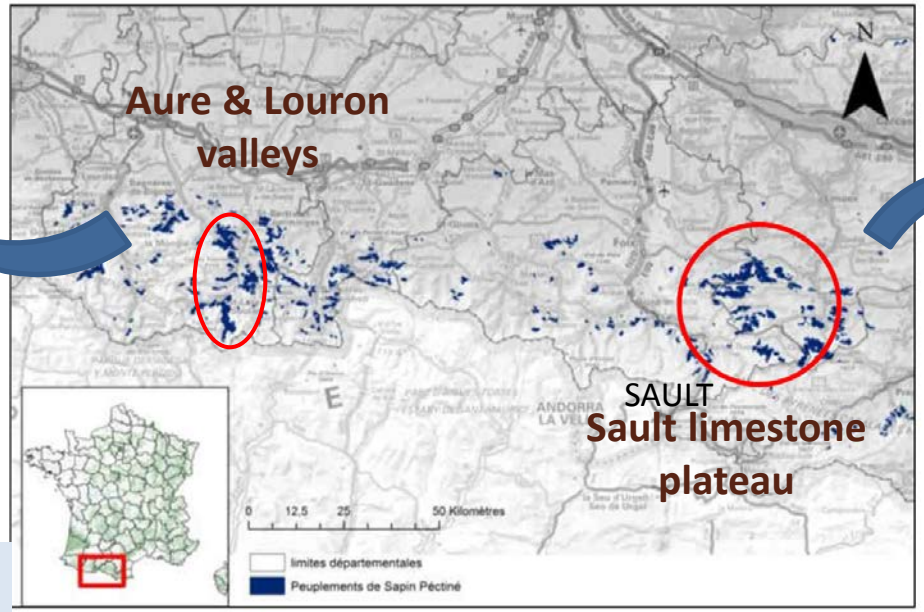
Stratifying factors

1. Local dieback intensity (-/+)
2. Dieback intensity at the landscape scale (-/+)
3. Salvage logging (0/1)

Design replicated in 2 regions

AURE

		Stand scale			
		Healthy	Declining		
			Low dieback level	High dieback level	
			No harvesting	No harvesting	Salvage logging
Landscape scale (R=200m)	Low dieback level	10	3	2	-
	High dieback level	0	3	4	6



		Stand scale			
		Healthy	Declining		
			Low dieback level	High dieback level	
			No harvesting	No harvesting	Salvage logging
Landscape scale (R=200m)	Low dieback level	5	3	3	-
	High dieback level	5	3	3	6

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Objectives of the French sampling design

3 crossed gradients to tackle several questions

1. Local decline intensity

		Stand scale			
		Healthy	Declining		
			Low dieback level	High dieback level	
			No harvesting	No harvesting	Salvage logging
Landscape scale (R=200m)	Low dieback level	15	6	5	-
	High dieback level	5	6	7	12

