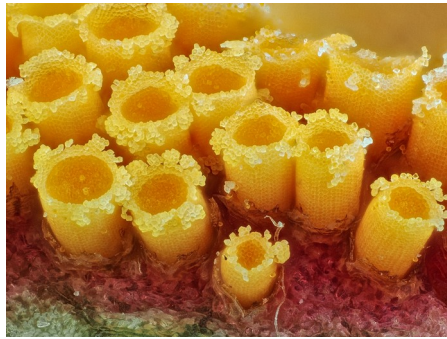


Host-associated biodiversity and tree choice in assisted migration

Brussels, 14 April 2026

Gilles San martin

Walloon Agricultural Research Centre (CRA-W)



Rationale

- Assisted migration : total or partial replacement of local trees with foreign provenances or tree species
- Question : How to take biodiversity into account in the choice of trees imported for assisted migration ?
 - 1) trees with high associated biodiversity ?
 - 2) trees with similar communities as the local trees ?
(so that they can be used as a “refuge” for native biodiversity)

No existing protocol → methodological explorations still ongoing



Data used and scope

- Curated European plant–host database
- Focus on phytophagous insects only
 - ~900 tree species
 - ~6000 insect species
 - ~37000 insect-tree interactions
- interactions are presence-only, not abundance, frequency, *etc.*

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Plant Parasites of Europe

leafminers, galls and fungi

ENGLISH NEDERLANDS

Leafminers and plant galls of Europe

Dr. Willem N. Ellis

genus Fagus

Filter <input type="text"/>									
ORGAN	MODE	STAGE	MAIN GROUP	GROUP	FAMILY	PARASITE	P	G	S
leaf	free		Insecta	Lepidoptera	Geometridae	Abraxas grossulariata		10	13
leaf	free		Insecta	Lepidoptera	Geometridae	Abraxas sylvata		9	10
leaf	gall		Acari	Eriophyoidea	Eriophyidae	Acalitus plicans		1	1
leaf	gall		Acari	Eriophyoidea	Eriophyidae	Acalitus stenaspis		1	2
dead wood	borer		Insecta	Coleoptera	Cerambycidae	Acanthocinus xanthoneurus		2	2
stem	scale		Insecta	Hemiptera Coccoidea	Eriococcidae	Acanthococcus aceris		12	16
stem	saprotrophic		Fungi	Ascomycota	Nitschkiaceae	Acanthonitschkea tristis		4	4

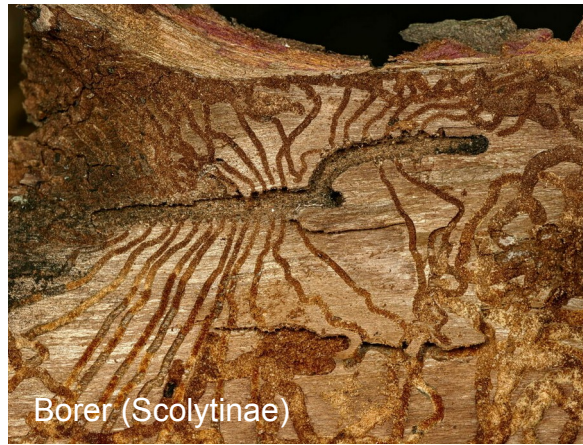
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6 Life Modes

Only **phytophagous insects from the 6 main life modes** (eg excluded predators, inquilines,...)



Borer (Scolytinae)



Miner (Micro moth Nepticulidae)

Borer : internal feeder, little external sign

Miner : internal feeder with visible gallery

Gall : tissue swelling or malformation

Hidden : concealed in folds, rolls, silk, etc.

Scale : fixed sap sucking

Free : free-living, mobile phytophagous



Gall (Aphid on Ulmus)



Hidden (Leaf roll of Tortricidae)



Scale (Coccoidea Diaspididae)



Free (True bug nymph)

Data used and scope

- **Strengths :**

- Very large and well curated dataset
- Broad taxonomic range (trees and insects)
- European fauna only (also on non native trees)

- **Limitations** (on the biodiversity estimates):

