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Could TReMs be relevant conservation forestry targets and/or biodiversity indicators ?

Christophe Bouget, Laurent Larrieu

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Could TReMs be relevant conservation forestry targets and/or biodiversity indicators ?

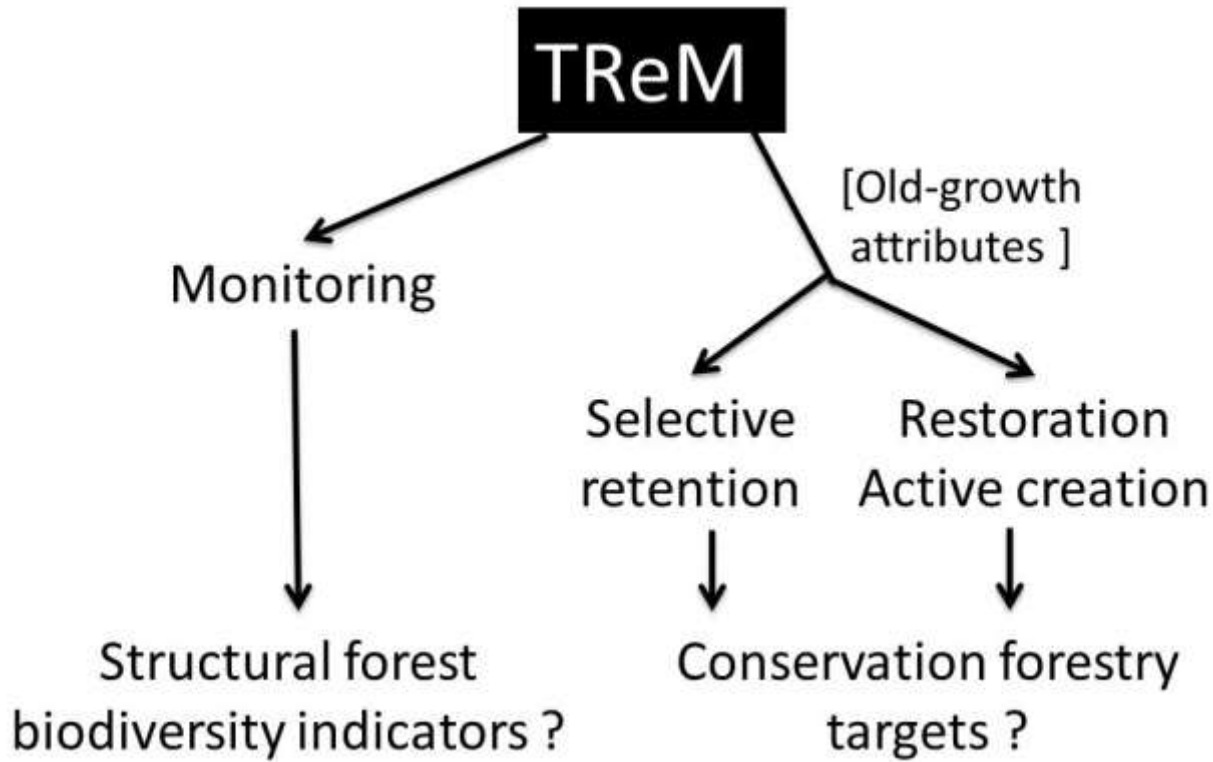


Christophe BOUGET & Laurent LARRIEU



Forest Conservation 2nd Conference
Bavarian National Park, Neuschönau, 26-29/04/2017

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

Forest - Bi

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

Livia Zapponi^{1,2}, Emma Minardi¹, Luca Longo¹, Ilaria Toni¹, Franco Mason¹, Alessandro Campanaro^{1,3}

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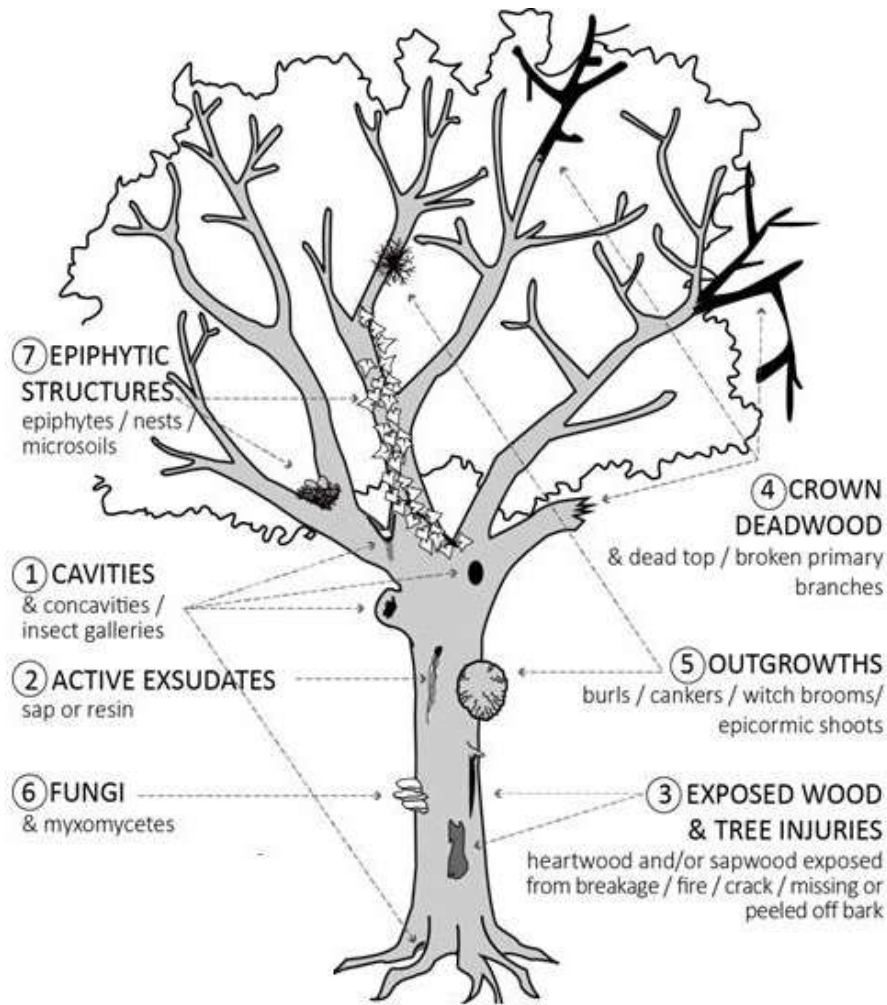
TReMs and biodiversity

What are Tree-Related Microhabitats (TReMs)?

