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Could Tree-related Microhabitats (TreMs) be relevant conservation forestry targets and/or biodiversity indicators ?

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Could Tree-related Microhabitats (TreMs) be relevant conservation forestry targets and/or biodiversity indicators ?

Laurent LARRIEU ¹
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²IRSTEA



LIFE MIPP

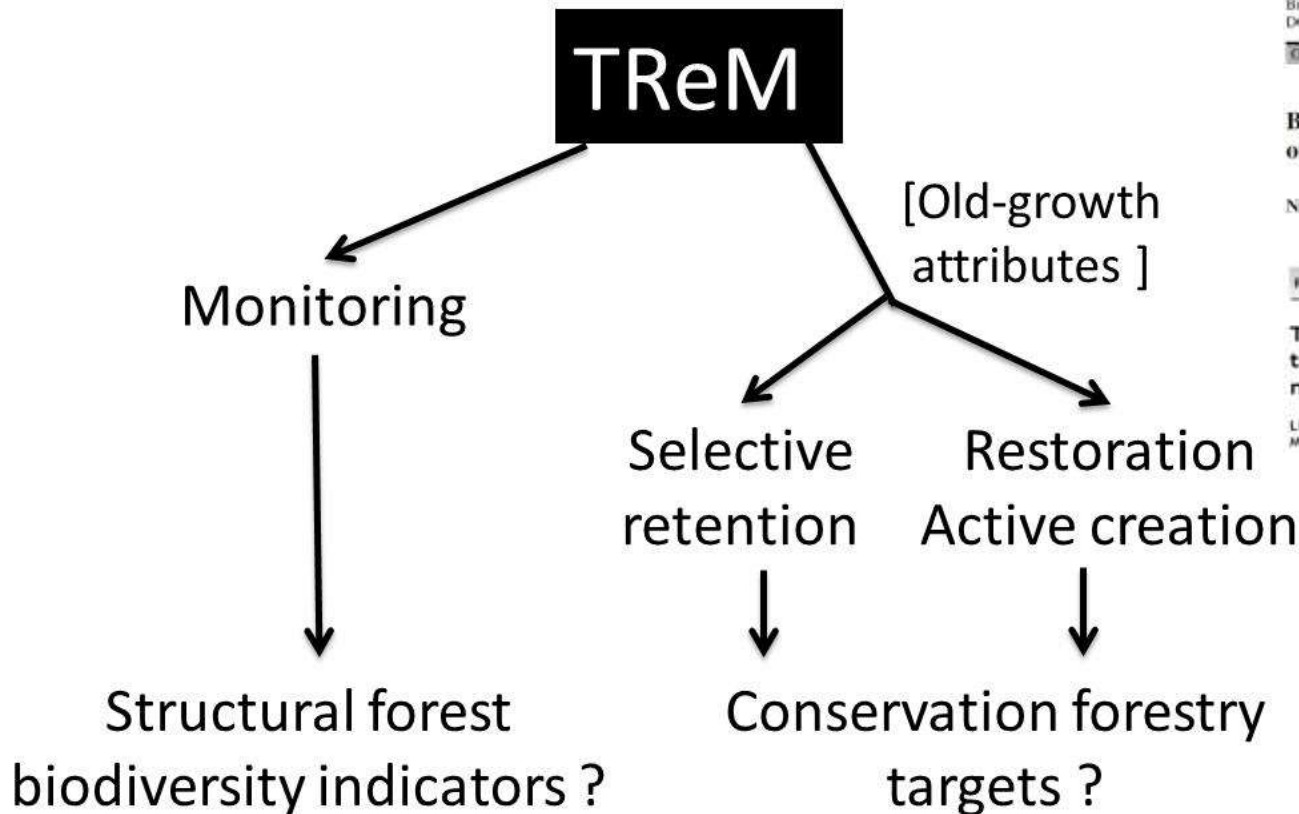
European Workshop

Monitoring of saproxylic beetles and other insects protected in the European Union

Mantova (Italy), 24th - 26th May 2017



TReMs, biodiversity and forestry



Biodivers Conserv (2009) 18:3891–3908
DOI 10.1007/s10531-009-9687-2

ORIGINAL PAPER

Boxes mimicking tree hollows can help conservation of saproxylic beetles

Nicklas Jansson · Thomas Ranius · Anna Larsson · Per Milberg

Research Article · doi: 10.3832/for1281-007

iForest - Bi

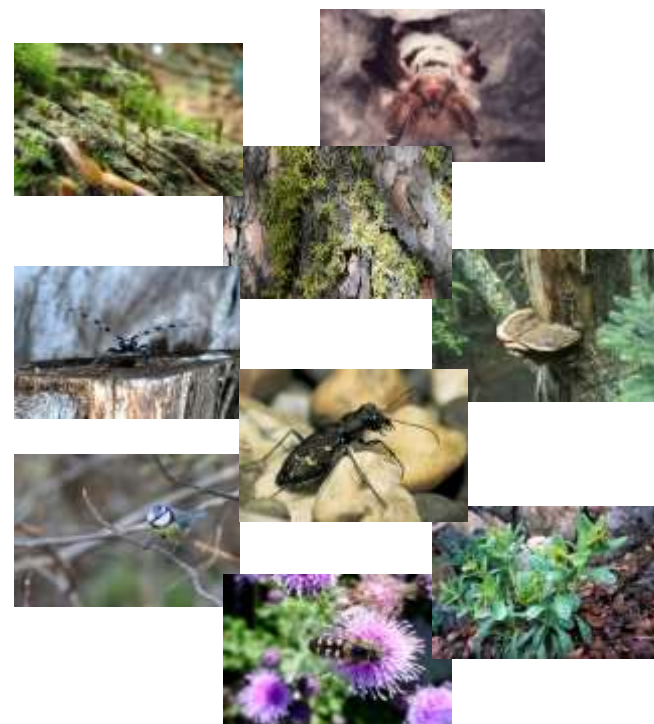
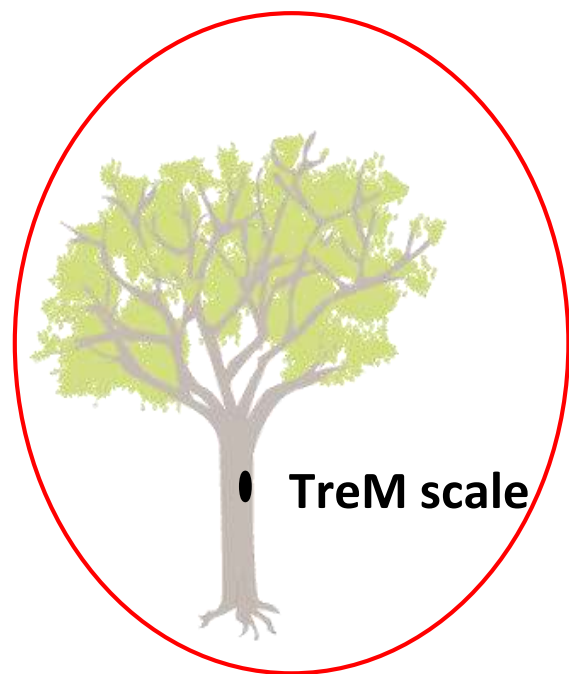
The Habitat-Trees experiment: using exotic tree species as new microhabitats for the native fauna