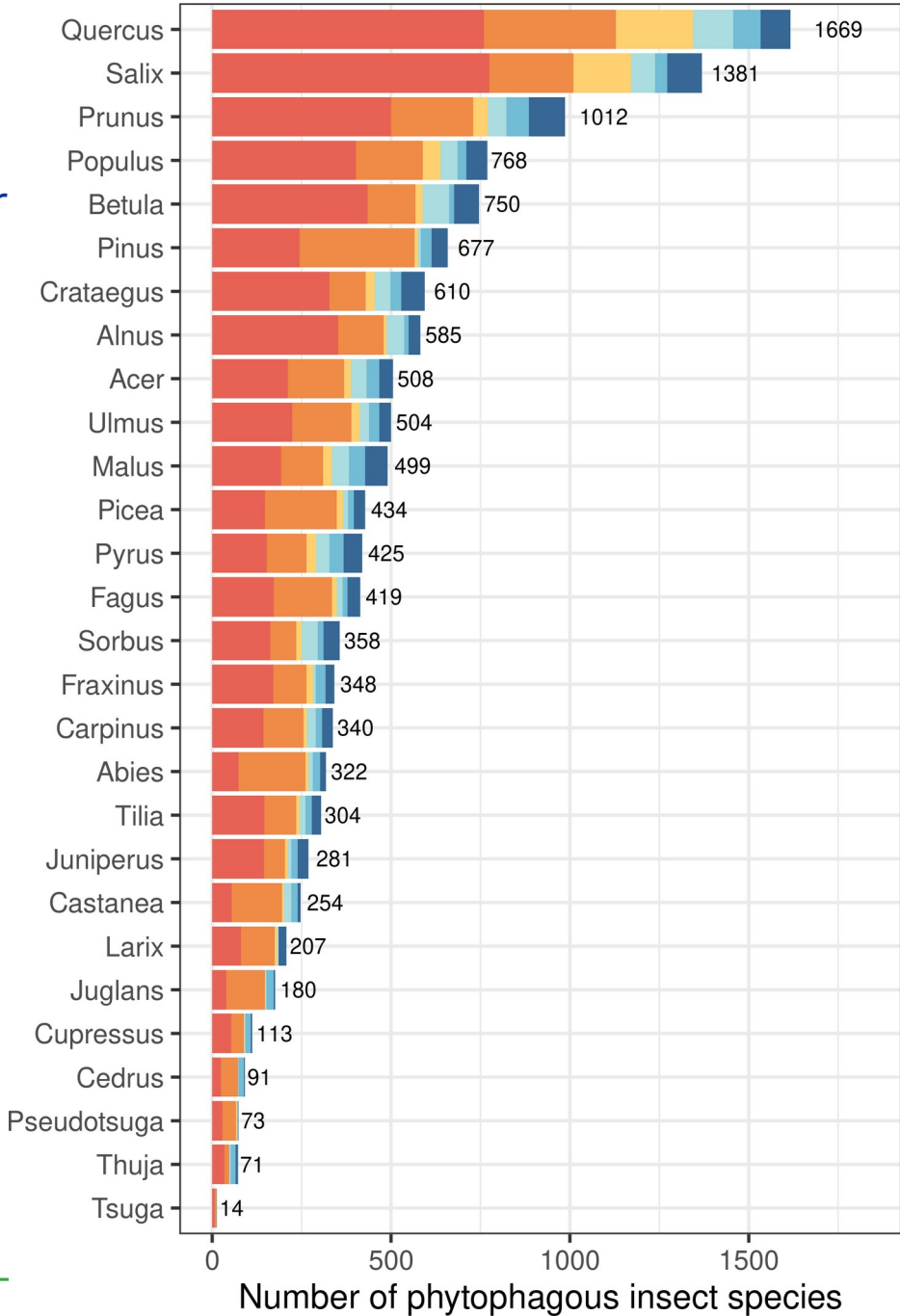
- Underestimation {
 - Based on current published knowledge, therefore incomplete
 - Likely underestimates poorly studied or narrowly distributed trees
 - Host use may change over time as trees spread or insects adapt
- Overestimation {
 - A used host might be sub-optimal (decreased fitness)
 - Potential associations in Europe may not all be realized in Belgium

→ This analysis evaluates potential host-associated insect biodiversity based on known plant-insect associations in Europe.



Large variations in diversity

Tree genera differ greatly in their potential to support host-associated insect richness



“Richness” depends on what is measured.