1



What are Tree-Related Microhabitats (TReMs)?



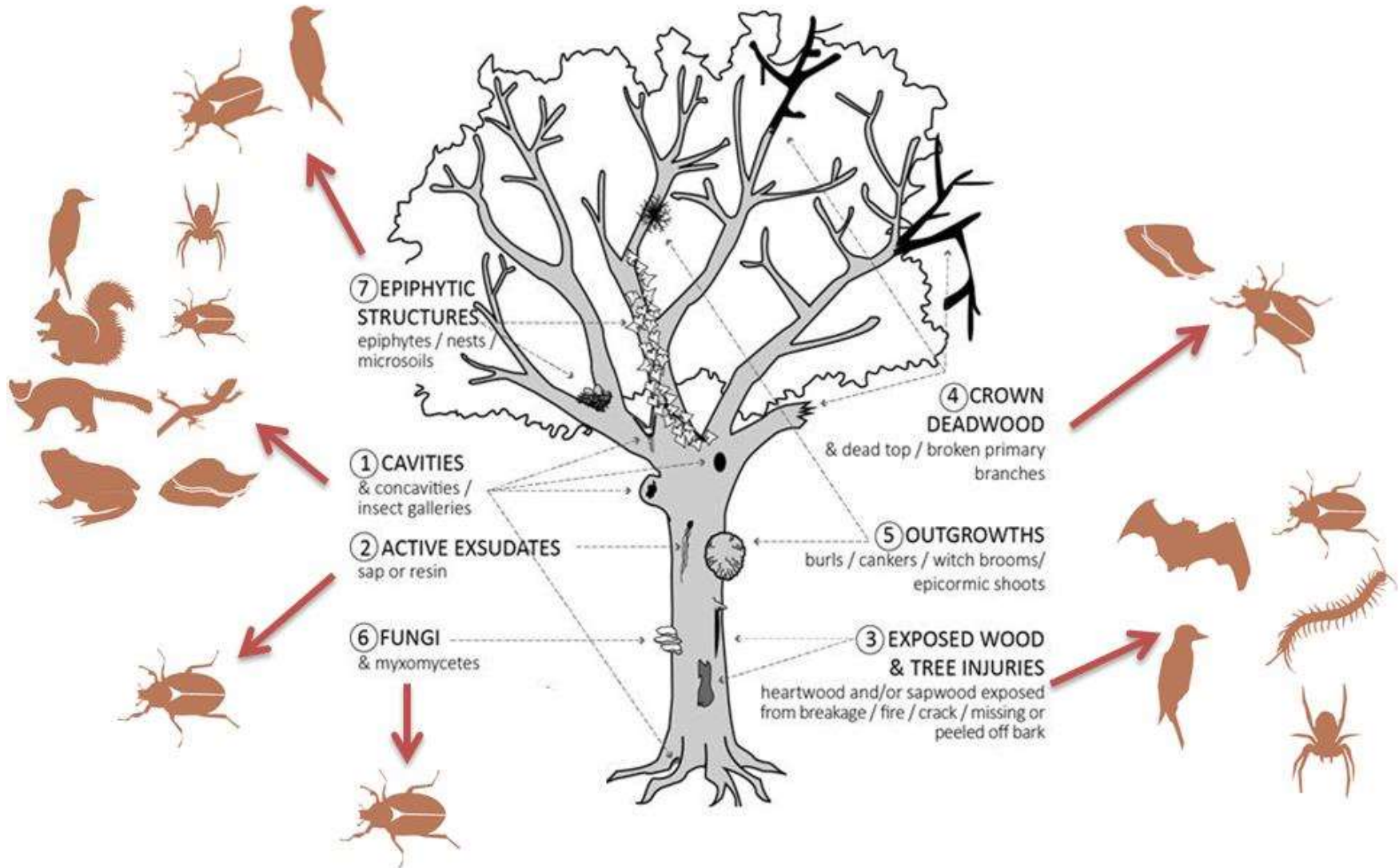
© Emberger (Larrieu & Heinz)

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

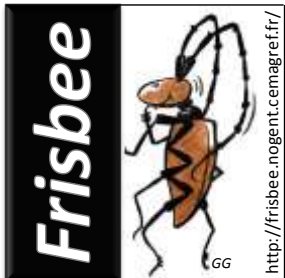
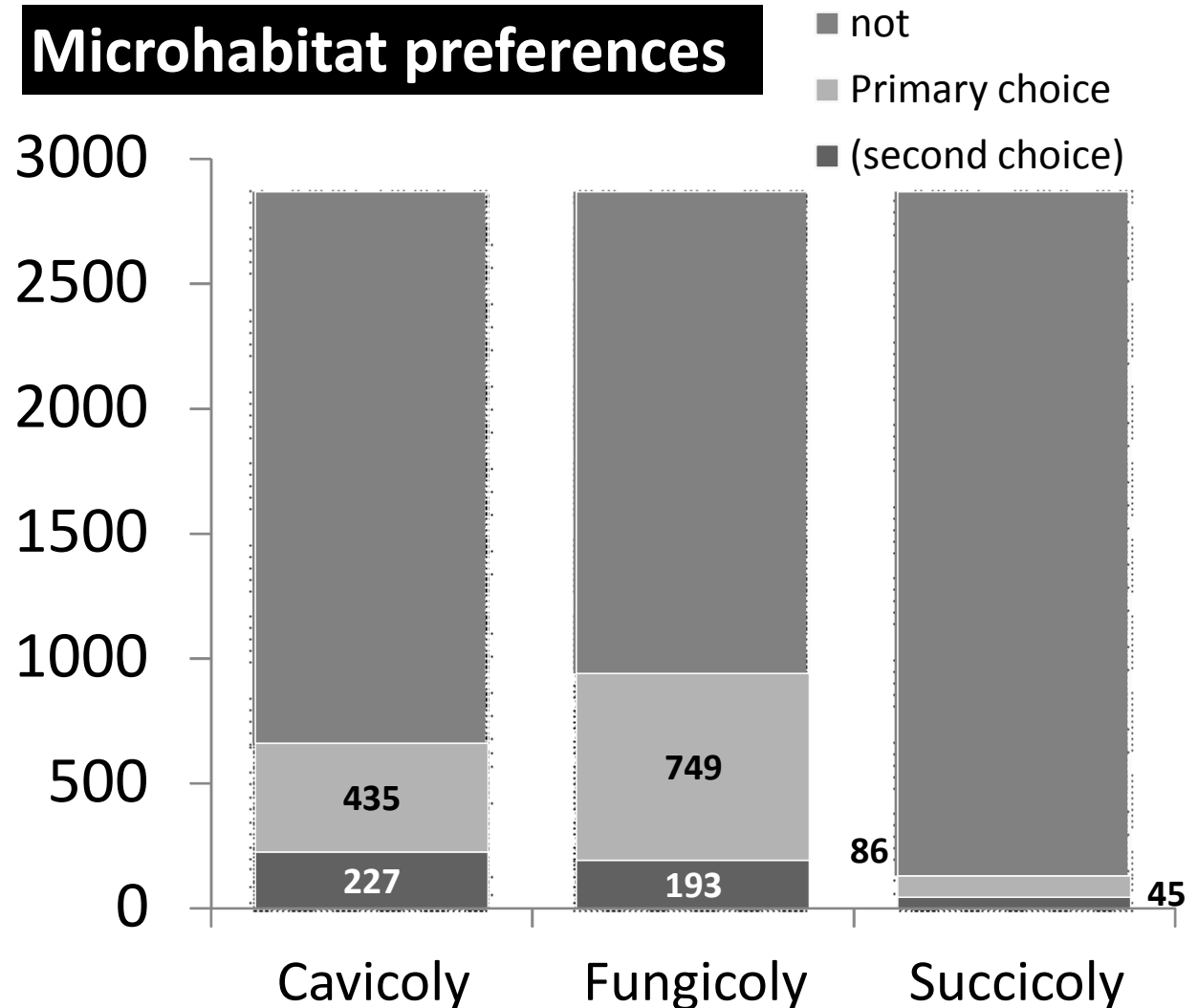