Livia Zapponi^{1,2}, Emma Minari¹, Luca Longo¹, Ilaria Toni¹, Franco Mason¹, Alessandro Campanaro^{1,3}

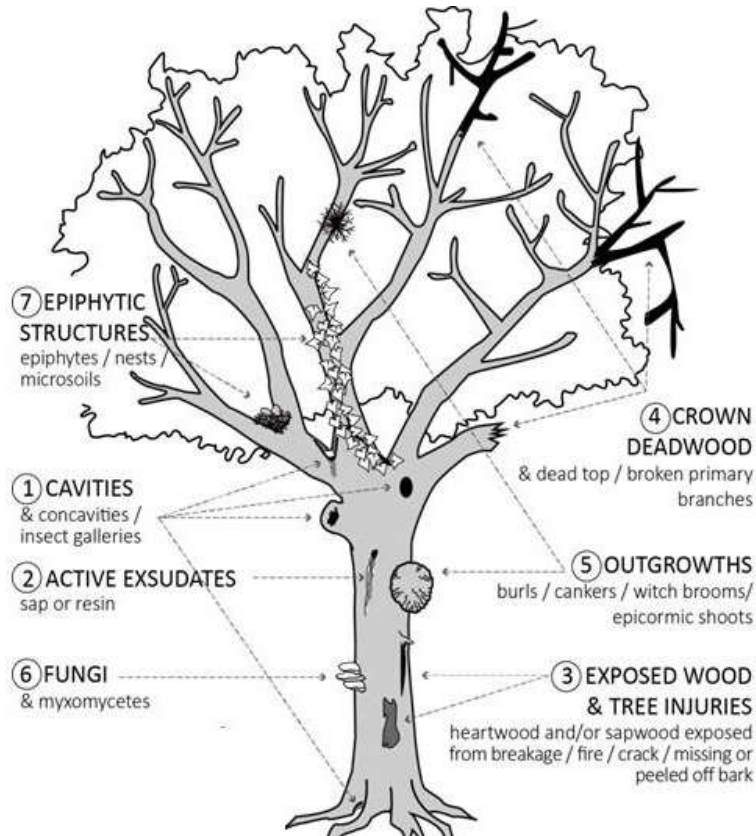
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1-TreMs and biodiversity at the TreM scale



TReMs are morphological singularities borne by living or dead trees



© Emberger (Larrieu & Heinz 2016)



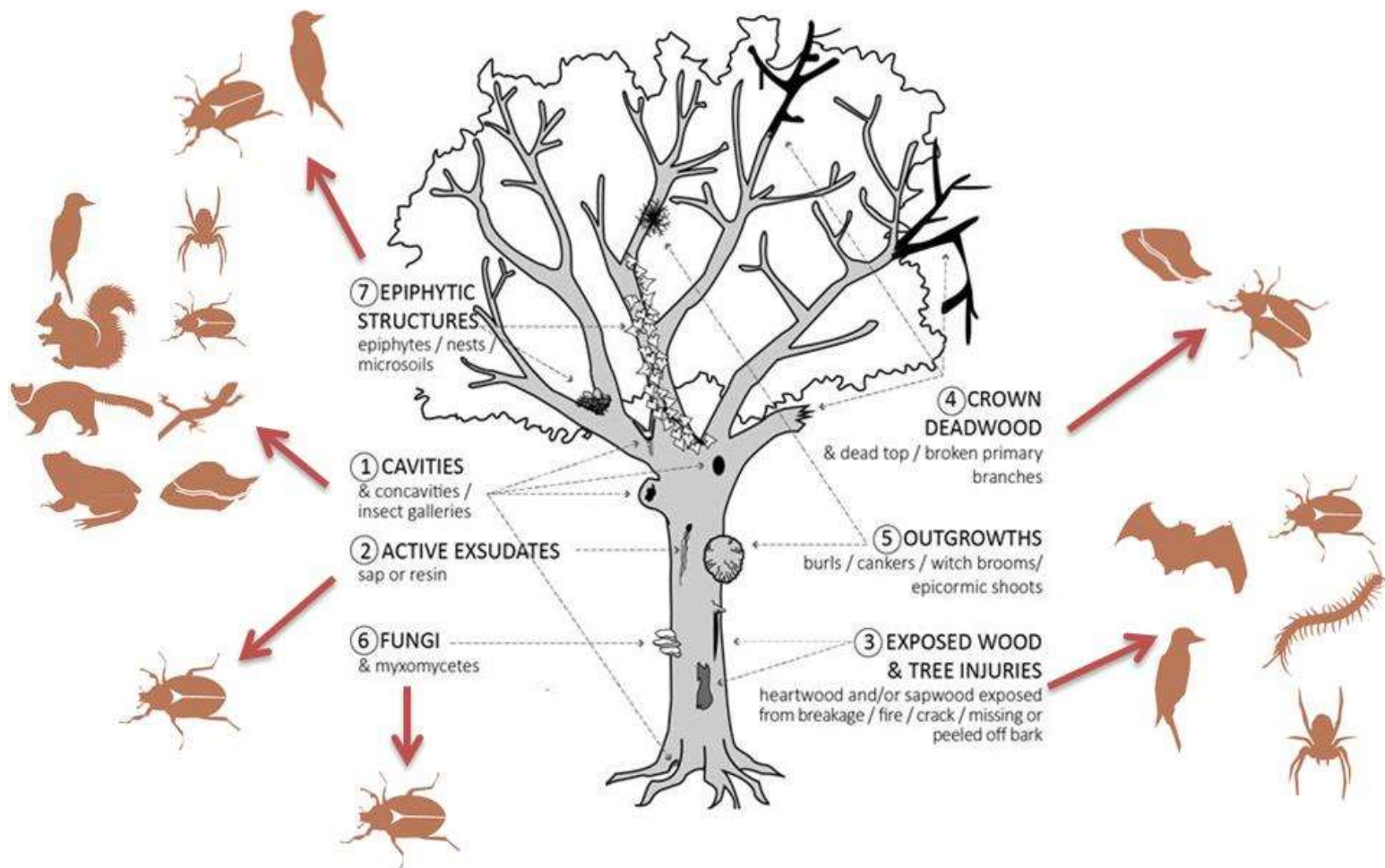
Italian Journal of Agronomy 2016; volume 11(s1)