2. Decline intensity at the landscape

3. Salvage logging

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Sampling methods

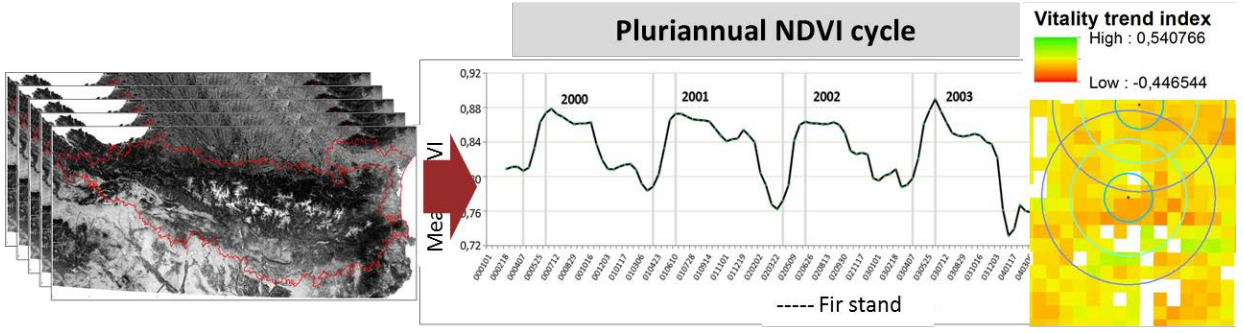
Local stand structure

- Dead wood
- Tree-related microhabitats
- Canopy openness

VITALITÉ DES ARBRES
ARCHI
CENTRE NATIONAL de la PROPRIÉTÉ FORESTIÈRE

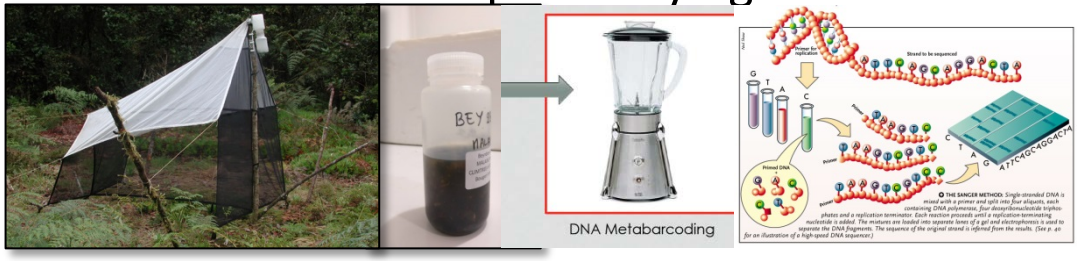
Fir dieback level

- Local scale
- Landscape scale



Insect communities

Malaise traps : all flying insects



WFT=Window-flight traps : sx beetles

Selected preliminary results

- Only sx beetles from WFT

Contrasting conditions between the two French study sites

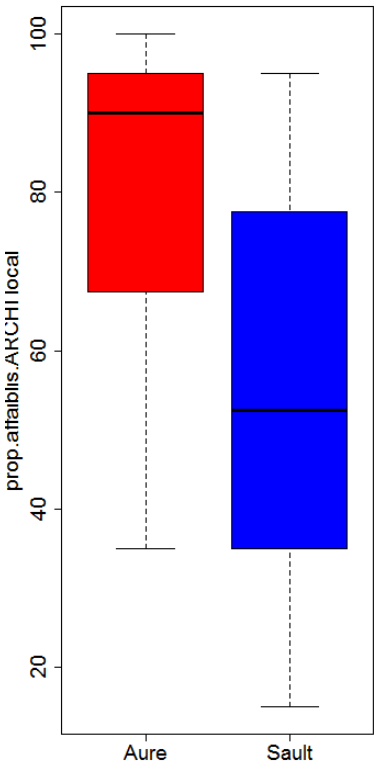
A DIFFÉRENTES ÉCHELLES SPATIALES

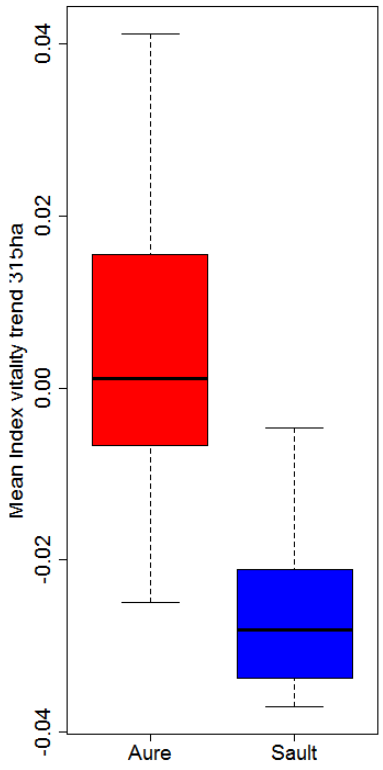
Local dieback level AURE > SAULT

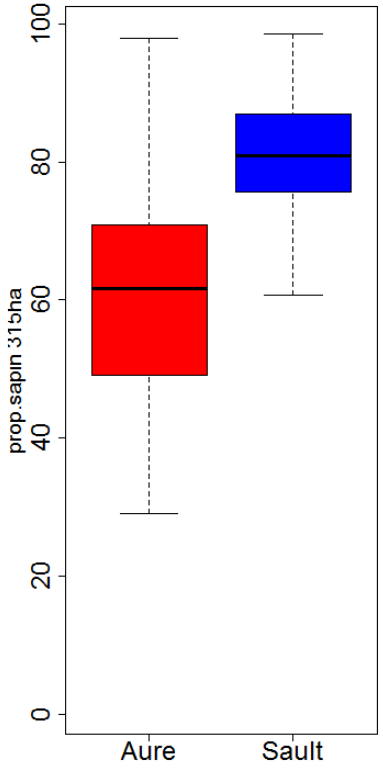
Regional dieback level SAULT > AURE

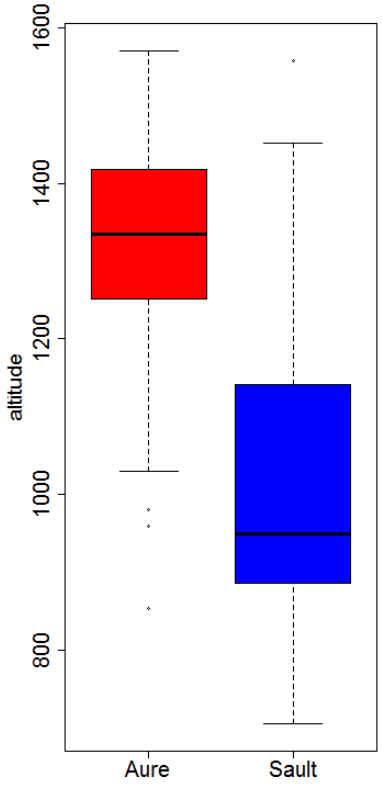
Landscape fir proportion SAULT > AURE

Altitude AURE > SAULT





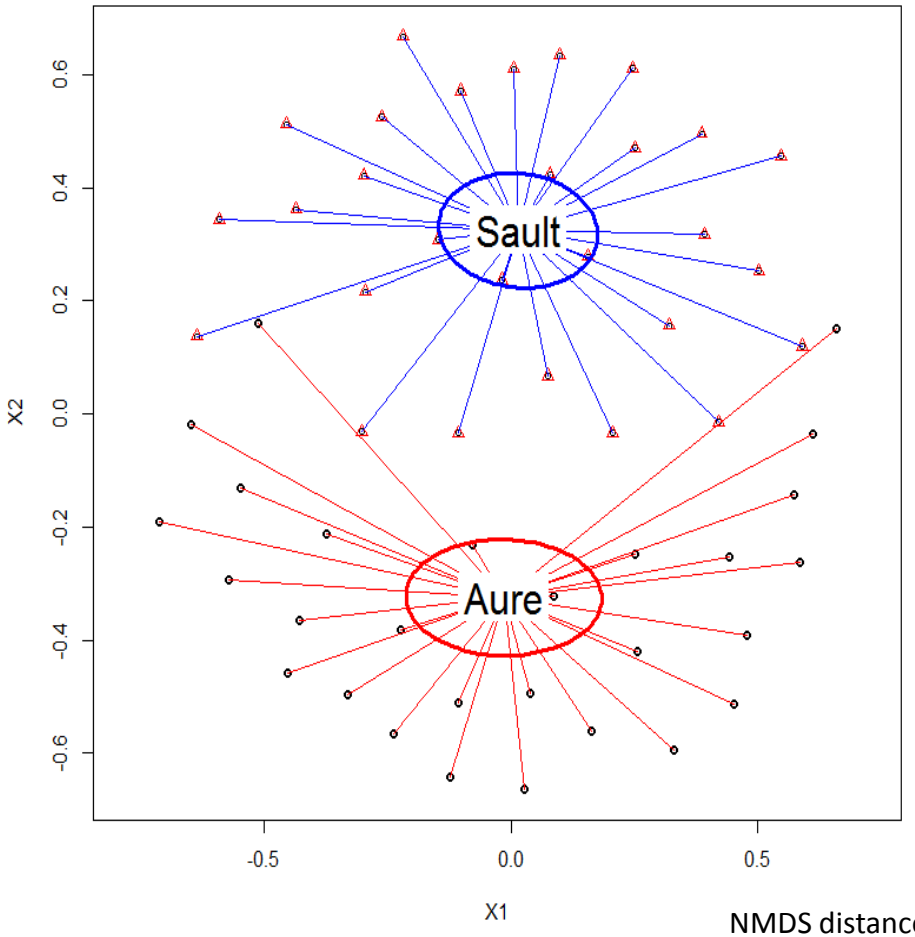




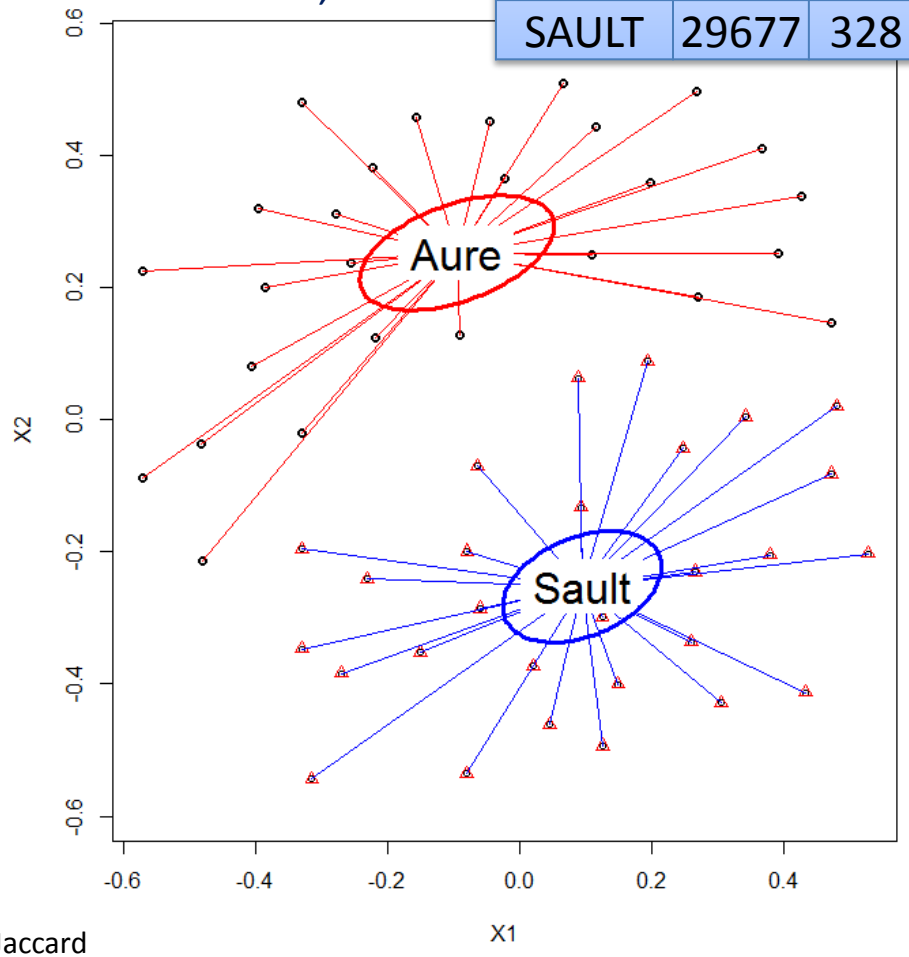
A strong region effect on insect assemblages !

	Colsx	
	Indiv.	Sp.
AURE	20390	315
SAULT	29677	328

All insects, Malaise traps



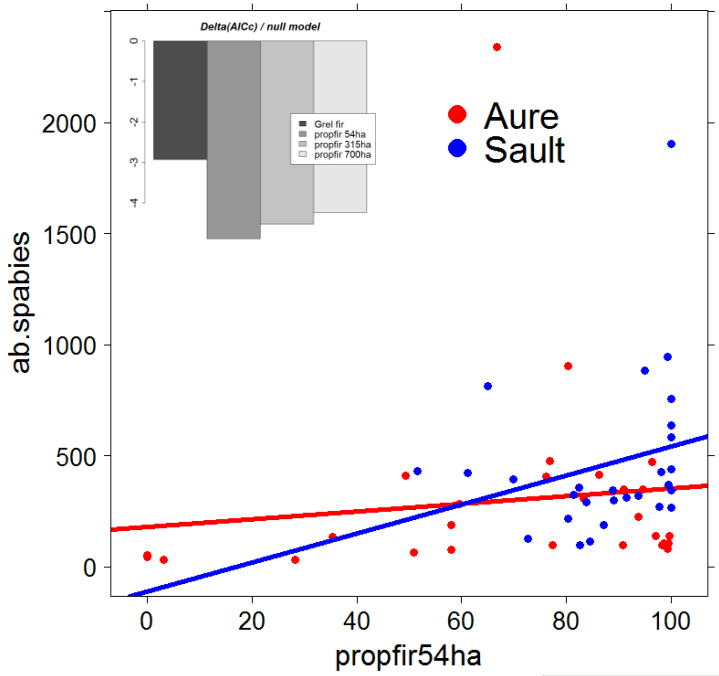
Sx beetles, WFT



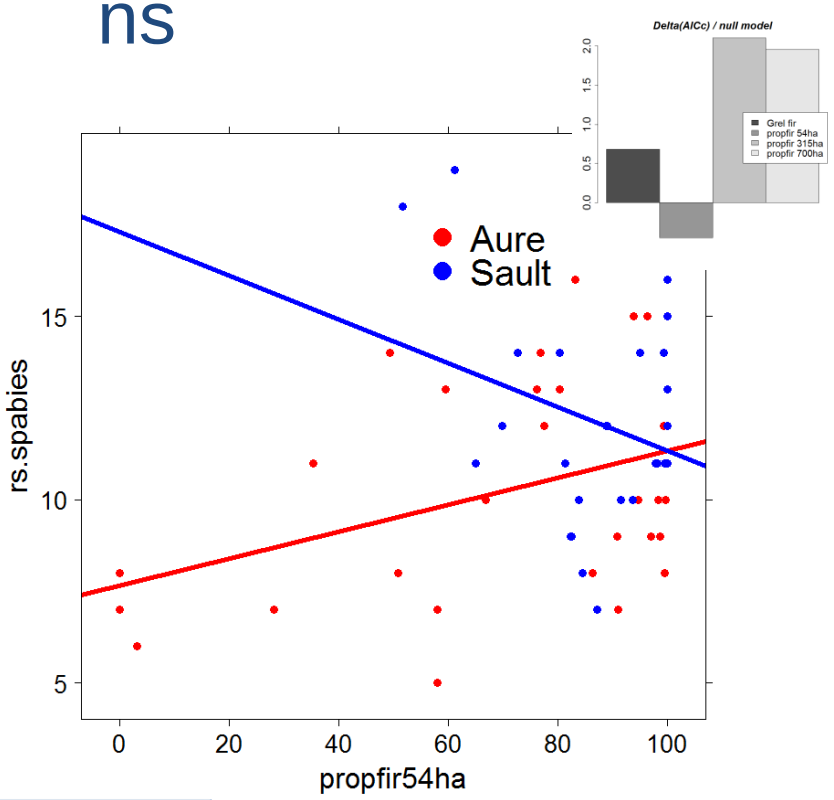
NMDS distance Jaccard

More individuals of fir-associated species in landscapes more dominated by fir trees

**



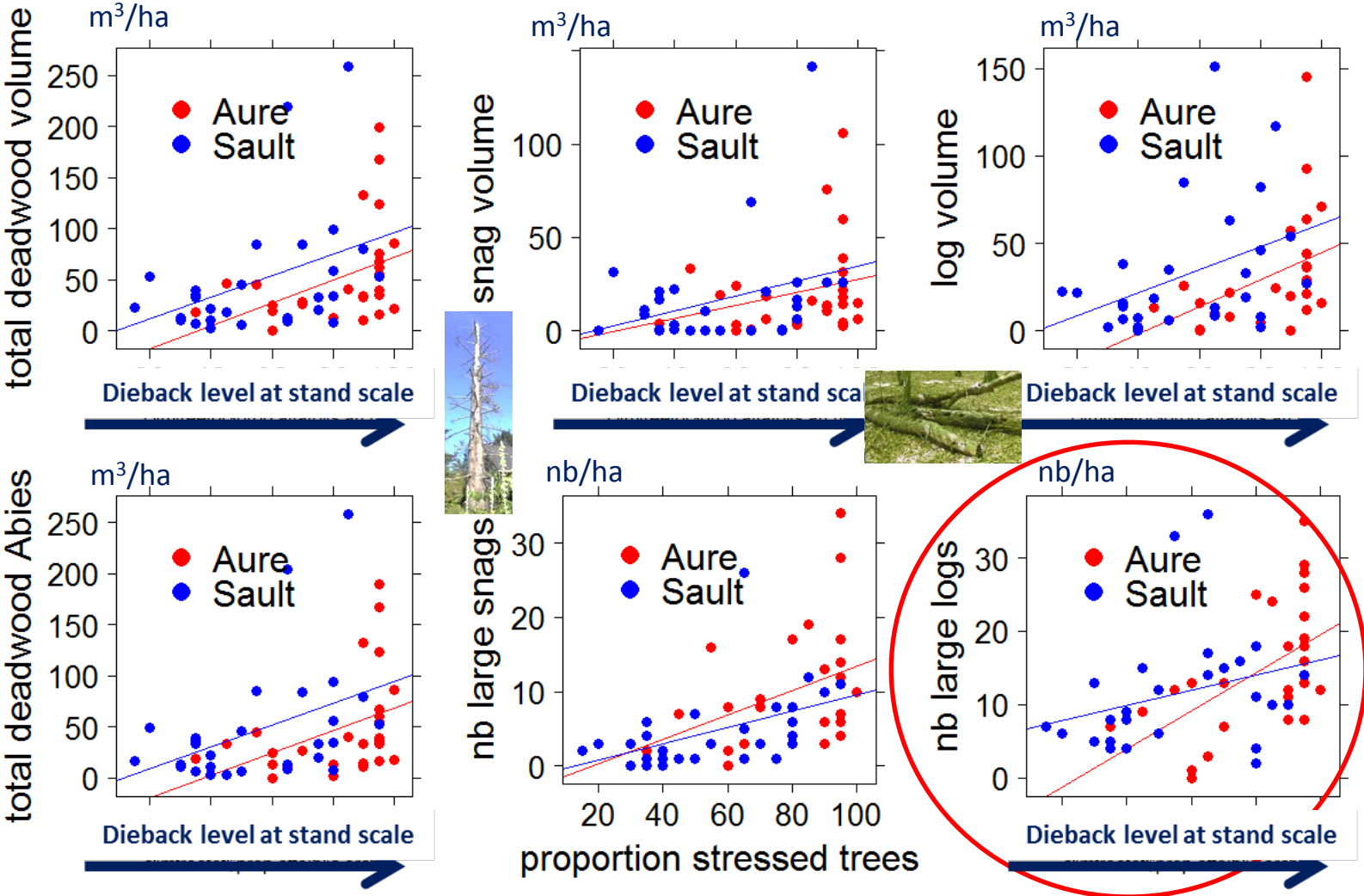
ns



	Colsx Abies	
	Indiv.	Sp.
AURE	8420	37
SAULT	12882	36

Significant effects of local dieback level on fir stand structure

An overall increase in deadwood, mainly fir deadwood in declining stands, depending on the region