TReMs host species-rich assemblages

e.g. many beetle species depend on TReMs !



Microhabitat preferences



At stand scale,
the relationships between
TReMs and saproxylic beetle
diversity...

...

...are strongly context-
dependent

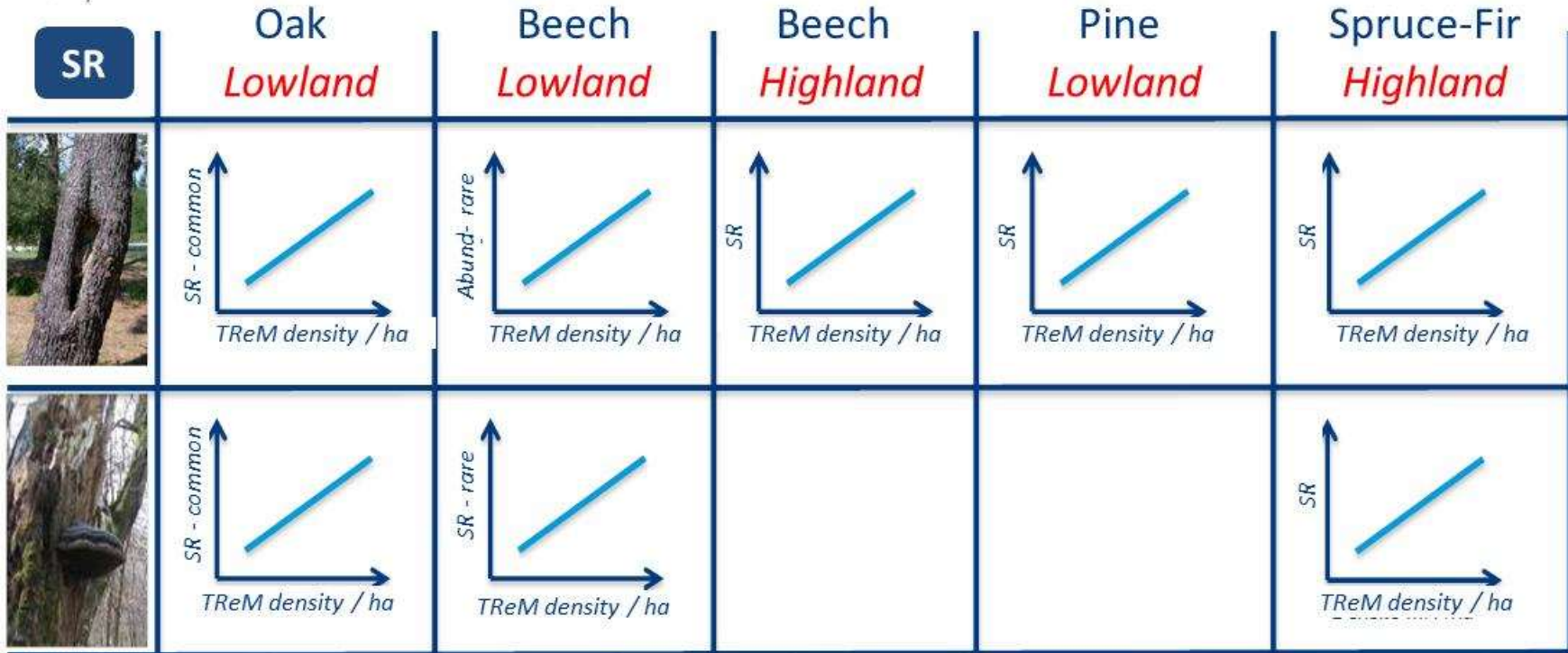
Saproxylic beetle species richness increases with the local amount of certain TreM-bearing trees in various but not all forest contexts



Contents lists available at ScienceDirect
Ecological Indicators
 journal homepage: www.elsevier.com/locate/ecolind

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

C. Bouget^{a,c}, L. Larrieu^{b,c}, A. Brin^d



In lowland deciduous forests, TReMs are significantly associated to variations in species richness, but to a lesser extent than deadwood or openness

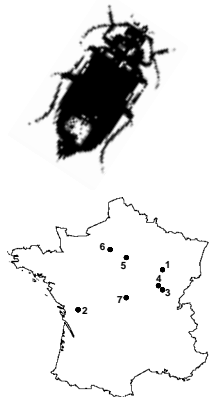
Biodivers Conserv (2013) 22:2111–2130
DOI 10.1007/s10531-013-0531-3