Forest management for invertebrate conservation

Maarten de Groot,¹ Livia Zapponi,^{2,3} Davide Badano,^{2,3} Serena Corezzola,^{2,3} Franco Mason^{2,3}



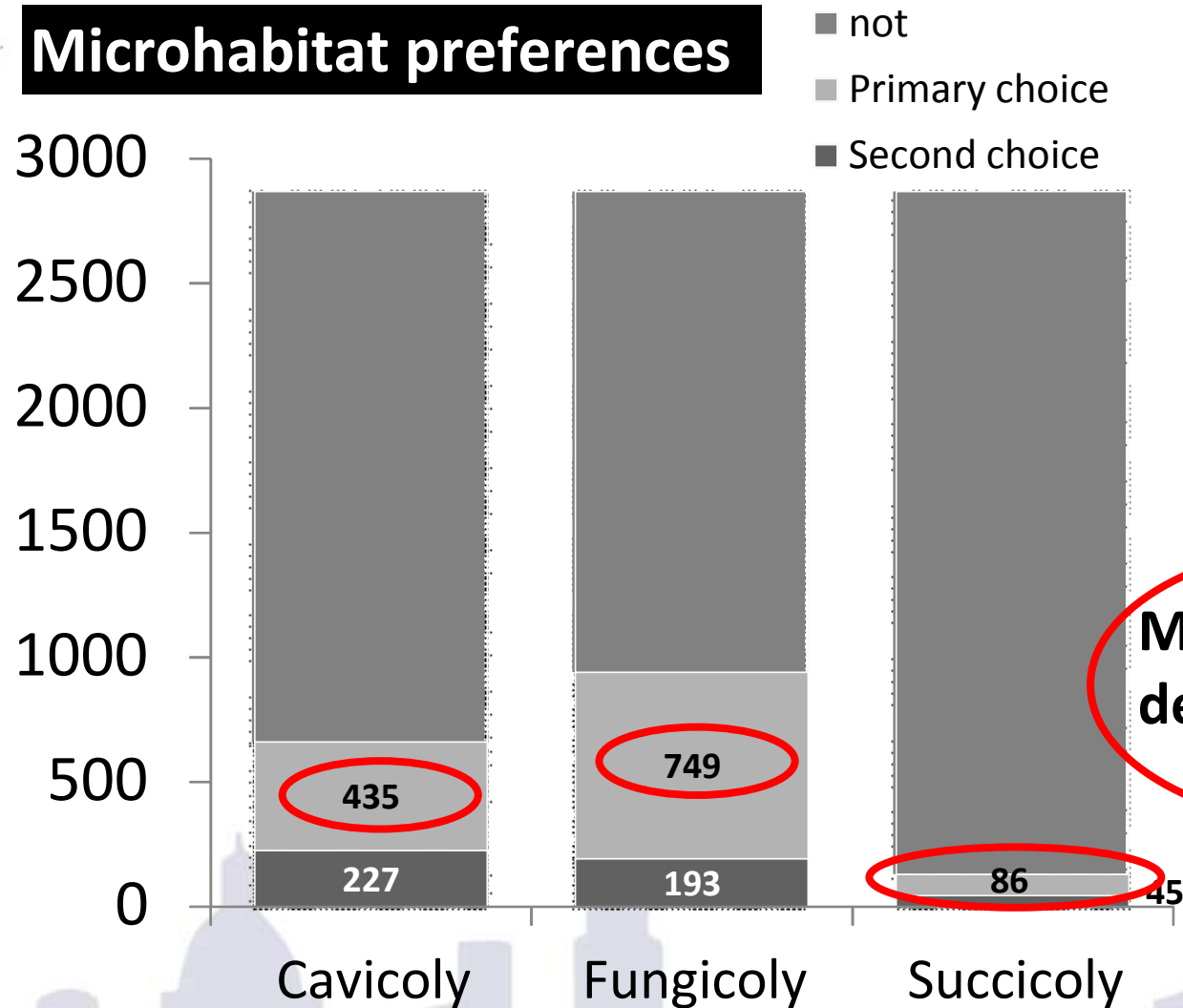
TreMs host a wide diversity of taxa



TreMs host species-rich assemblages



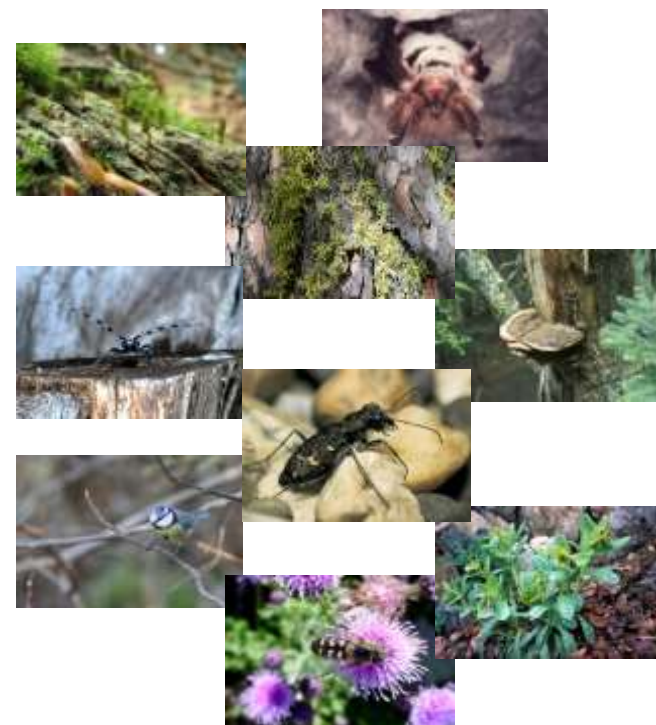
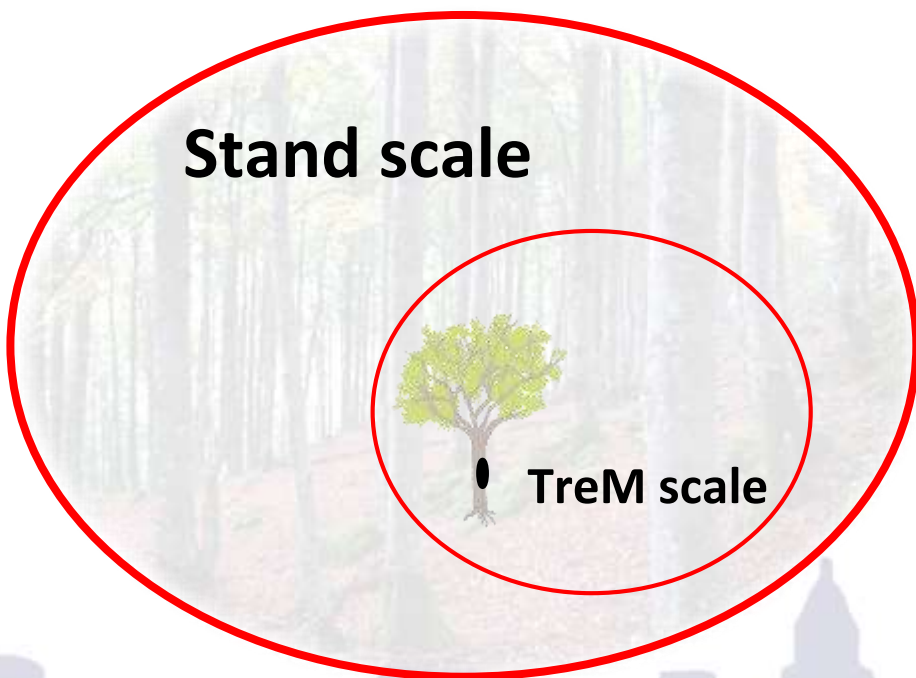
Microhabitat preferences



Bouget et al., in prep.

Many beetles depend on TreMs !

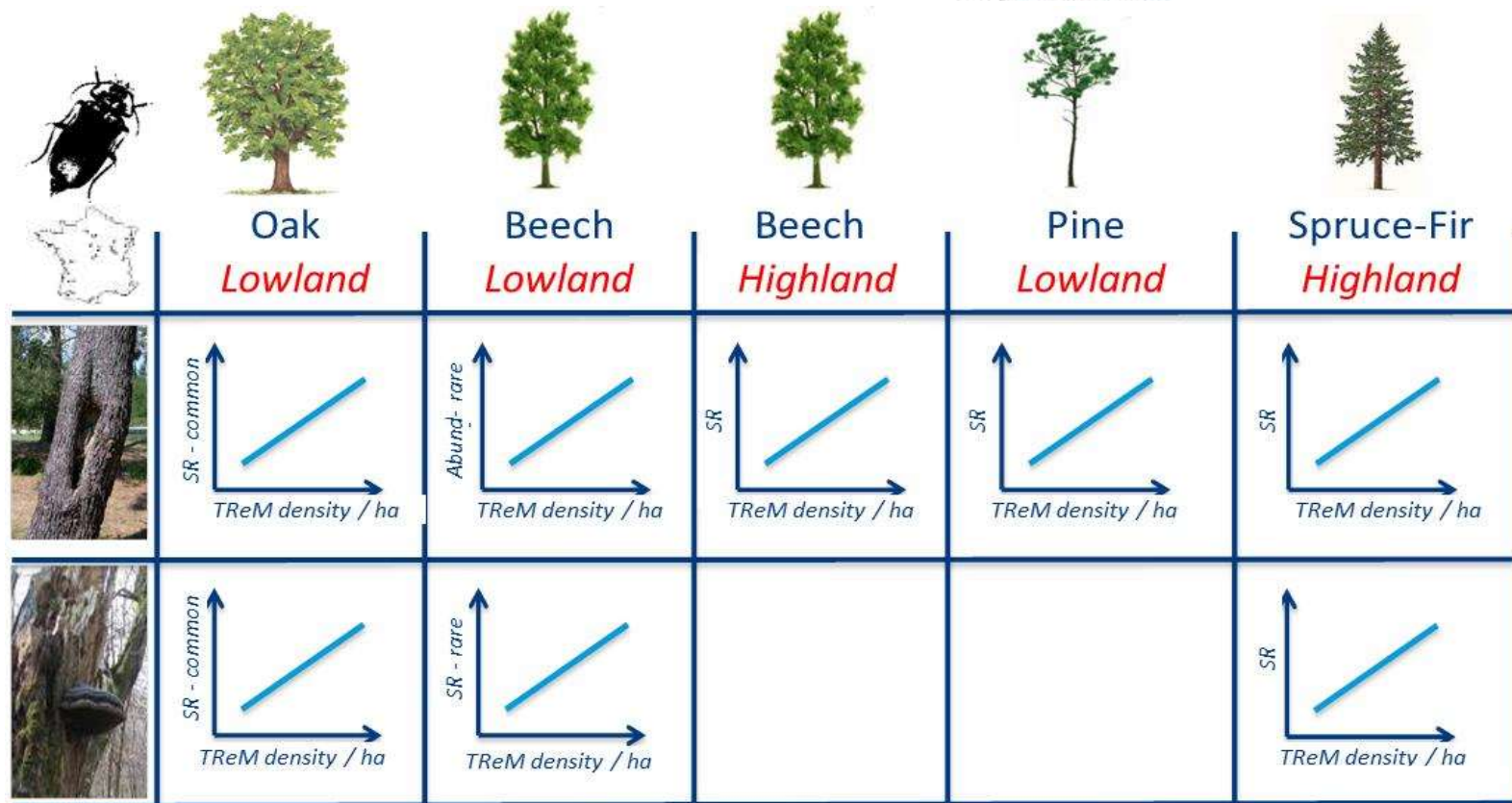
2-TreMs and biodiversity at the stand scale



Saproxylic beetle species richness increases with the local amount of certain TreM-bearing trees in various but not all forest contexts



Key features for saproxylic beetle diversity derived from rapid habitat assessment in temperate forests
C. Boget ^{1,2}, L. Larrieu ^{1,2}, A. Brin ¹



TreMs are significantly associated to variations in species richness, but to a lesser extent than deadwood or openness

Biodivers Conserv (2013) 22:2111–2130
DOI 10.1007/s10531-013-0531-3

ORIGINAL PAPER



In search of the best local habitat drivers for saproxylic beetle diversity in temperate deciduous forests