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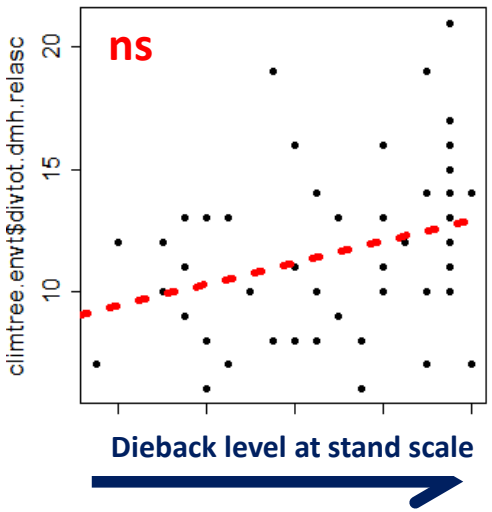
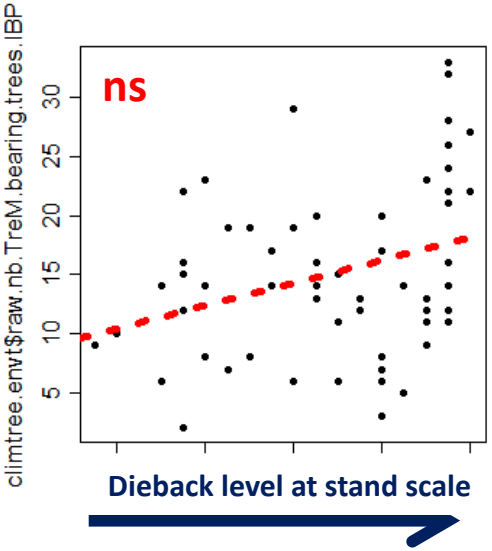
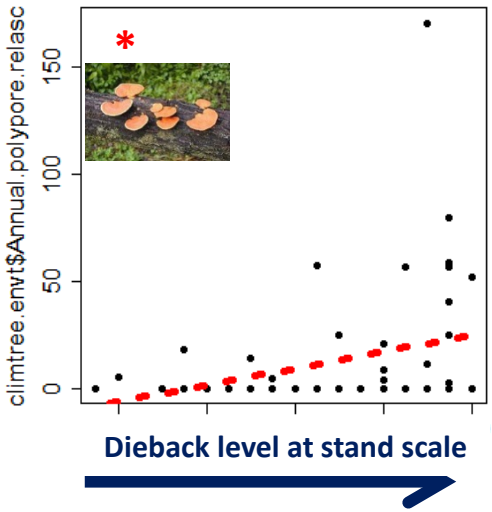
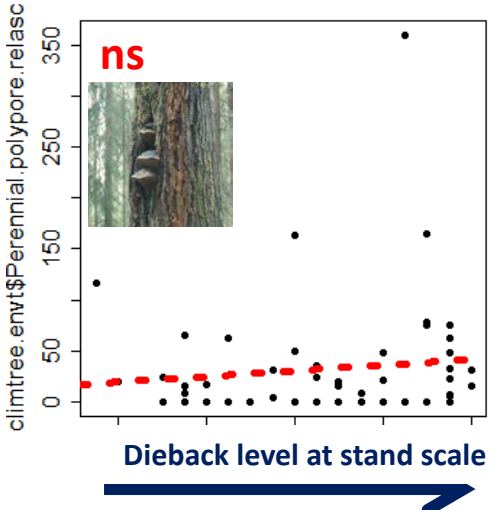
Significant effects of local dieback level on fir stand structure

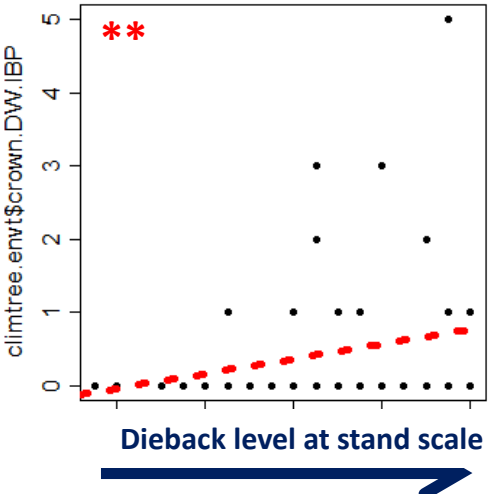
A slight increase in tree-related microhabitat density

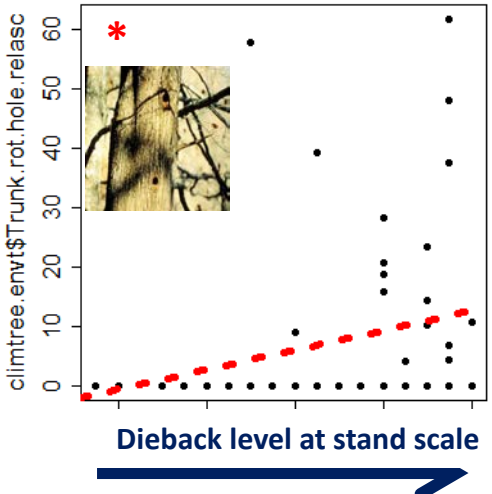












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Significant effects of local dieback level on species composition of saproxylic beetle communities

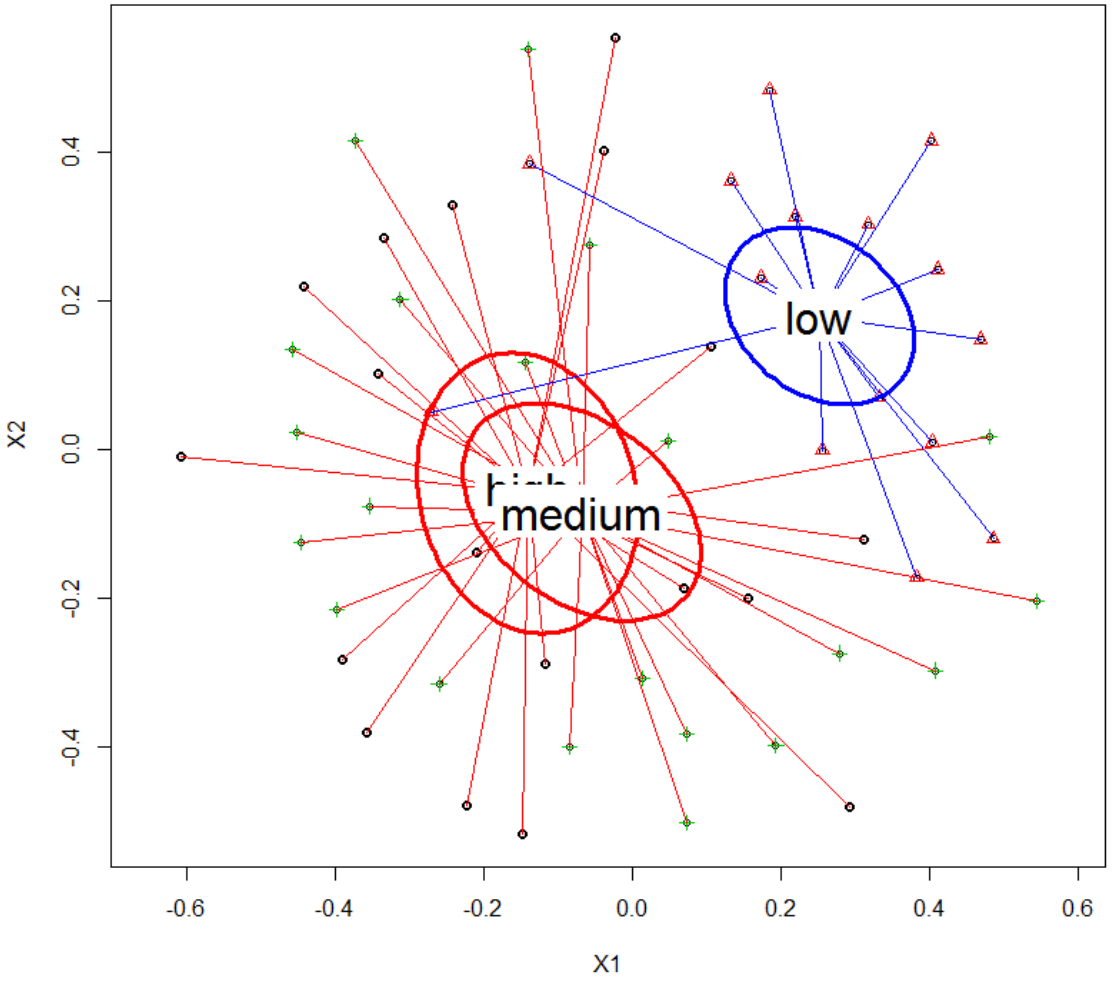
Jaccard dissmilarity, singletons excluded

NPManova (site constrained)