A tree can rank high for one component of biodiversity and lower for another

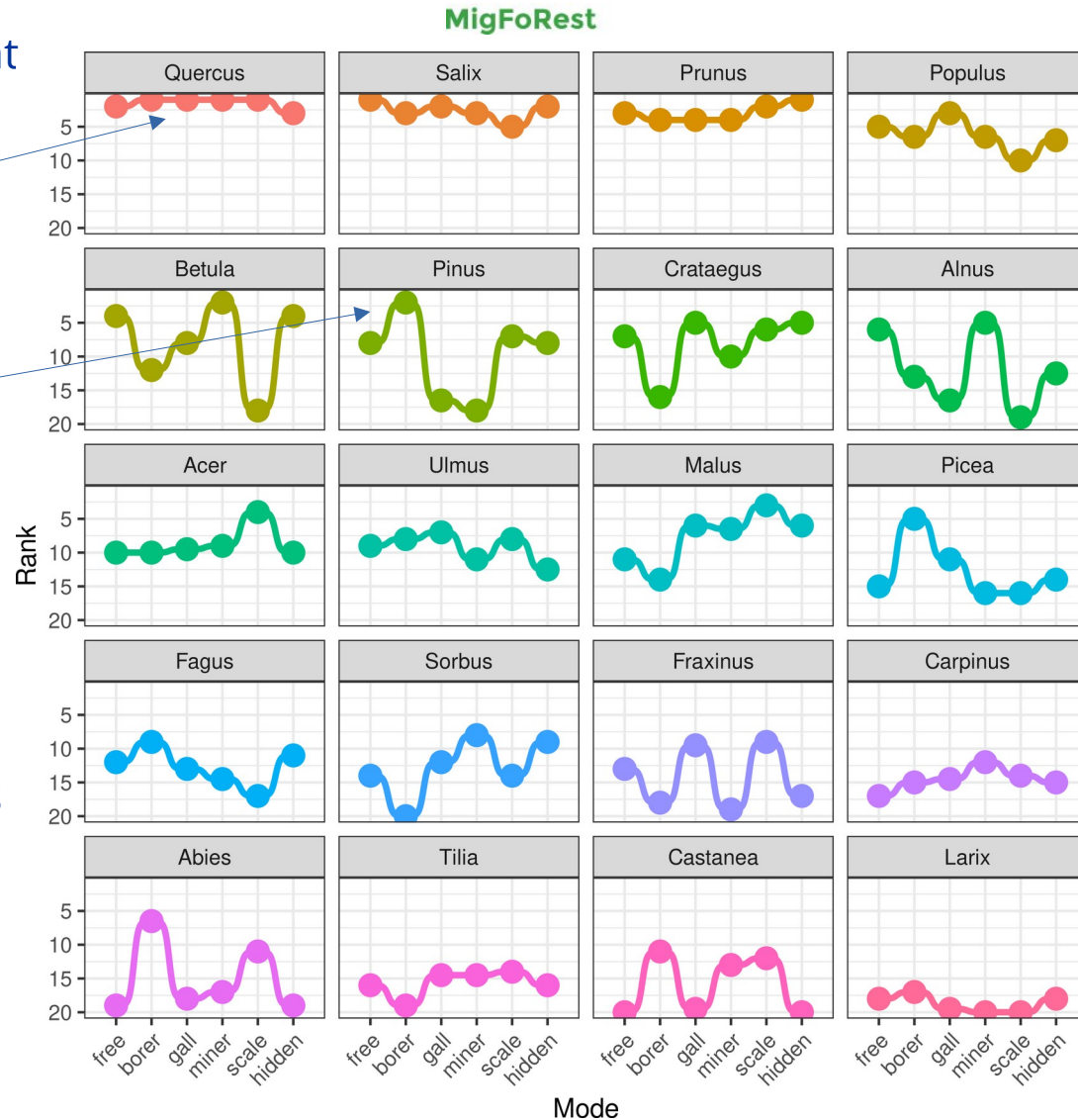
Some trees support balanced assemblages

Others are especially important for specific guilds (e.g. borers on conifers, miners on *Betula*, etc.)