C. Bouget · L. Larrieu · B. Nusillard · G. Parmain

Key factors of saproxylic beetle diversity



lowland deciduous forests

		<u>rare sp</u>		<u>common sp</u>	
Oak 	Abiotic	2=Openness		1=Openness	
	Deadwood	1=Deadwood diversity		2= Lying deadwood volume 3= Large lying deadwood volume 4= Deadwood diversity	
	TReMs	ns		5=density fungus-bearing trees 6=density cavity-bearing trees	
Beech 	Abiotic	ns		1=Openness	
	Deadwood	ns		2=Deadwood diversity	
	TReMs	1=density fungus-bearing trees		3=density crown-deadwood-bearing trees	

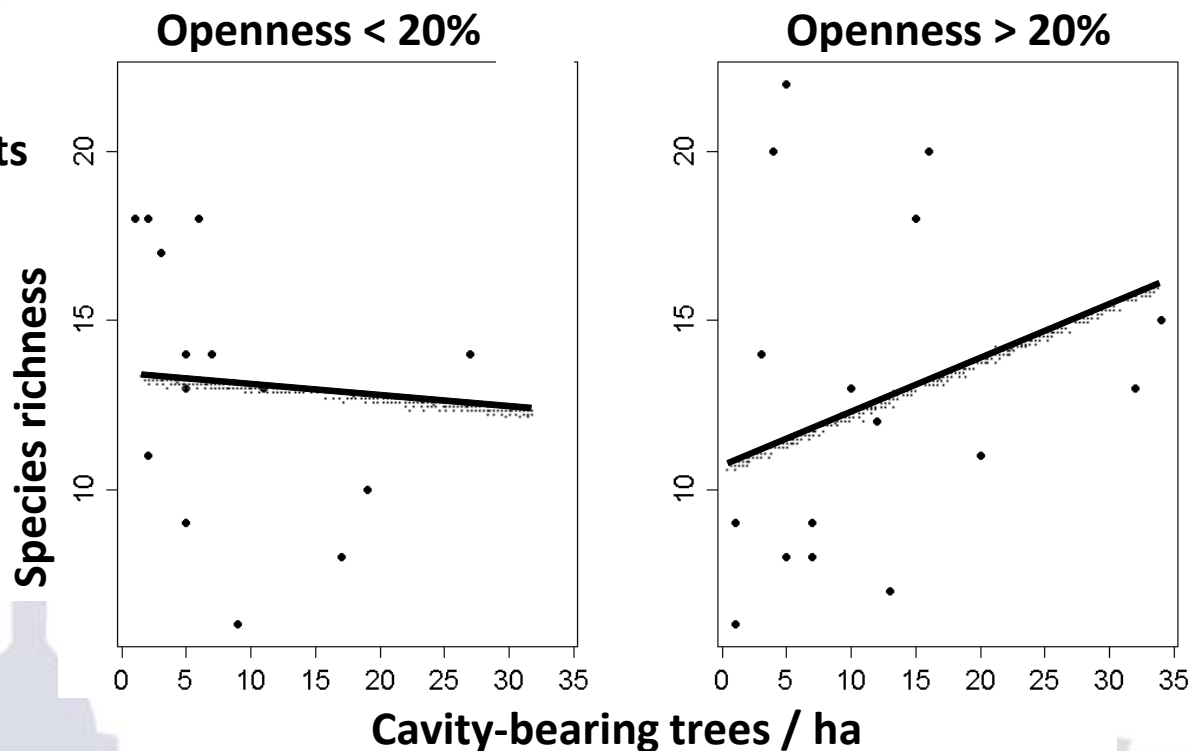


Some relationships between TreM density and saproxylic beetle diversity depend on stand openness



Key features for saproxylic beetle diversity derived from rapid habitat assessment in temperate forests

C. Bouget^{1,*}, L. Larrieu^{2,3}, A. Brin⁴



TreM diversity only slightly correlates with saproxylic beetle assemblage structure



highland forests


Contents lists available at ScienceDirect
Biological Conservation
 journal homepage: www.elsevier.com/locate/bioco




Forest continuity acts congruently with stand maturity in structuring the functional composition of saproxylic beetles



Philippe Janssen ^{a,*}, Marc Fuhr ^a, Eugénie Cateau ^c, Benoit Nusillard ^b, Christophe Bouget ^b

	Mean trait CWM	Trait variance FDIs	Sp. richness	Abundance
 Body Size	ns	ns		
Canopy prefer.	ns	ns		
Decay prefer.	↗	↗		
Diameter prefer.	↗	ns		
Low-dispersal			ns	ns
High-dispersal			ns	ns
Cavicolous			ns	ns
Fungicolous			ns	ns

3-Why are TreM-biodiversity relationships so weak at stand scale in ecological studies?



TreM metrics

□ TreM values are too low in managed forests?

- Values below ecological thresholds ?

– Bad biodiversity sampling ?

- Analysis of the response of TReM-associated organisms only
- sampling methods dedicated to TReM-associated organisms

– Bad TReM sampling ?