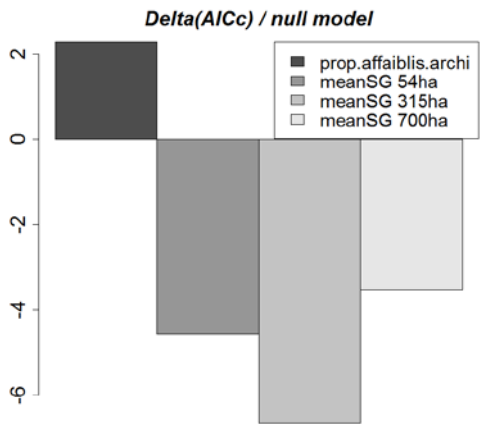
low-medium ***

Low-high ns

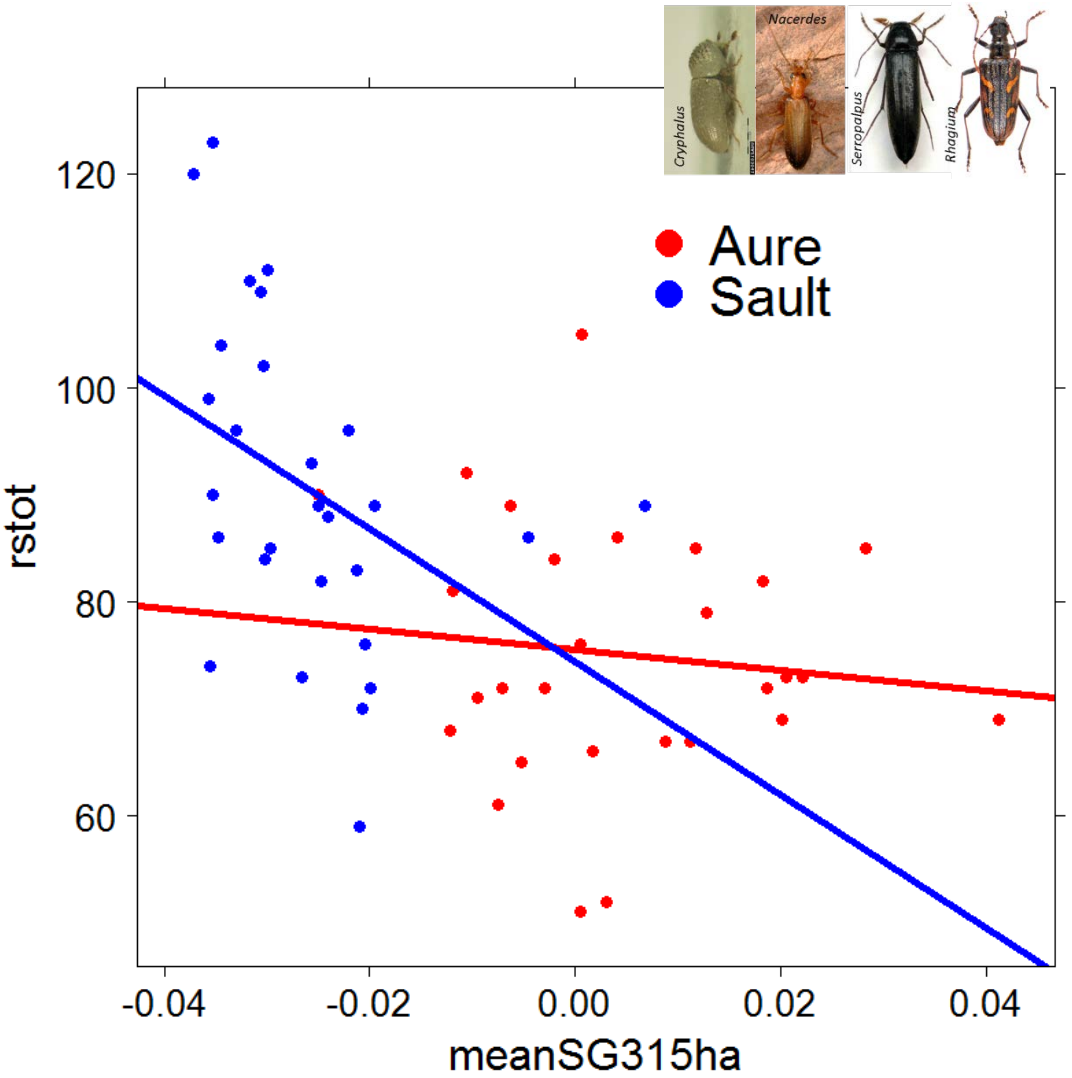
High-medium ns



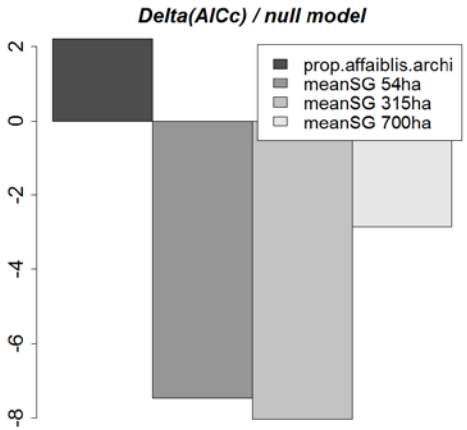
No effect of local dieback level on mean saproxylic beetle species richness…



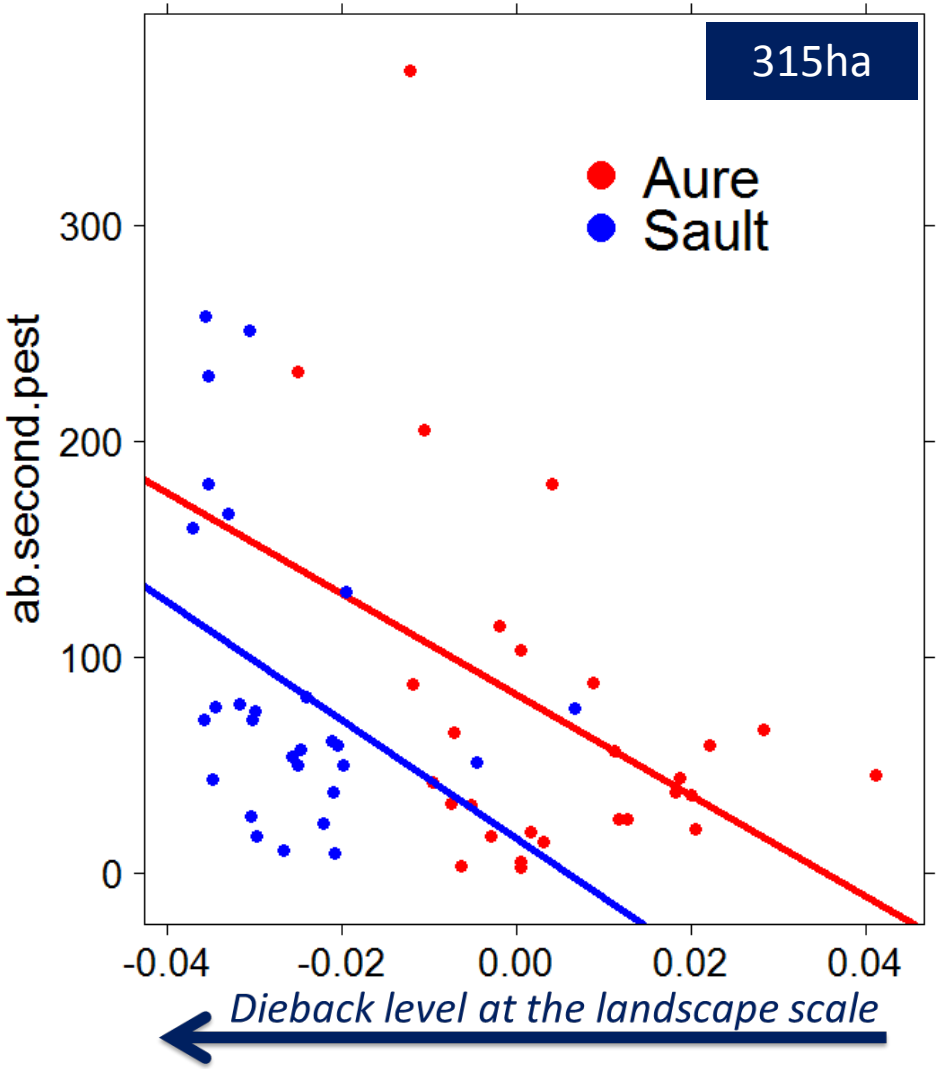
…but positive effect of regional dieback level !



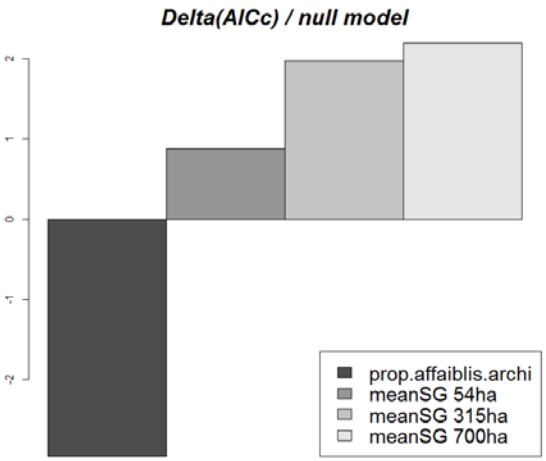
Significant positive effect of regional dieback level on secondary fir pest abundance (xylophagous beetles)