→ Associated predators, parasitoids, fungi, plants, could give different patterns

Trees are major structural components of forest ecosystems

→ impact on microclimate, soil, plants
→ impact on all the associated fauna

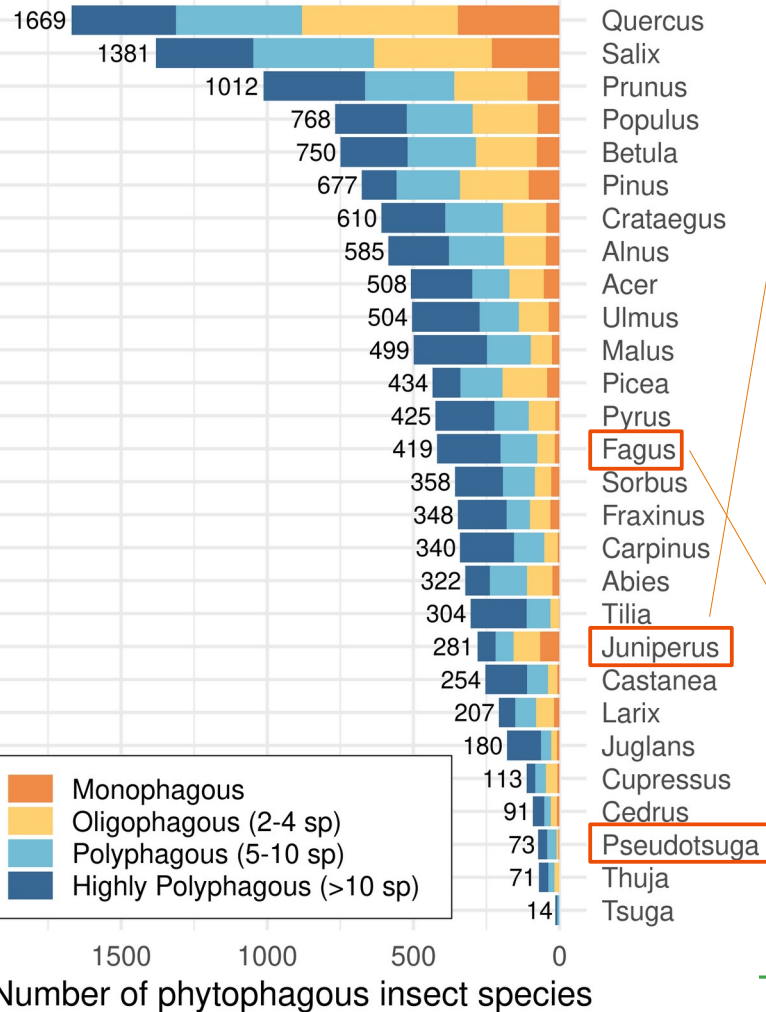


Specialisation matters

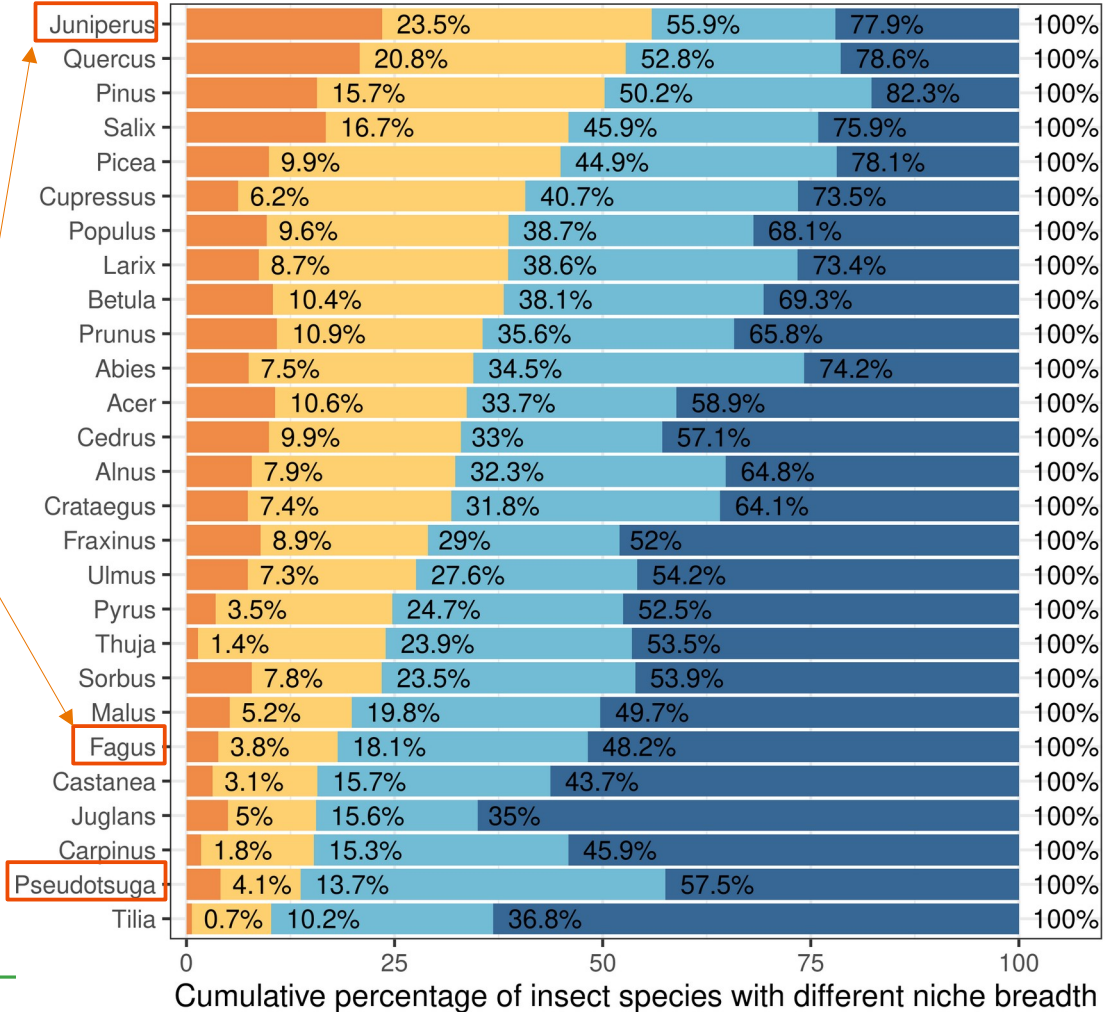
All insects species are not equal :
Some insects are specialized on a few hosts (oligophagous)
→ more at risk to disappear → can strongly change the relative importance of host trees