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



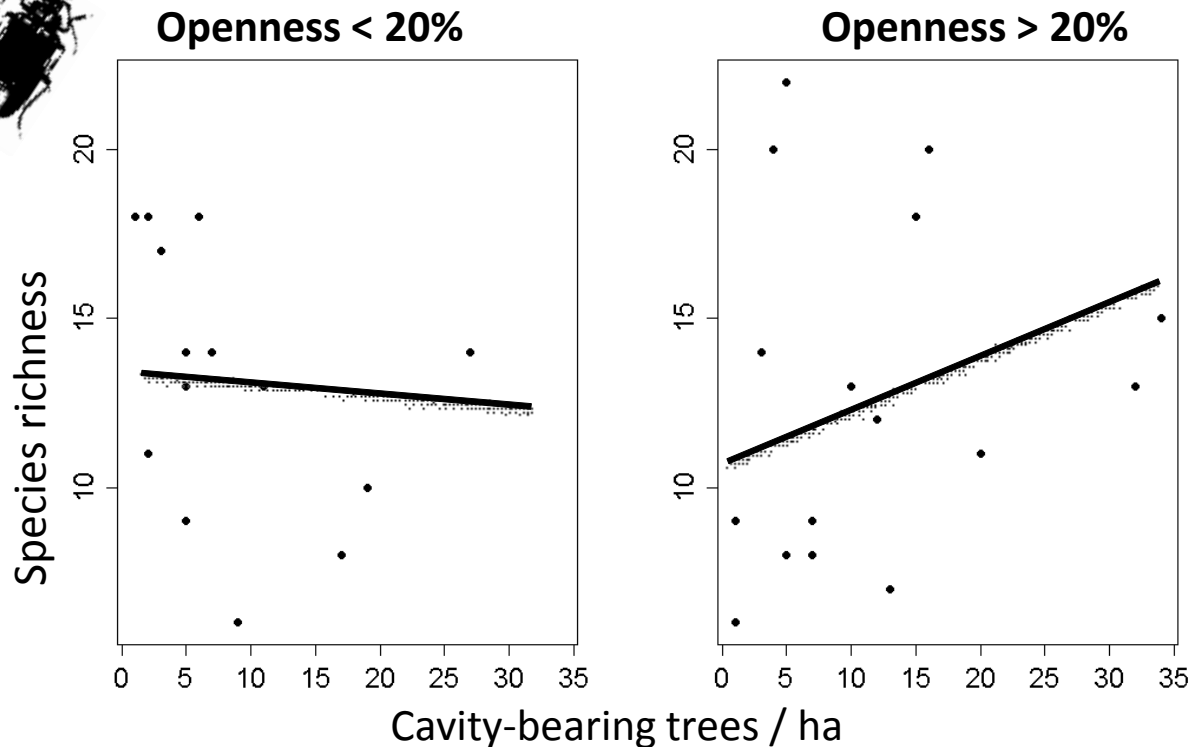
		<u>rare sp</u>	<u>common sp</u>
Oak 	Abiotic	2=Openness	1=Openness
	Deadwood	1=Deadwood diversity	2= Lying deadwood volume 3= Large lying deadwood volume 4= Deadwood diversity
	TReMs	ns	5=density fungus-bearing trees 6=density cavity-bearing trees
Beech 	Abiotic	ns	1=Openness
	Deadwood	ns	2=Deadwood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

In highland forests 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^{a,c}, L. Larrieu^{b,c}, A. Brin^d



In highland forests TReM diversity only slightly correlates with saproxylic beetle assemblage structure



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	Functional Dispersion 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

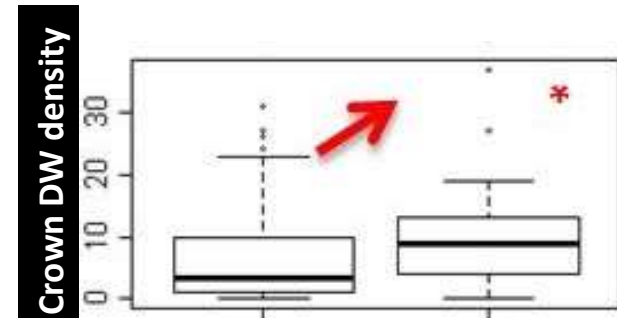
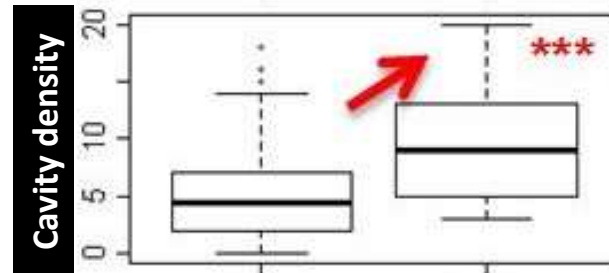
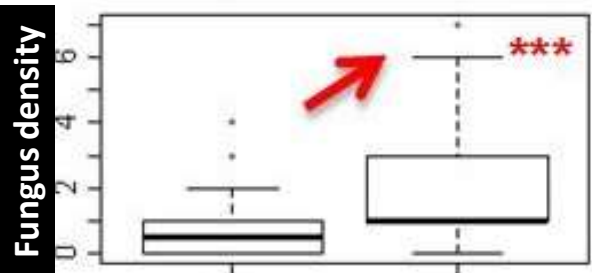
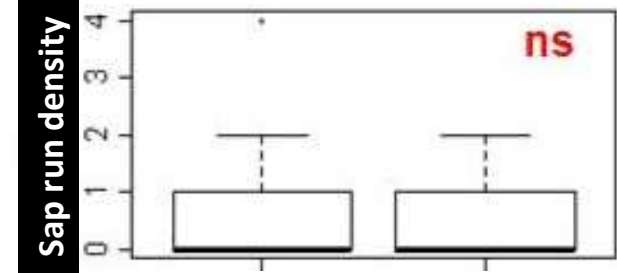
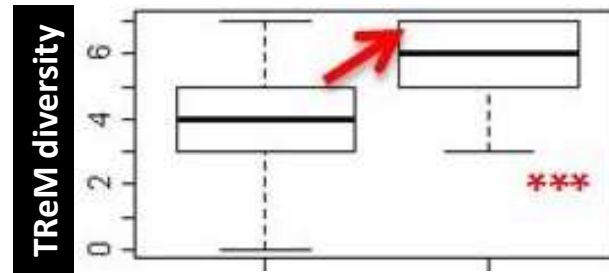
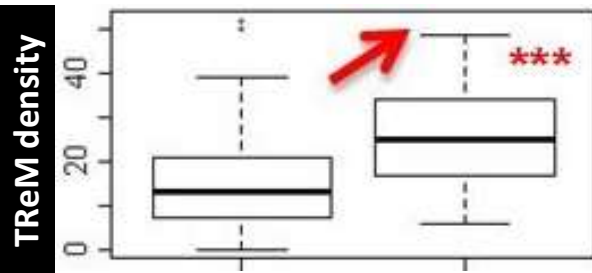
Why are TReM-
biodiversity relationships
so weak at stand scale in
ecological studies?