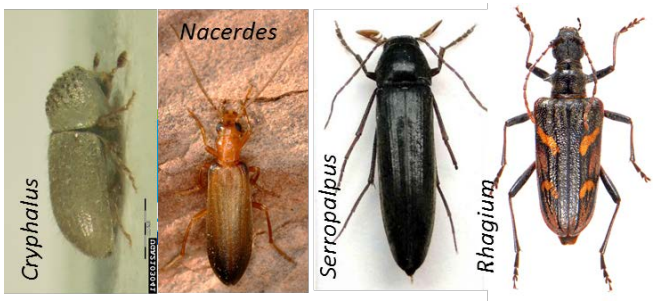


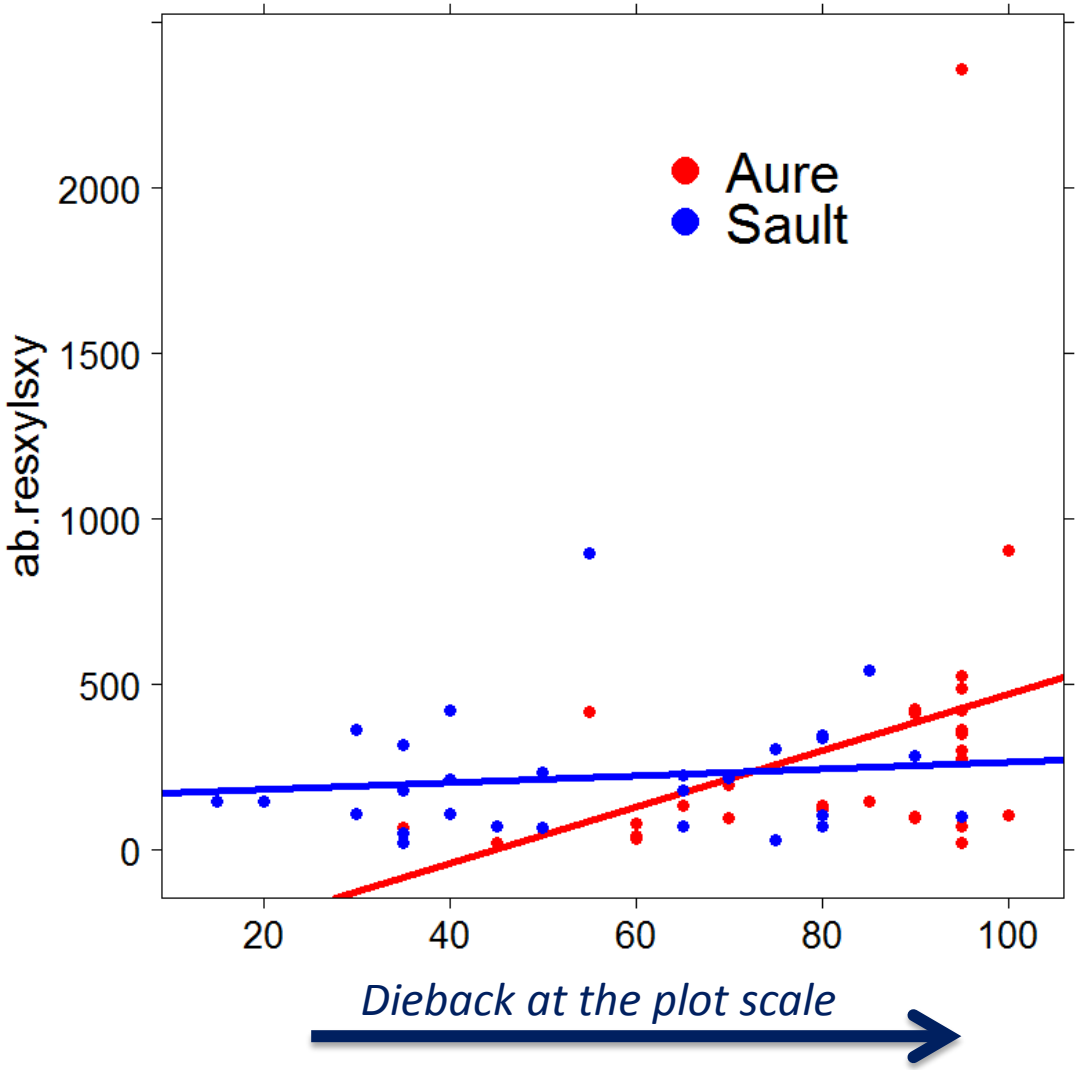
Pityokteines



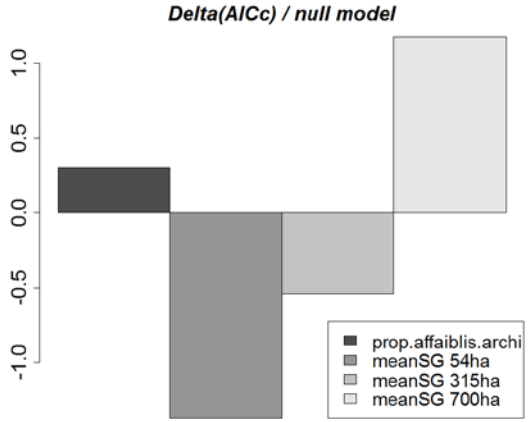
Conifer deadwood borers increase in abundance with local dieback intensity, in one of the two regions only

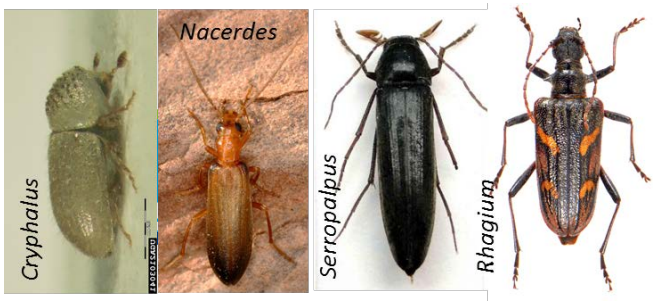


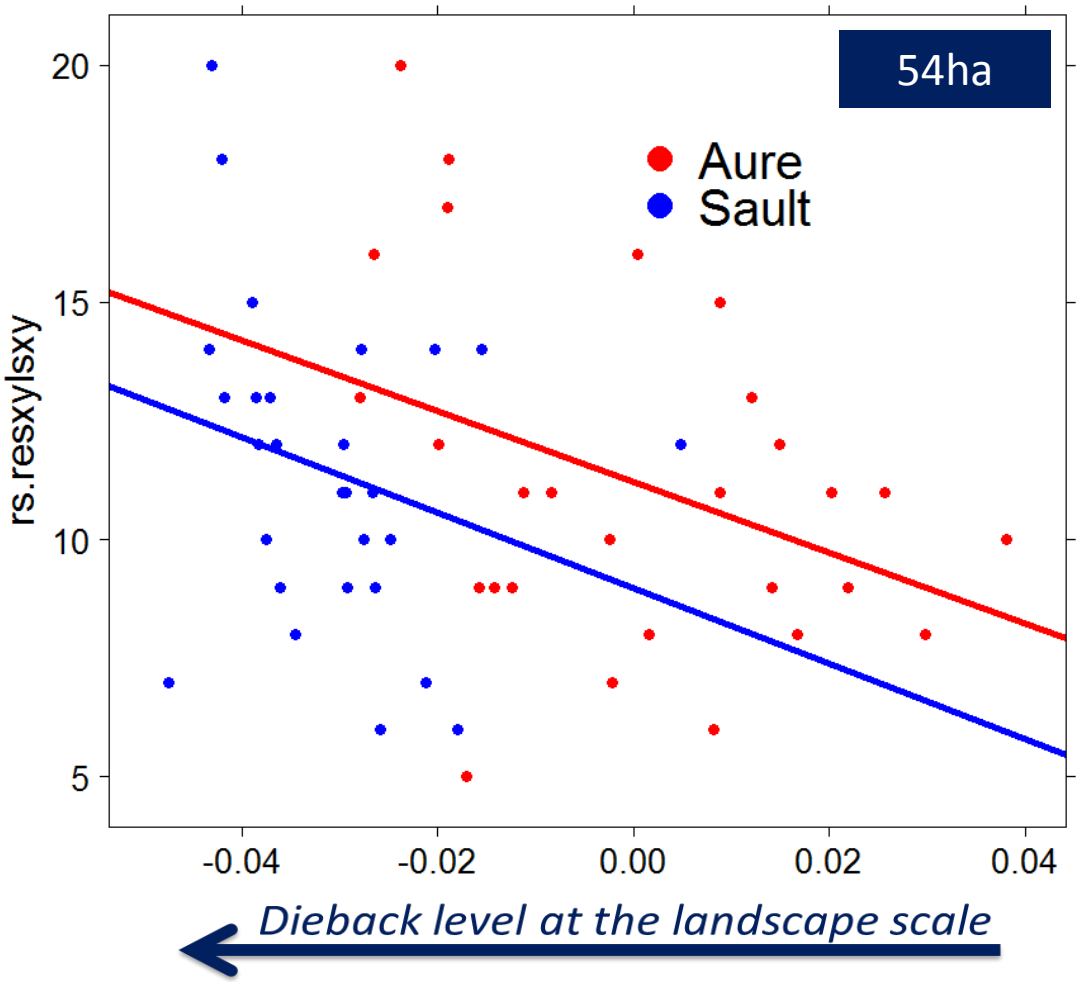




Conifer deadwood borers increase in richness with regional dieback intensity



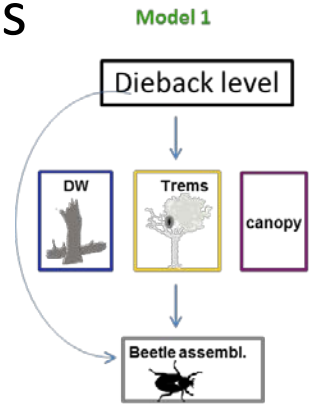




The response of conifer deadwood borers to local dieback intensity is mediated by stand variables

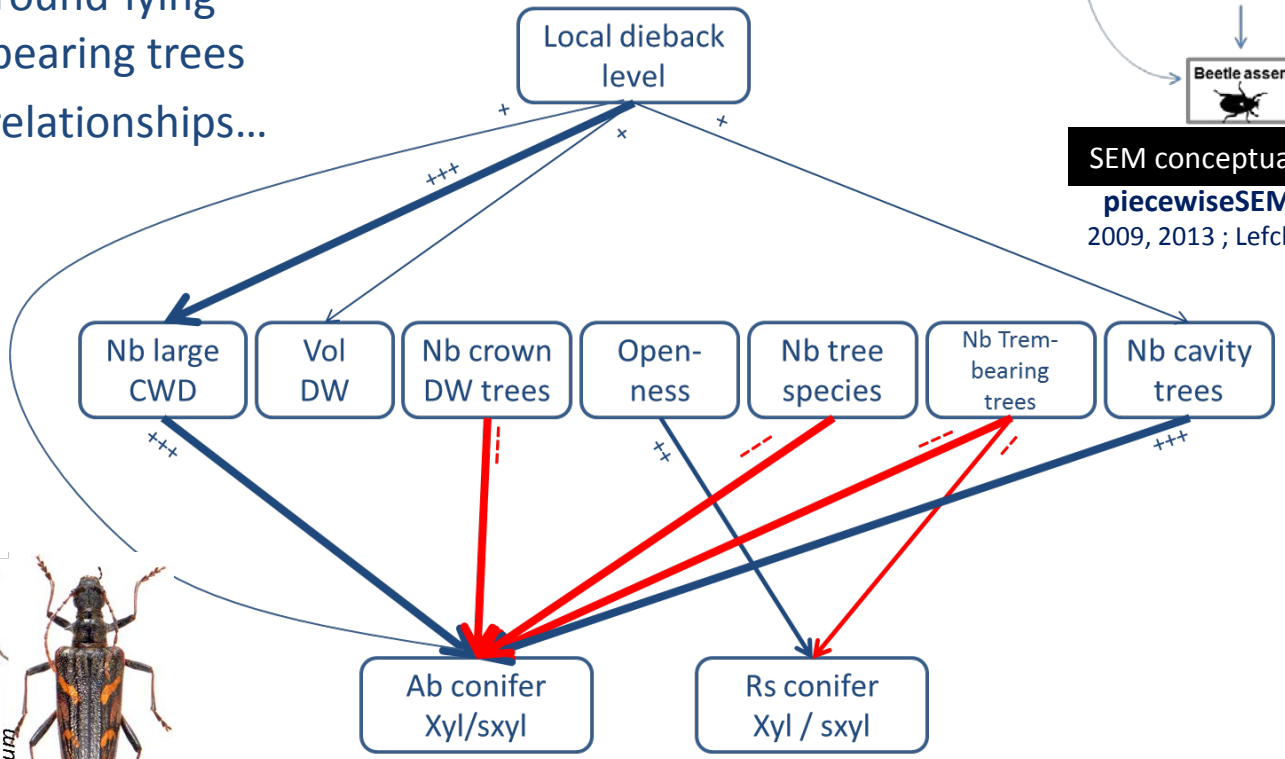
Positive effect of dieback level seems to be mediated by resource metrics such as the density of large ground-lying deadwood and canopy-bearing trees