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Number of insects species

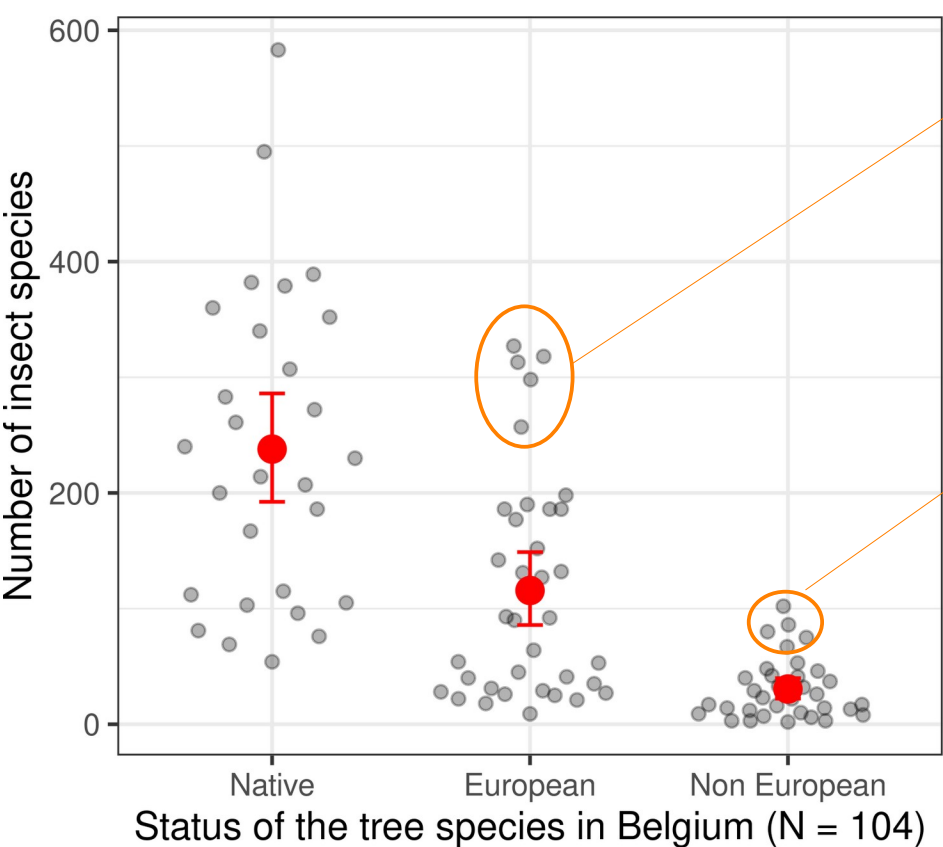


% of specialist insect species



Native status and region of origin matter

On average, more native trees support a higher diversity of insects
This pattern is robust, despite some uncertainty in how “Native” or “European” are defined.