1. 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



Harvested

Unharv.

Harvested

Unharv.

Harvested

Unharv.

Unharv > 30 yrs



Animal Conservation

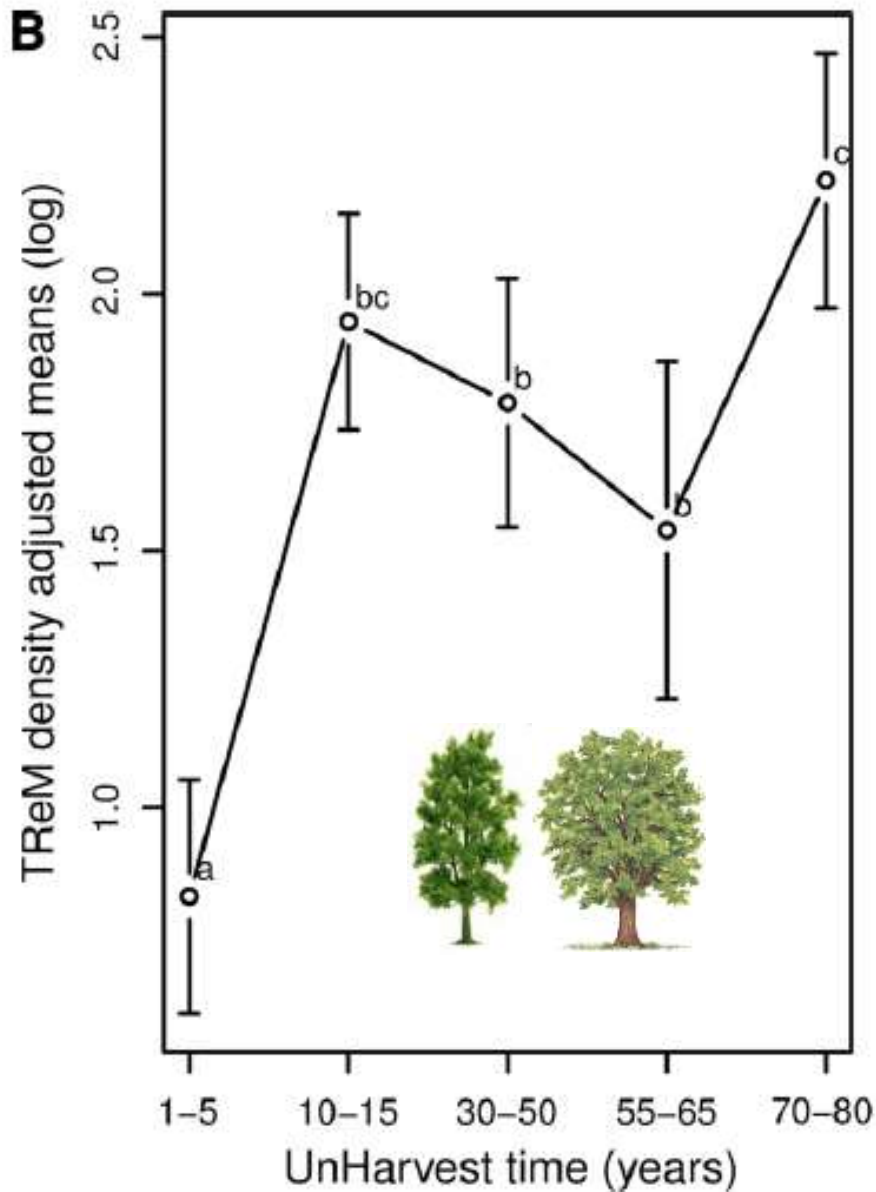
ZSL

Animal Conservation Print ISSN 1367-9430

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. Noblecourt², B. Nusillard¹, Y. Paillet¹, C. Pernet¹, L. Larrieu^{5,6} & F. Gosselin¹

After forestry abandonment, TreM stock recovery needs decades



Eur. J. Forest Res.
DOI 10.1007/s10342-016-1006-3

ORIGINAL PAPER

Development over time of the tree-related microhabitat profile: the case of lowland beech-oak coppice-with-standards set-aside stands in France

Laurent Larrieu^{1,2} · Alain Cabanettes² · Nicolas Goux³ · Laurent Burnel² · Christophe Bouget⁴ · Marc Deconchat¹

*Beech-oak coppice-with-standards stands
24 forests, France*

TReM density/diversity sharply increase in overmature stands



Biodivers Conserv (2016) 25:1167–1185
 DOI 10.1007/s10531-016-1116-8



ORIGINAL PAPER

Are biodiversity patterns of saproxylic beetles shaped by habitat limitation or dispersal limitation? A case study in unfragmented montane forests

Philippe Janssen^{1,2} · Eugénie Cateau⁴ · Marc Fuhr^{1,2} · Benoit Nusillard³ · Hervé Brustel⁴ · Christophe Bouget³