Trem density and diversity are affected by forestry



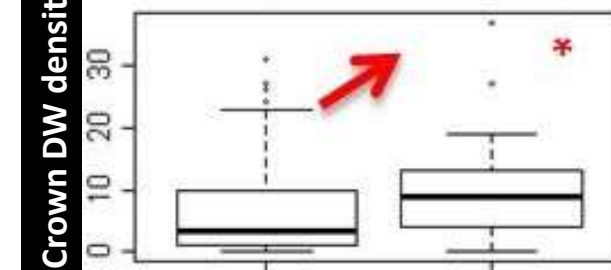
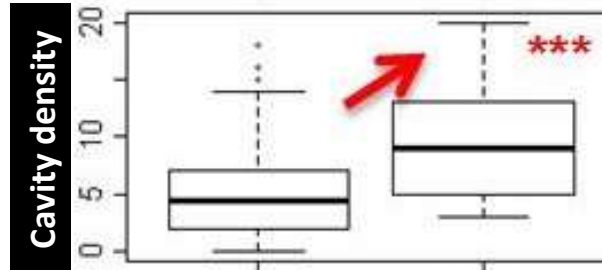
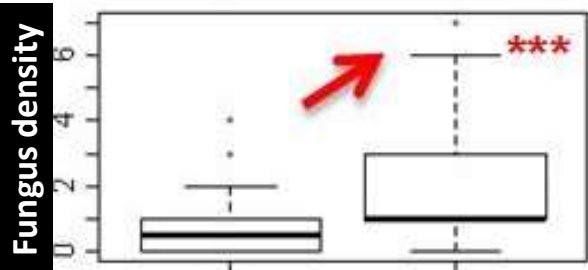
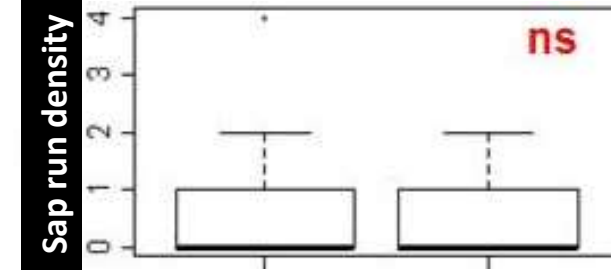
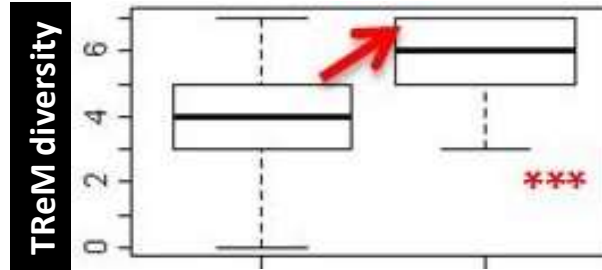
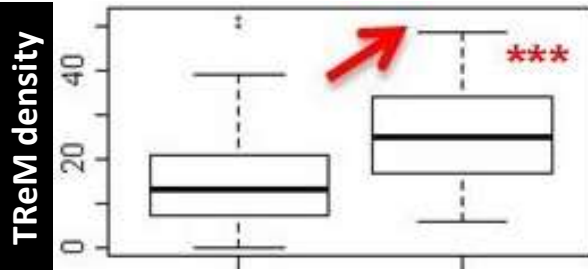
Animal Conservation

ZSL

Animal Conservation, Print ISSN 1367-8430

Does a set-aside conservation strategy help the restoration of old-growth forest attributes and recolonization by saproxylic beetles?

C. Bouget¹, G. Parmain^{1,2,3}, O. Gilg⁴, T. Noblecourt⁵, B. Nusillard⁶, Y. Paillet¹, C. Pernet¹, L. Larrieu^{5,6} & F. Gosselin¹



Harvested Unharv > 30 yrs

Harvested Unharv > 30 yrs

Harvested Unharv > 30 yrs

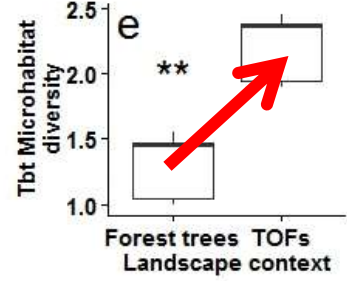
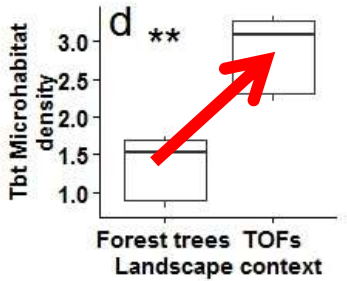
TreM density and diversity are higher in and around veteran trees outside than inside forests

Insect Conservation and Diversity

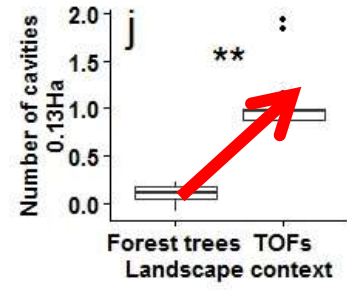
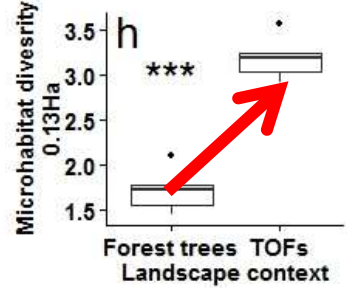
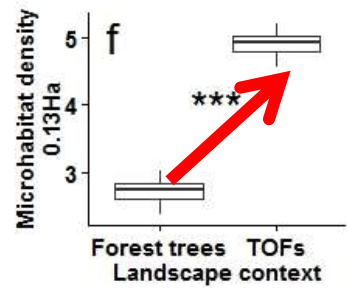
Parmain & Bouget, 2017



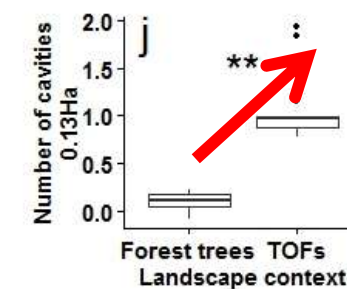
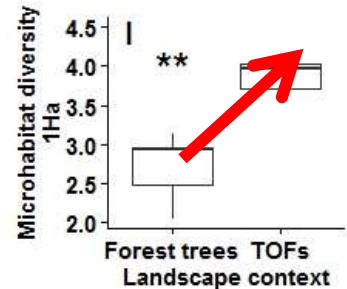
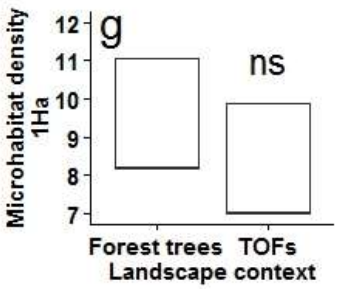
Veteran tree scale



0.13ha-scale



1ha-scale



TreM effects increase with TreM values

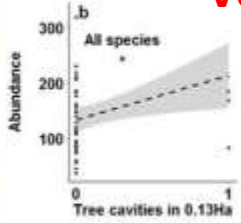
➔ The effects of TreM metrics on saproxylic beetle diversity are stronger outside than inside forests!