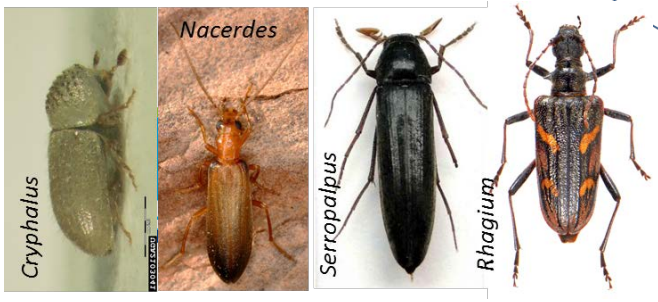
…but other ambiguous relationships…



SEM conceptual model

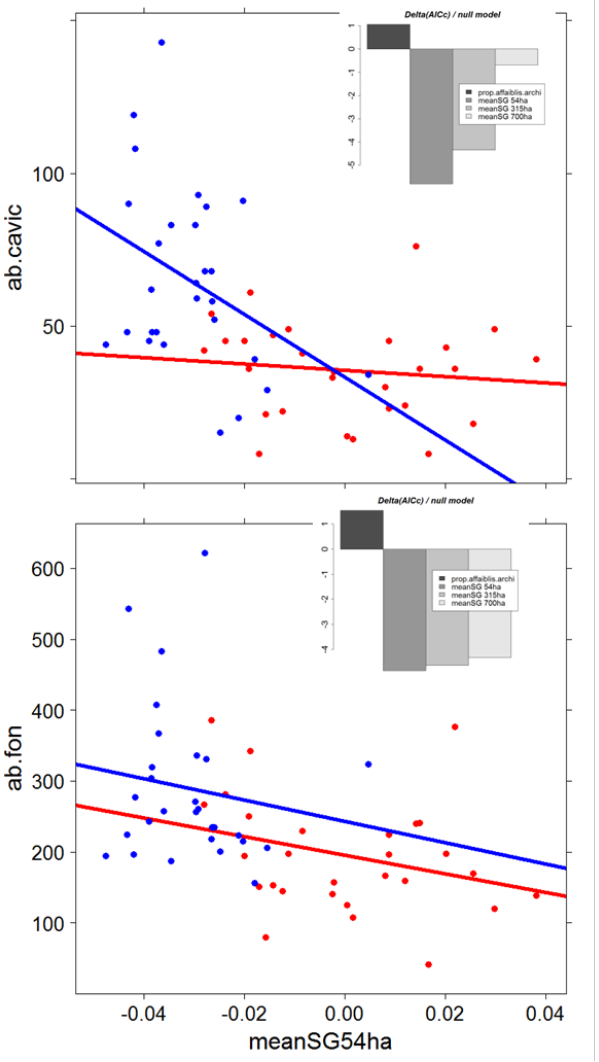
piecewiseSEM (Shipley 2009, 2013 ; Lefcheck 2015)

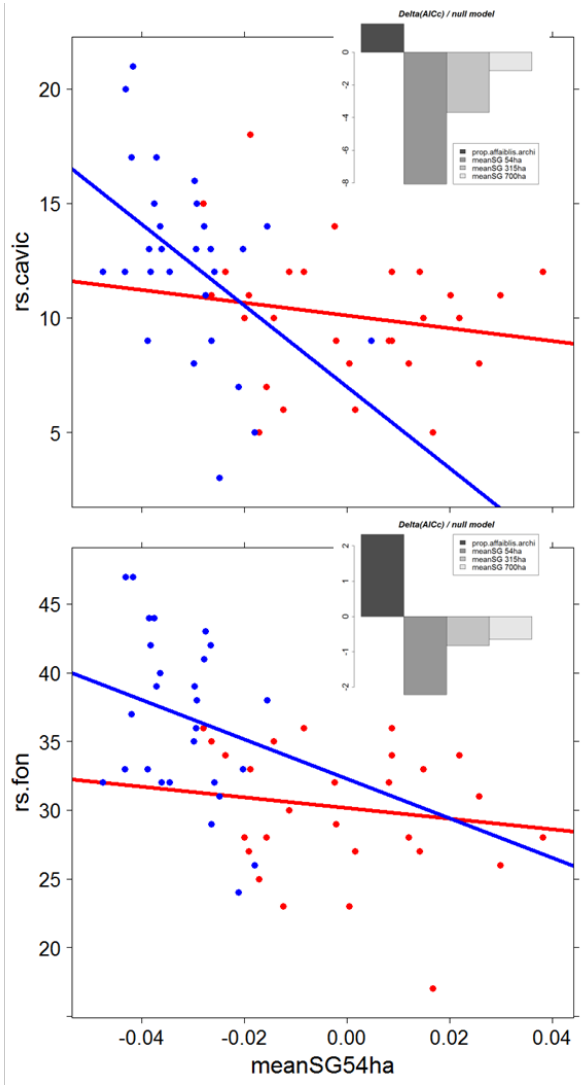




Structural Equation Modelling / GlmmTMB, glmer.nb, glmer.poisson

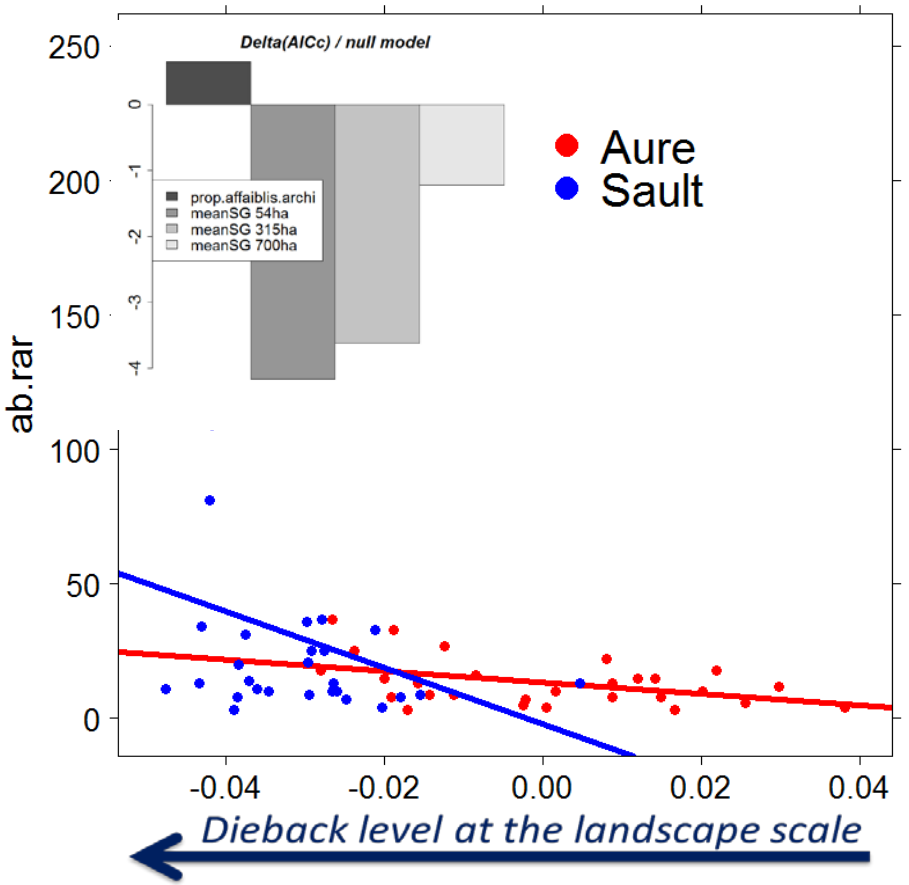
Tree-related microhabitat-associated beetle increase in abundance and richness with dieback intensity at the landscape but not at the stand scale

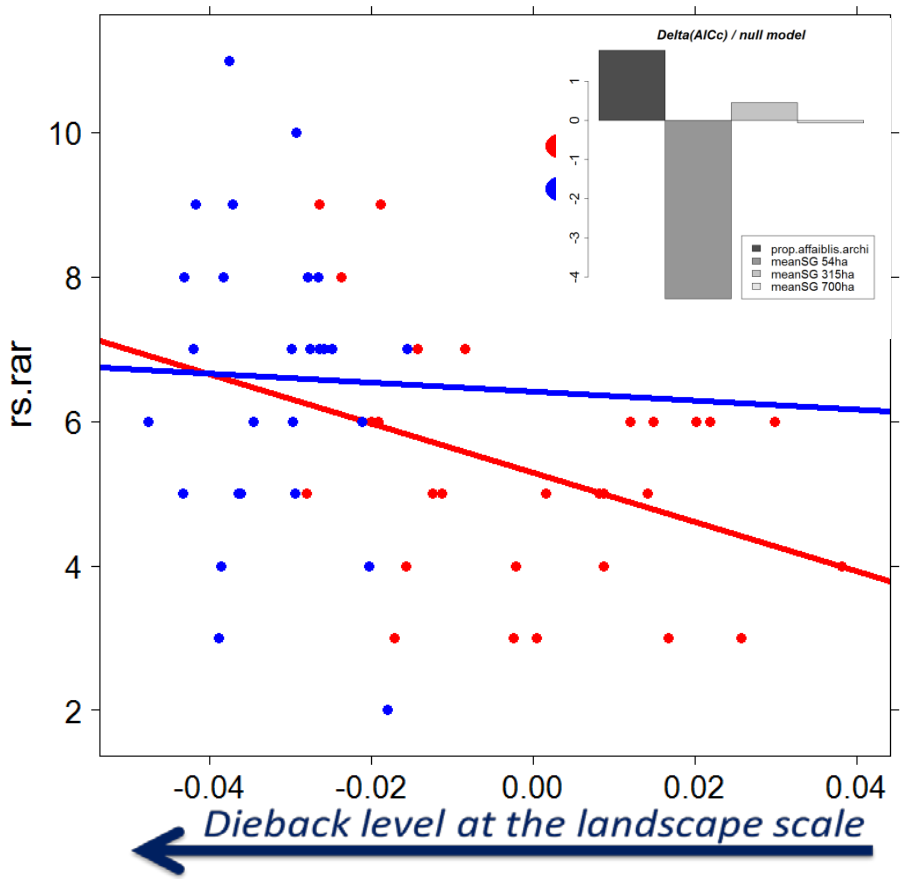




Rare sx beetles increase in richness and abundance with the regional dieback level

54ha-scale

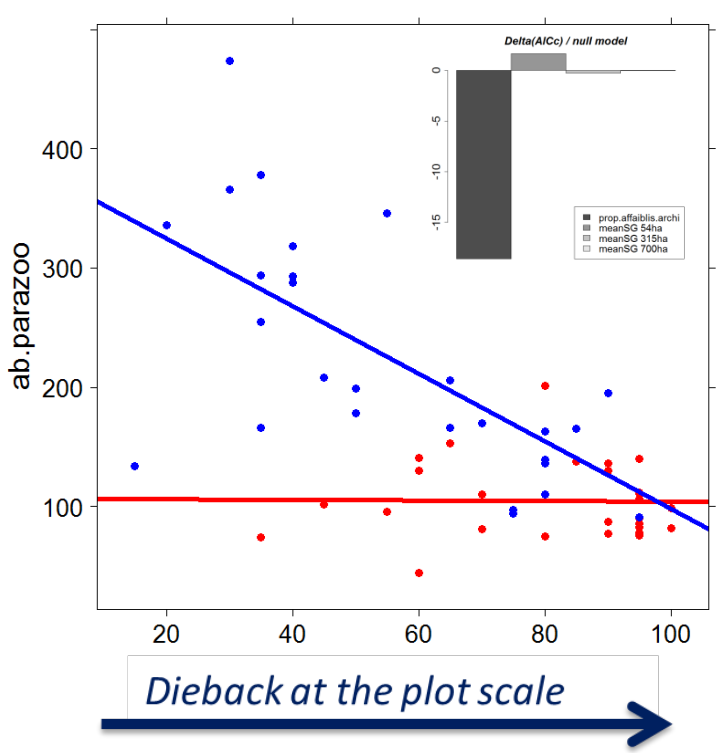


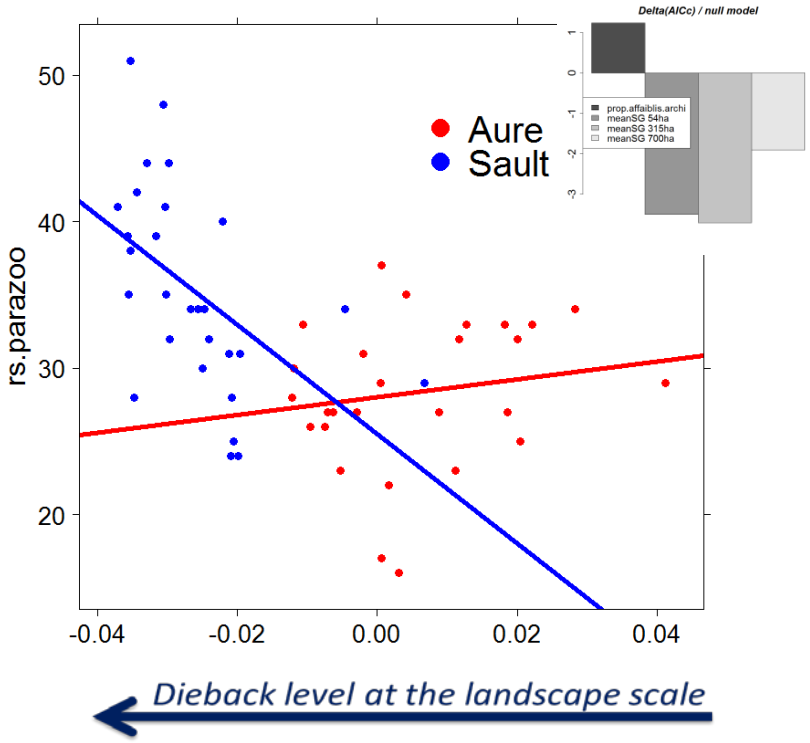


Some functional responses…

In the Sault region :