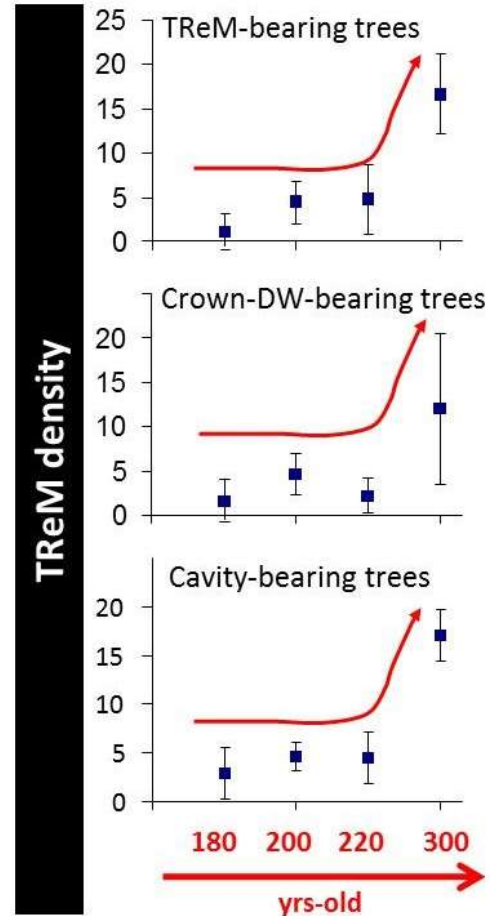
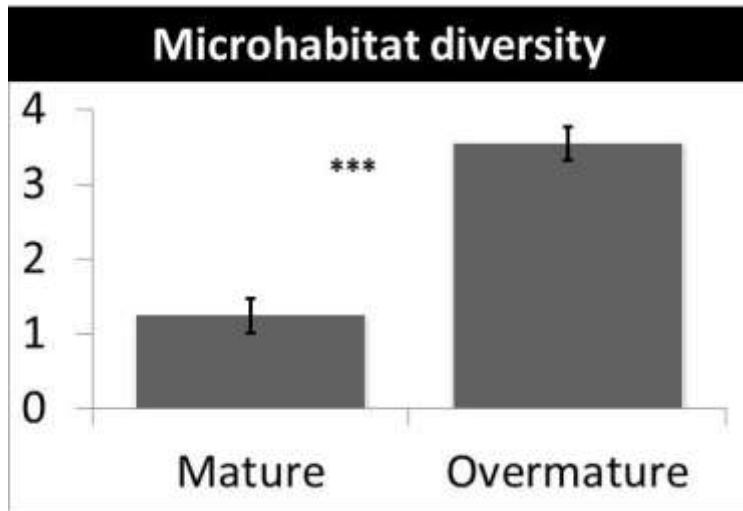


Insect Conservation and Diversity

Insect Conservation and Diversity (2012) doi: 10.1111/j.1752-4598.2012.00214.x

The effects of forest age on saproxylic beetle biodiversity: implications of shortened and extended rotation lengths in a French oak high forest

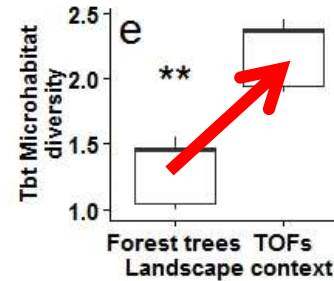
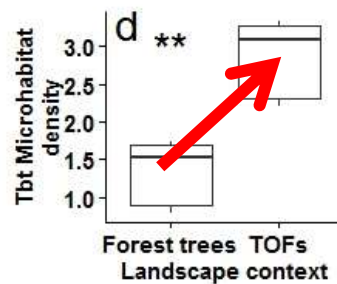
AUORE LASSAUCÉ,^{1,2} LAURENT LARRIEU,^{3,4} YOAN PAILLET,¹ FRANCOIS LIEUTIER⁵ and CHRISTOPHE BOUGET¹ ¹Inra, UR EFNO, Nogent-sur-Ouche



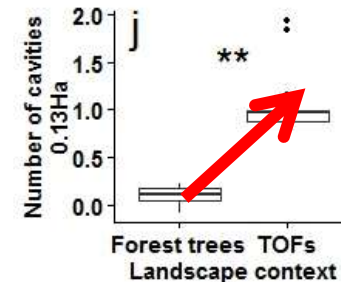
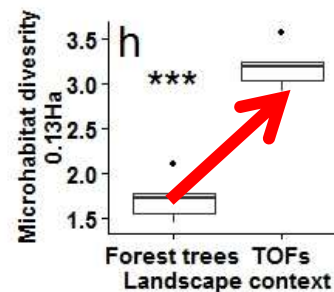
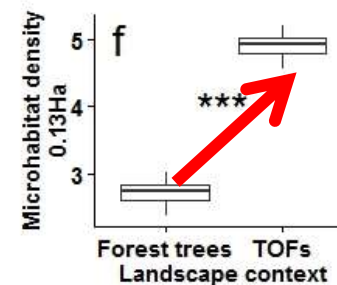
TReM effects increase with TReM values

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

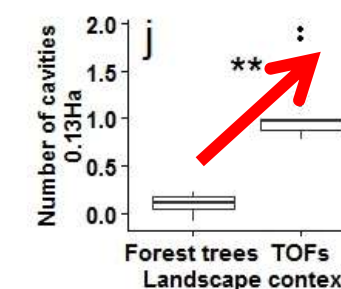
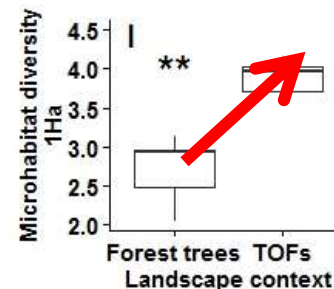
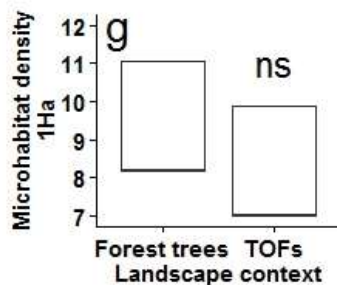
Veteran tree scale



0.13ha-scale



1ha-scale



TReM effects increase with TReM values

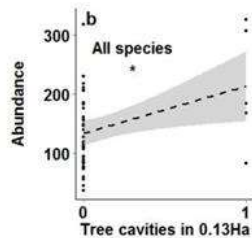
The effects of TReM metrics on sx beetle diversity are **stronger outside** than **inside** forests!