Veteran trees inside forest



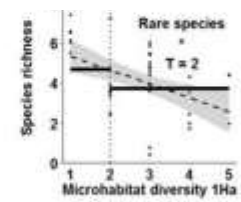
All sx beetle species



Rare sx beetle species

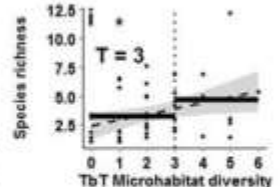
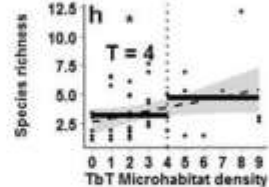
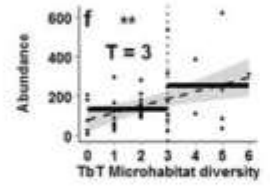
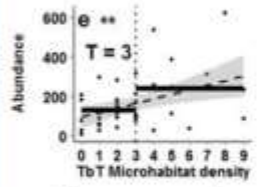
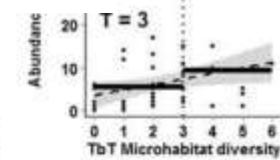
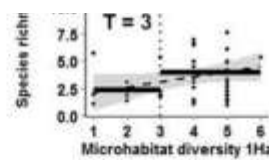
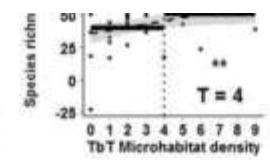
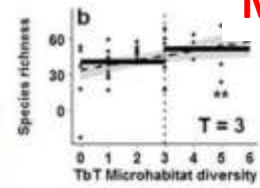


Very few positive effects inside forest



Veteran trees outside forests

Many positive effects outside forest



Insect Conservation and Diversity

Parmain & Bouget, 2017



TReM sampling

Low TReM values in managed forests ?

Irrelevant TreM sampling ?

– Bad biodiversity sampling ?

- Analysis of the response of TReM-associated organisms only
- Sampling methods dedicated to TReM-associated organisms
- Multi-taxon approaches



Facing low TreM detectability...by the use of proxies?

Environmental variables (1ha-plot)

Density of very large trees (dbh>70cm)

Density of living TreM-bearing trees

Taxa (Composition)

Saproxylic beetles

Bats

Bryophytes

Lichens

Birds


Hoverflies

Fungi



487 plots
19 areas

Larrieu et al., in prep.

 $p < 0.001$
 $p < 0.05$

Biodiversity metrics

Low TReM values in managed forests ?

Irrelevant biodiversity metrics ?

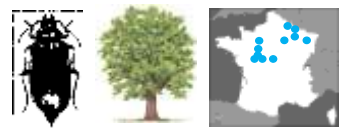
- Diversity of TreM-associated taxa only vs overall diversity
- sampling methods dedicated to TReM-associated organisms

– Bad TReM sampling ?



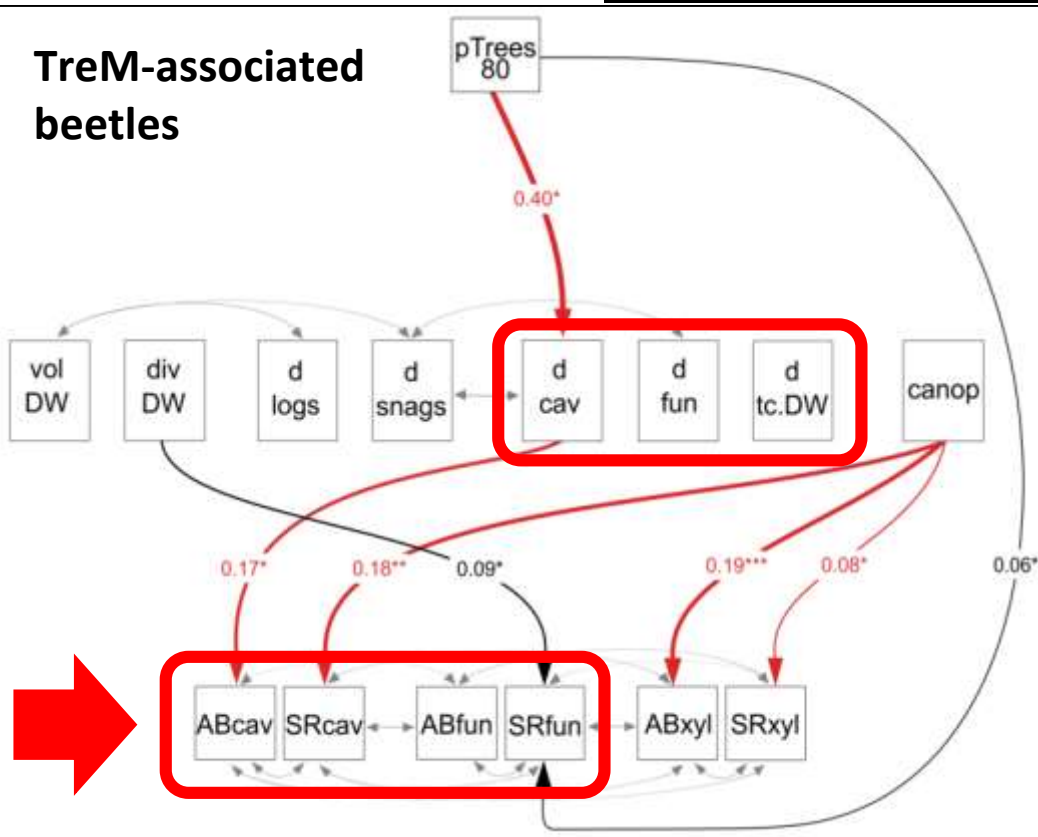
TreMs are fostered by an extended rotation...

...but only TreM-associated (and not all saproxylic) taxa correlate to TreM rise

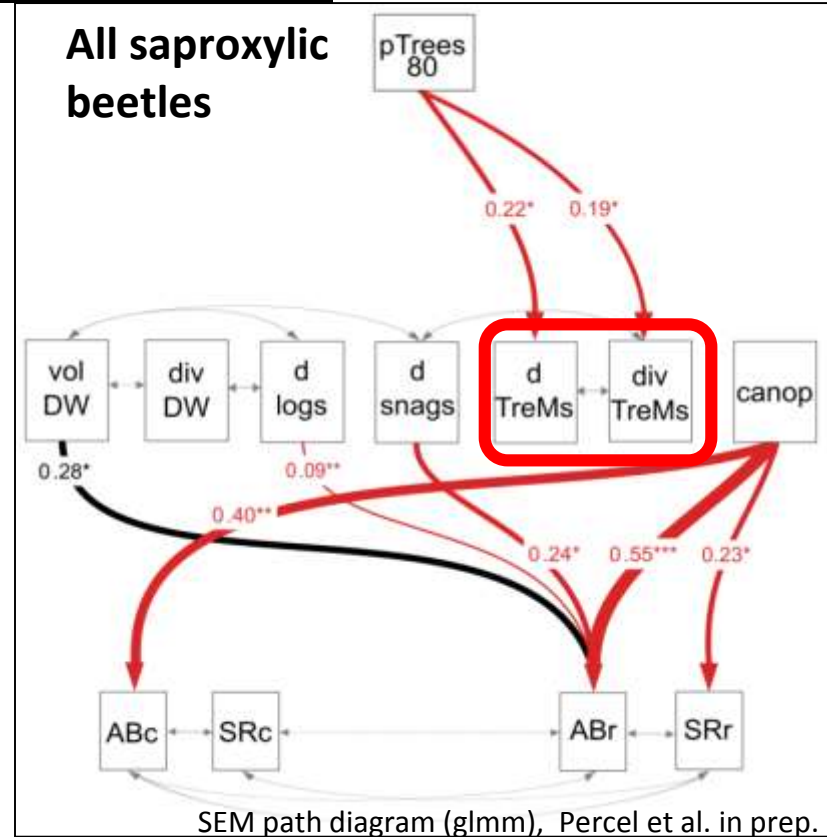


Extended rotation (+ 50 yrs)

TreM-associated beetles



All saproxylic beetles



SEM path diagram (glmm), Percel et al. in prep.