Malus domestica
Prunus domestica
Picea abies
Quercus cerris
Quercus ilex

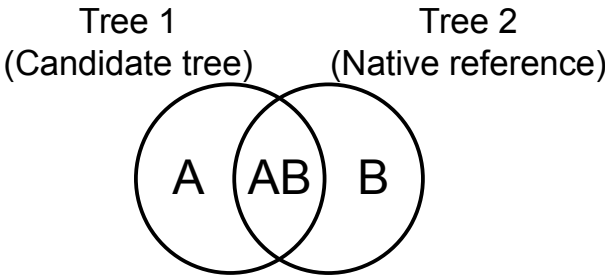
Robinia pseudoaccacia
Quercus rubra
Prunus serotina
Populus x canadensis

Non European trees with large distribution (some invasive!) and present for a long time
→ higher diversity but still much lower than most native trees (mostly generalist insects)

How different are the insect communities ?

Richness is only one part of the story.

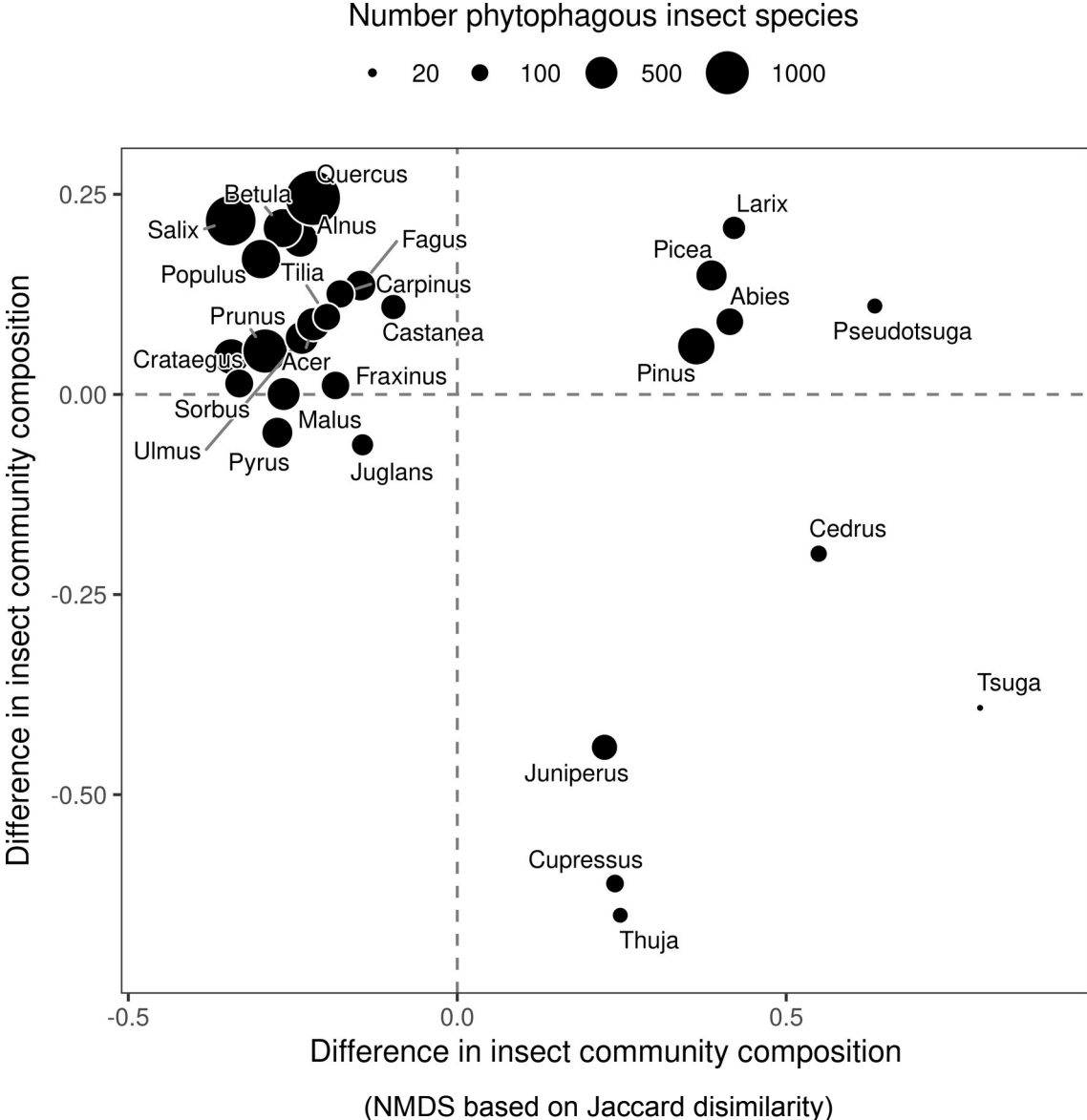
Two trees can host similar numbers of insects but very **different insect communities**.