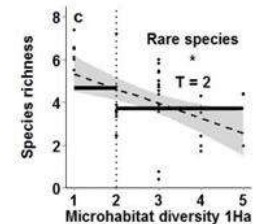
Veteran trees inside forest



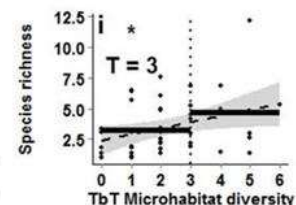
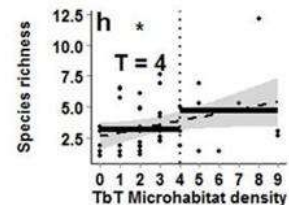
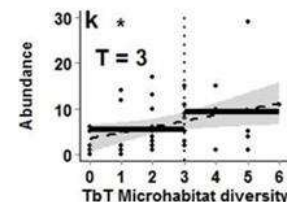
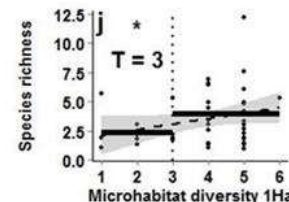
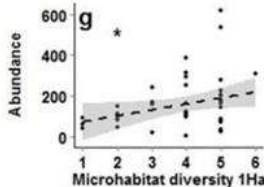
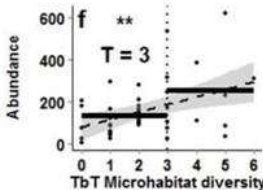
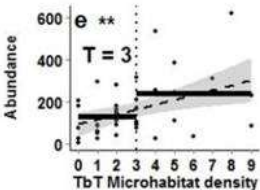
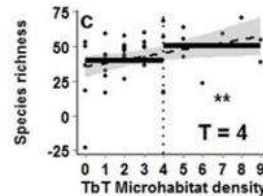
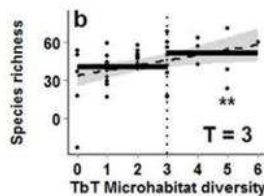
All sx beetle species



Rare sx beetle species



Veteran trees outside forests



2. 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

Taxa (Composition)

Density very large trees dbh>70cm

Density of living microhabitat-bearing trees

Sx beetles

Bats

Bryophytes

Lichens

Birds

Hoverflies

Fungi

→ $p < 0.001$
→ $p < 0.05$



487 plots in 19 areas

Larrieu et al., in prep.

3. Biodiversity metrics

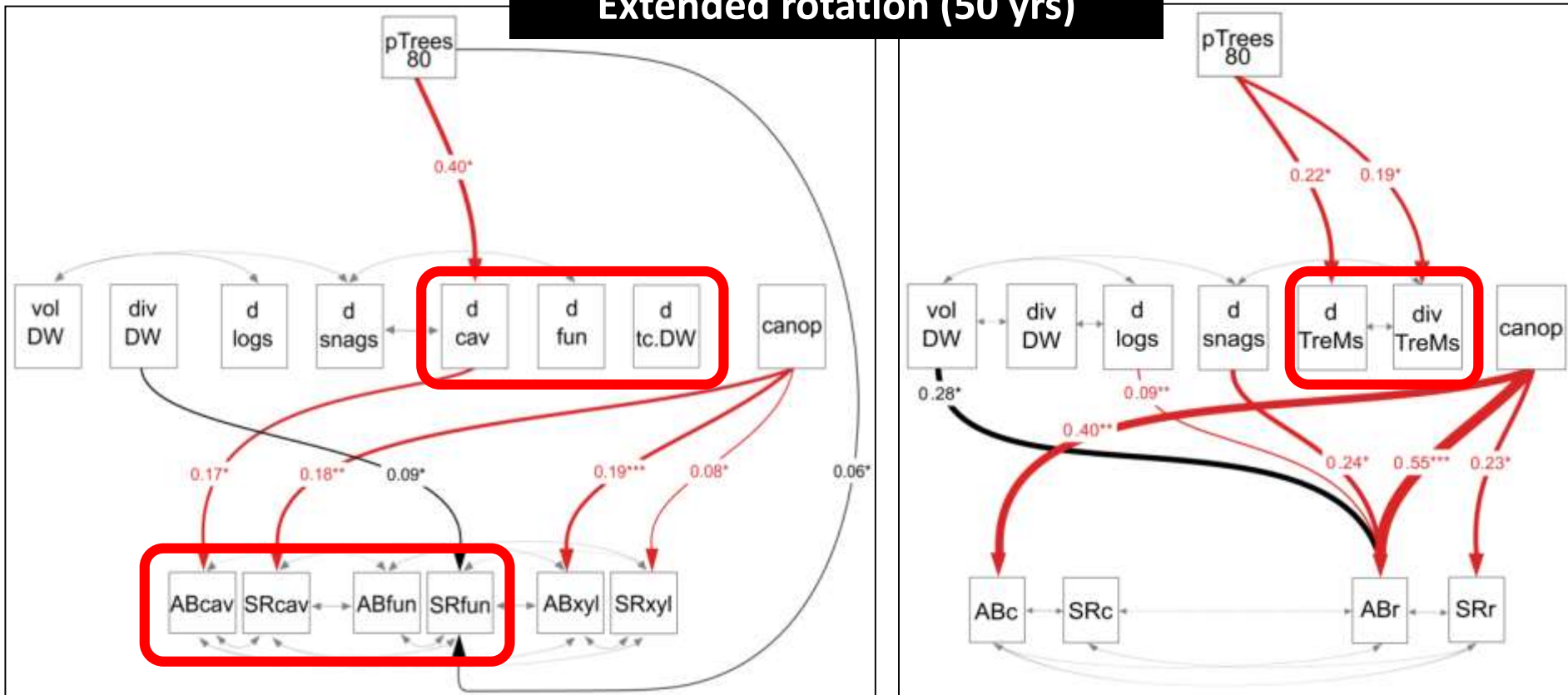
- Low TReM values in managed forests ?
- Irrelevant biodiversity metrics ?
 - Diversity of TReM-associated taxa only vs overall diversity
 - sampling methods dedicated to TReM-associated organisms
- Bad TReM sampling ?

TReM are fostered by extended rotation...