Biodiversity metrics

Low TReM values in managed forests ?

Irrelevant biodiversity metrics ?

- Saproxylic beetles only vs Multi-taxon approaches
- sampling methods dedicated to TReM-associated organisms

– Bad TReM sampling ?



Monitoring more taxa --> more TreM-biodiversity relationships

...sometimes difficult to interpret

Environmental variables (1ha-plot)

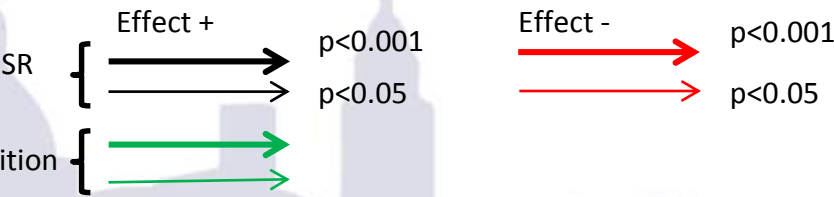
Sp richness/composition

- Density of cavity-bearing trees
- Density of fungus-bearing trees
- Density of missing-bark-bearing trees
- Density of epiphyte-bearing trees
- Diversity of TreM types
- Density of TreM-bearing trees

- Saproxylic beetles
- Bryophytes
- Bats
- Birds
- Hoverflies
- Fungi
- Lichens



487 plots
19 French forest areas
Larrieu et al., in prep.



Biodiversity sampling

Low TReM values in managed forests ?

Irrelevant biodiversity sampling ?

- Analysis of the response of TReM-associated organisms only
- Freely hanging flight interception traps

VS

sampling methods explicitly dedicated to TreM-associated taxa

– Bad TReM sampling ?

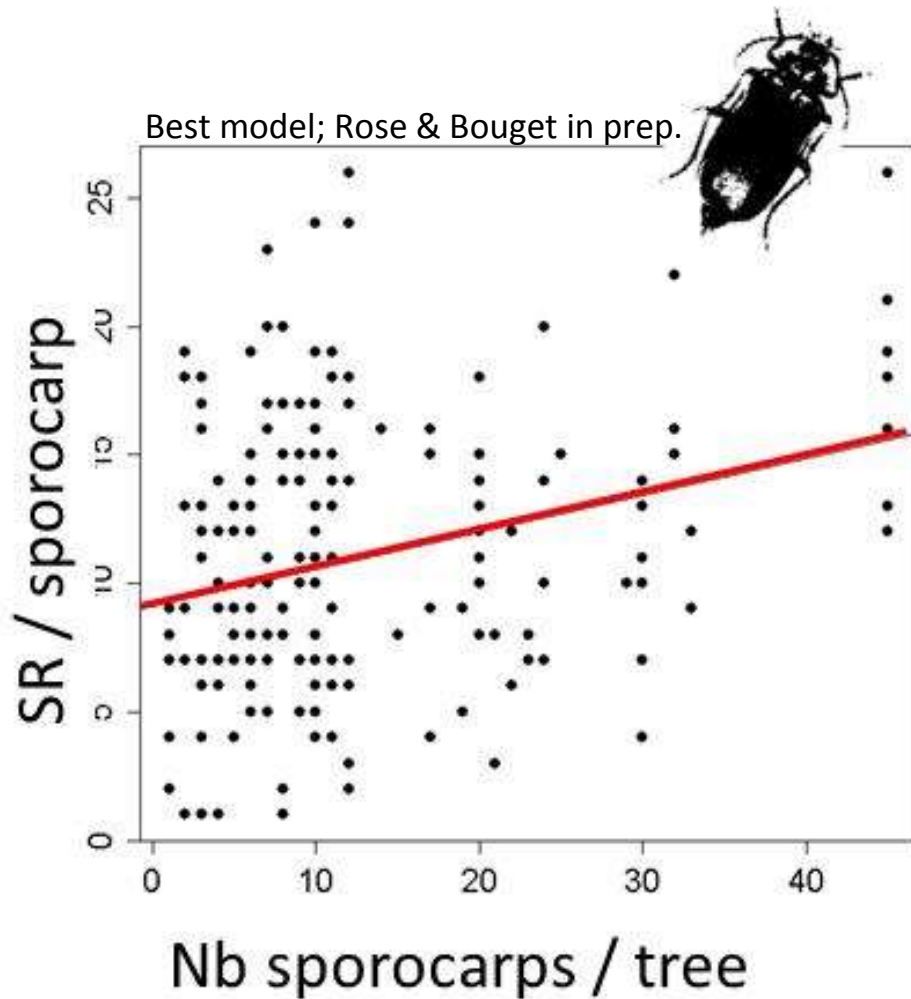
Stronger TreM effects are demonstrated by using dedicated methods to sample TreM-associated beetles

Selection of

1. Biodiversity metrics of TreM associated taxa (fungus-dwelling)
2. TreM metrics (polypore density)



Specific sampling:
polypore emergence trap



Conclusion

- ❑ At the stand scale: study results about TreM effects on biodiversity showed low significance, magnitude and consistency

- ❑ Need of protocol and analysis improvements
 - taxon sampling method adequation
 - TreM sampling
 - relevant variables

TreMs are actually key structures for biodiversity

But...

Further research is required to inspire quantitative management guidelines...

Acknowledgements

❑ Our PhD students

Aurore Lassauce

Gwendoline Percel

Guillem Parmain

Philippe Janssen

❑ ...and technicians

Carl Moliard

Benoit Nusillard

Laurent Burnel

Jérôme Wilmm

Be patient,
kid;
come back
in 2117!



Thank you for your attention