- fewer sx beetle predator individuals in the most declining stands
- but more sx beetle predator species in the most declining landscapes (315ha)

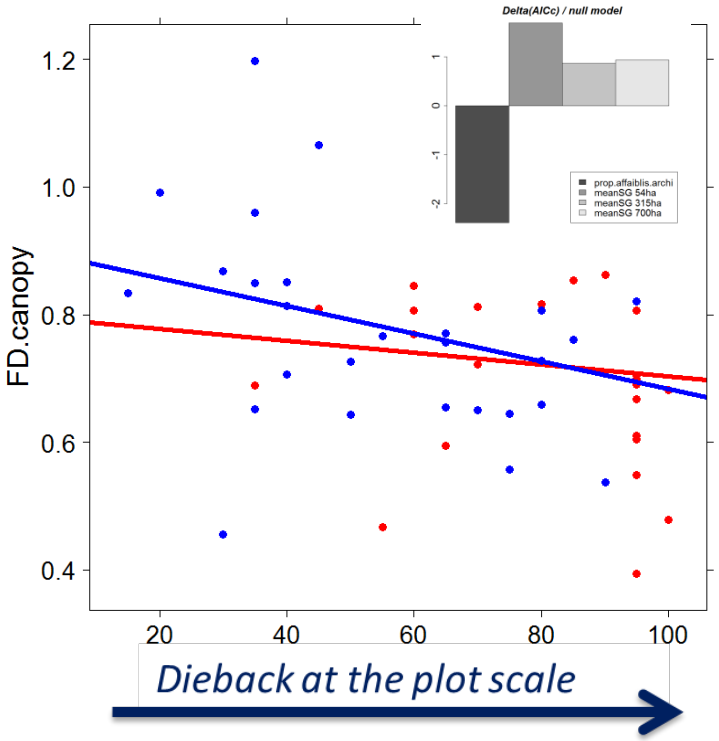


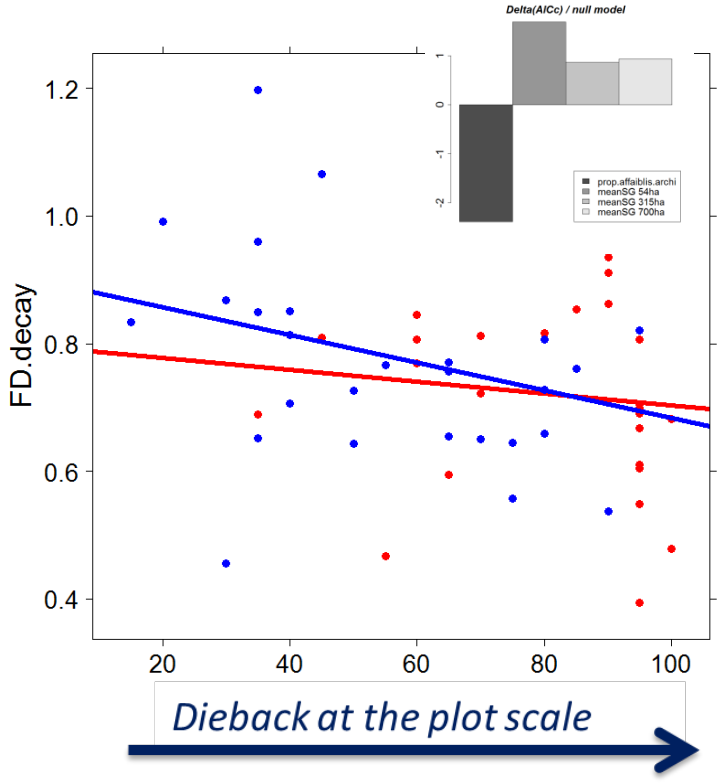


Some functional responses…

Despite potential increase in canopy heterogeneity and deadwood diversity with increasing dieback :

slight but significant decrease of functional dispersion of canopy and decay trait with increasing local dieback

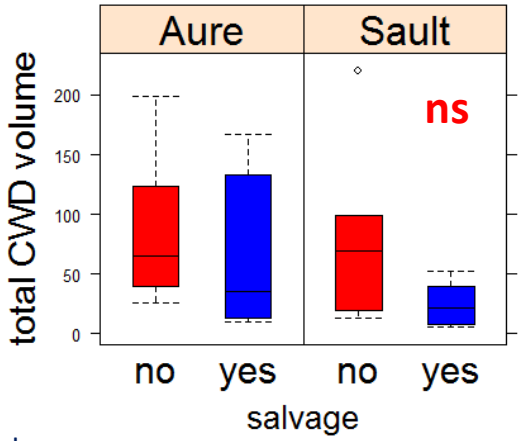


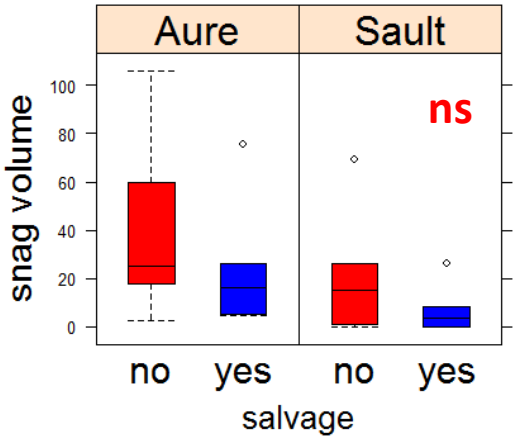


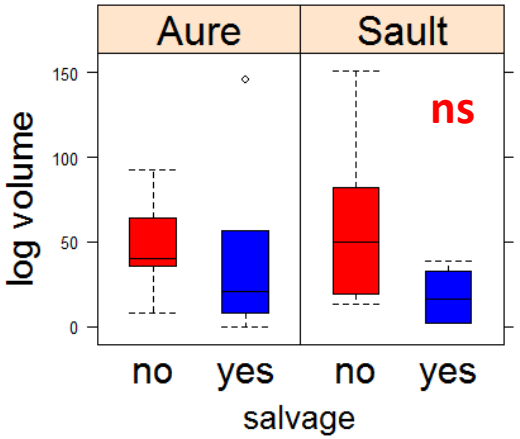
Slight effects of salvage logging on stand structure

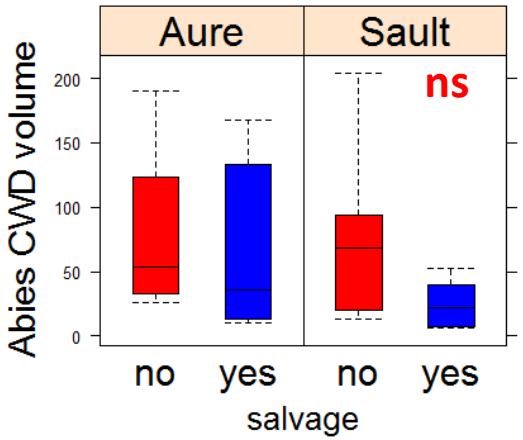
Overall but slight decrease in deadwood…

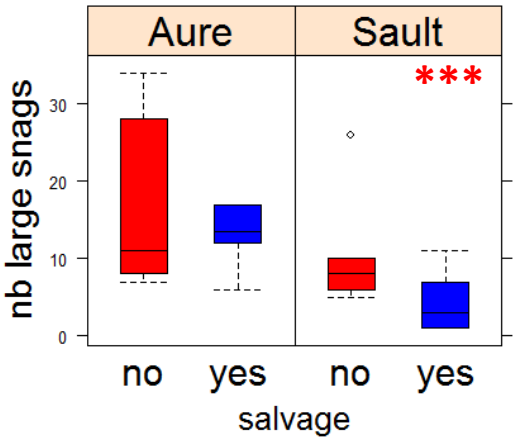
Mixed models
(« region » as a random variable)