Only TReM-associated (and not all sx) taxa correlate to TReM rise



Extended rotation (50 yrs)

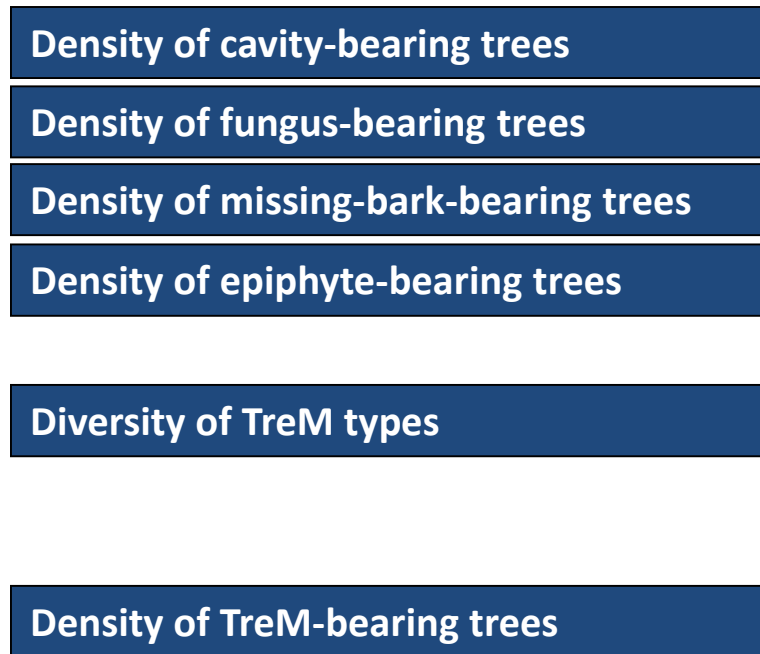


3. Biodiversity metrics

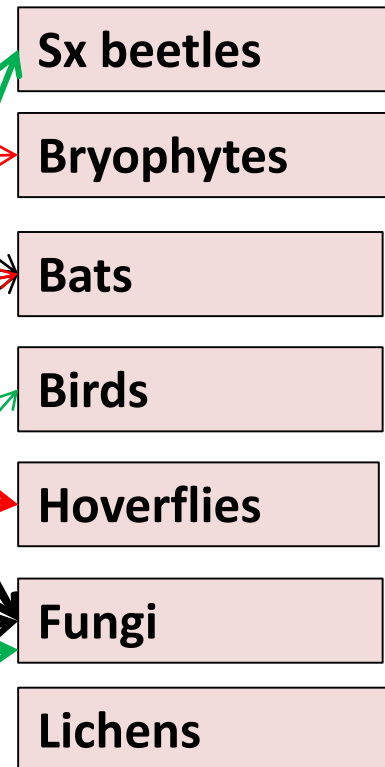
- Low TReM values in managed forests ?
- Irrelevant biodiversity metrics ?
 - Saproxylic beetles only
- vs
- Multi-taxon approaches
 - sampling methods dedicated to TReM-associated organisms
- Bad TReM sampling ?

Monitoring more taxa --> more TReM-biodiversity relationships...sometimes difficult to interpret

Environmental variables (1ha-plot)



Sp richness/composition



Effect + \rightarrow $p < 0.001$
 \rightarrow $p < 0.05$

Effect - \rightarrow $p < 0.001$
 \rightarrow $p < 0.05$

\rightarrow composition



487 plots in 19 French forest areas

Larrieu et al., in prep.

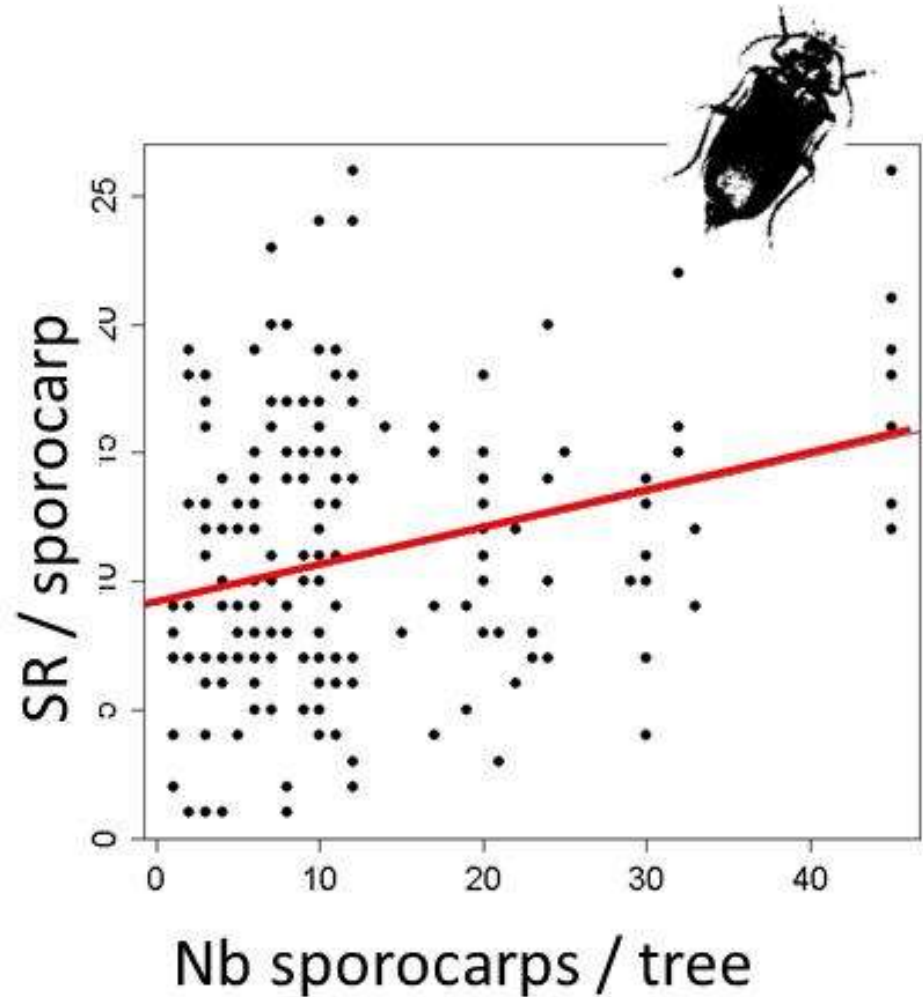
4. Biodiversity sampling

- 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 ?

Sporocarp-associated beetle sampling

Positive effects of
aggregation of
suitable
microhabitats

Specific emergence traps



Nb sporocarps/tree >> Nb fungus-bearing trees/0.3ha

Conclusion

- At the stand scale : TReM effects on biodiversity
 - Low significance, magnitude and consistency
- Role of finer-scale connectivity effects (tree scale)
- Importance of :
 - taxon sampling method adequation
 - TReM sampling improvements
- ...Further research required to inspire quantitative management guidelines...

Acknowledgements

Our PhD students

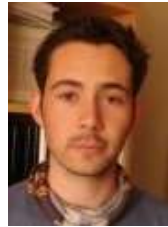
Aurore Lassauce



Gwendoline Percel



Guillem Parmain



Philippe Janssen



...and technicians

Carl Moliard



Benoit Nusillard