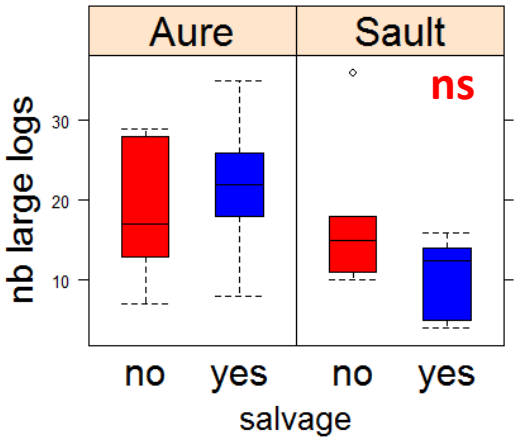












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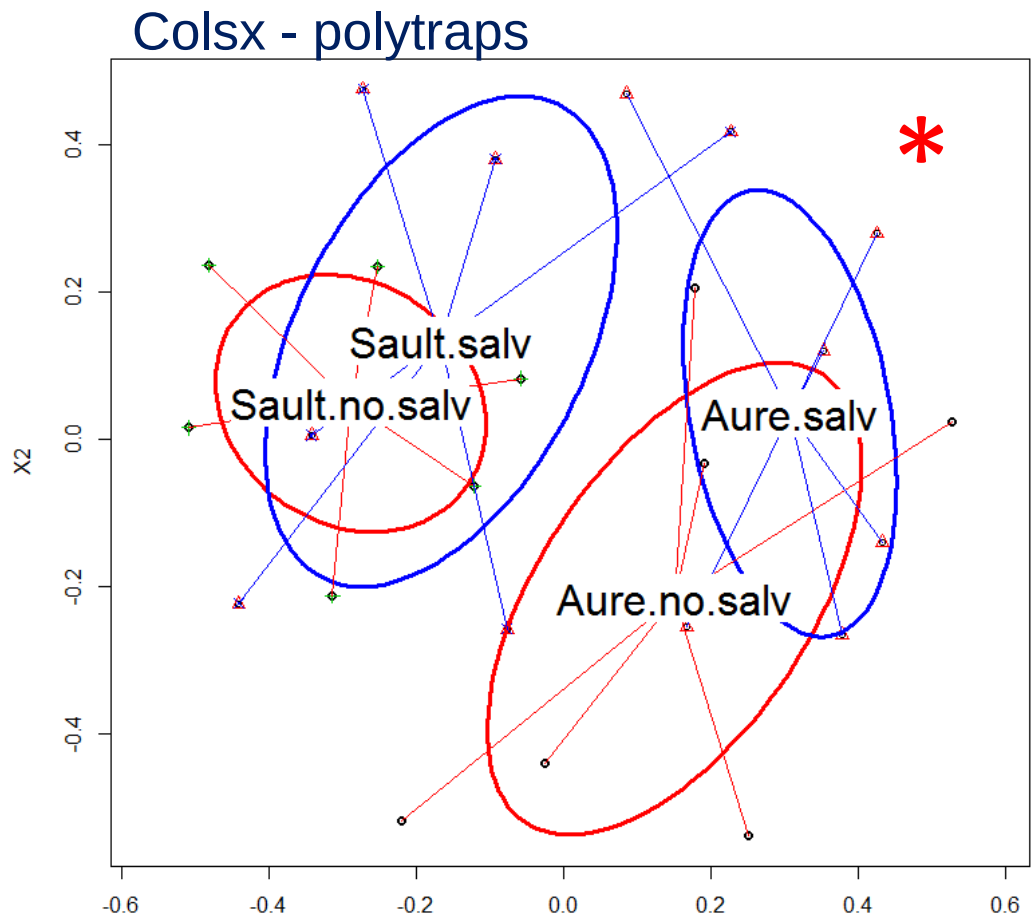
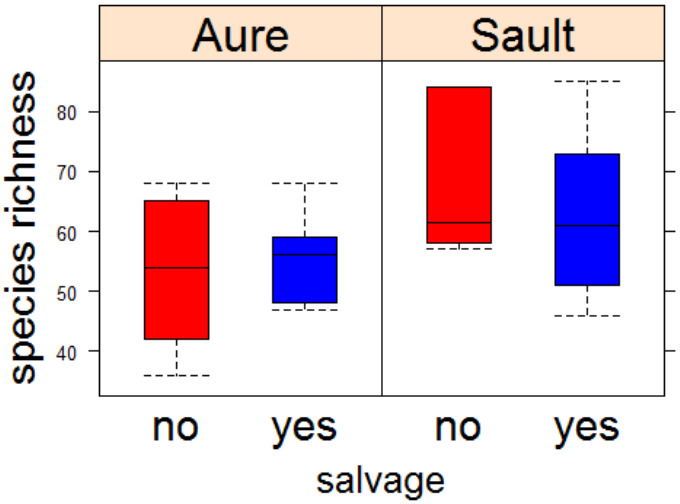
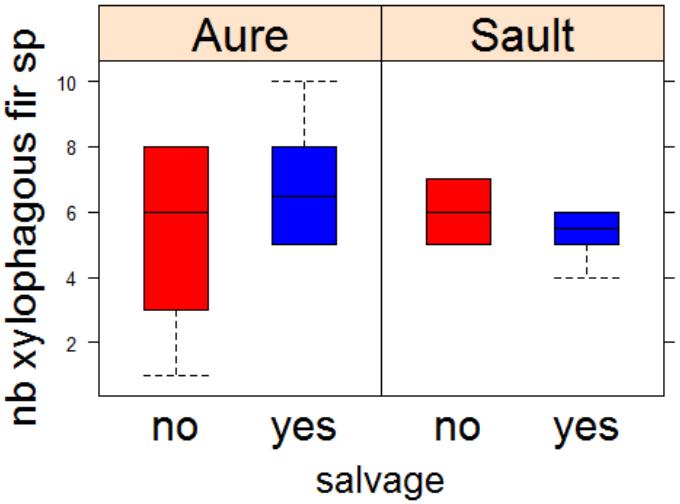
Slight changes induced by salvage logging in community species composition

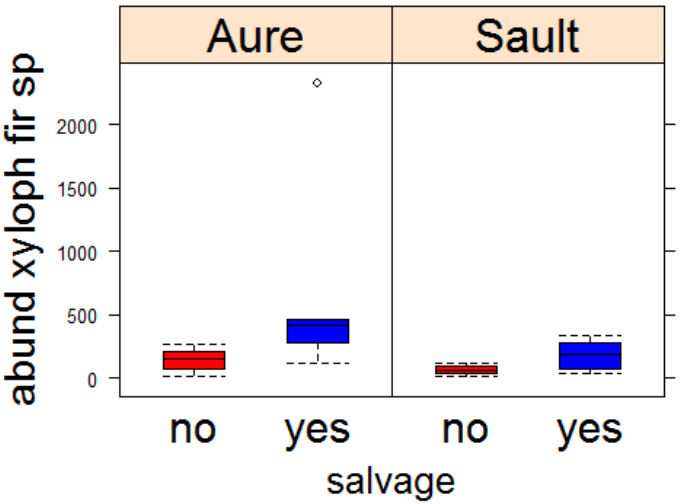


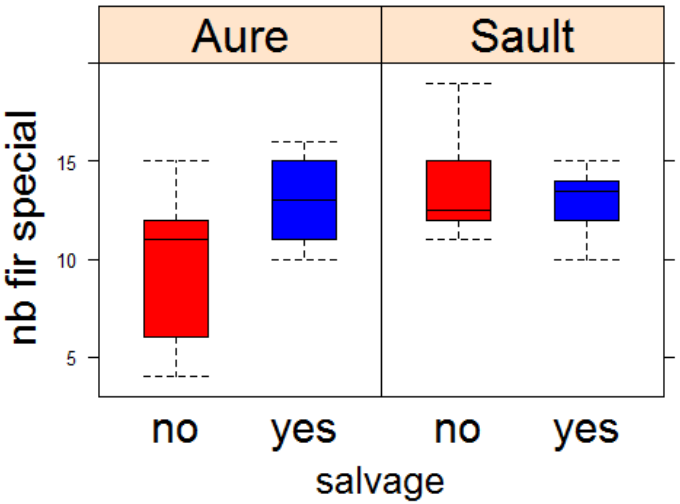
NMDS, Jaccard, singletons excluded, NP Manova

No overall decrease of sx beetles in salvaged stands









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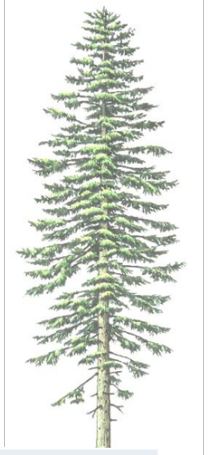
Perspectives

PhD study in forest entomology at Irstea lab

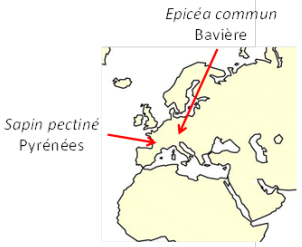
- *How do forest diebacks drive tree-associated insect communities?*
- November 2019 – October 2022
- Jérémy COURS

Merging French and German WFT-caught sx beetle datasets for opportunistic co-analyses ?



France
2017
Silver fir

Treatment
declining stands (n=24 plots)
salvage (n=12 plots)
vital fir forest (n=20 plots)
TOTAL

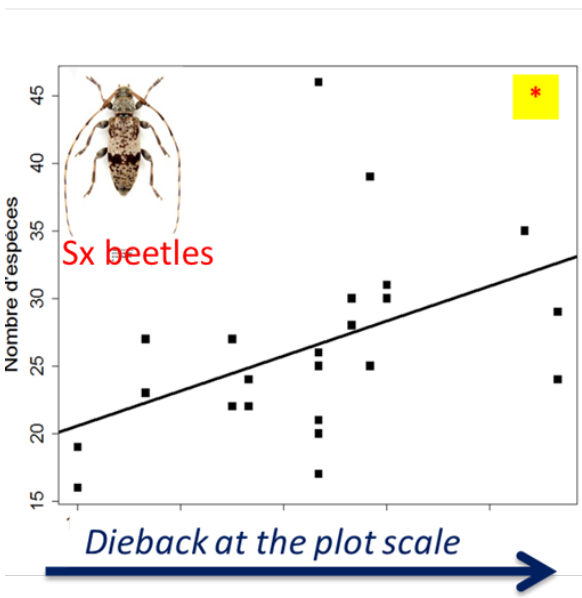


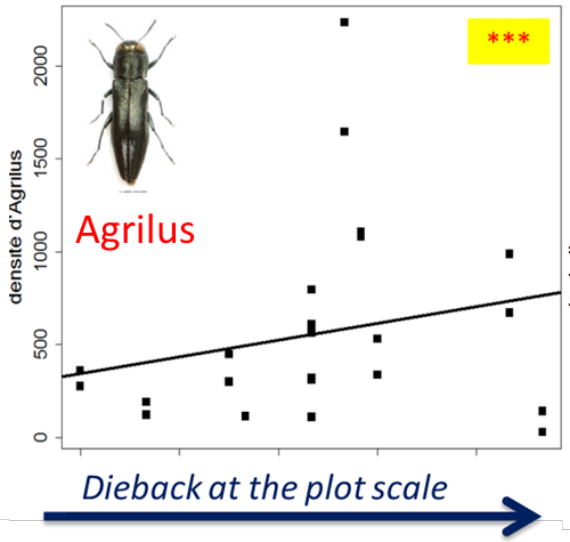
Germany
2016
Spruce

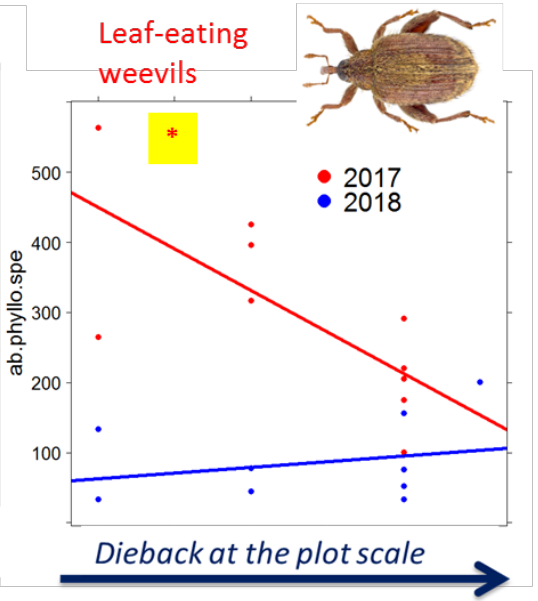
Treatment
Ips forest (n=10 plots)
salvage (n=10 plots)
vital spruce forest (n=10 plots)
TOTAL

Perspectives

+ French research projects focusing on ecological effects of oak diebacks
  - BUCHE & CANOPEE (beetles & lowland oak dieback)
  - Interesting first trends







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Olivier Courtin, Benedikt Feldmann, Pierre Zagatti

….for field, lab and GIS work

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