Richness = $A + AB$
 Similarity = $AB / (A + AB + B)$

Complementarity: does the candidate tree add new species? (high A)

Substitution/refuge: could it host part of the fauna of a native reference tree? (high AB : i.e. shared species)

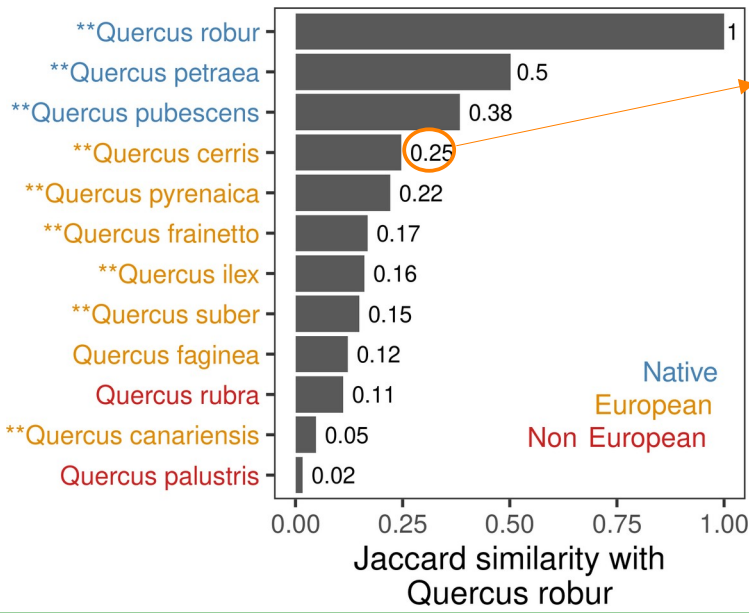
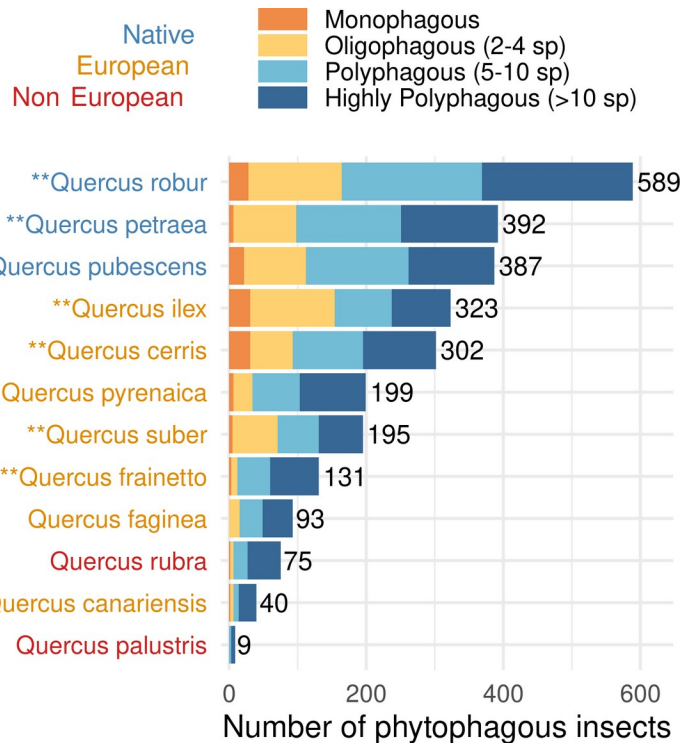
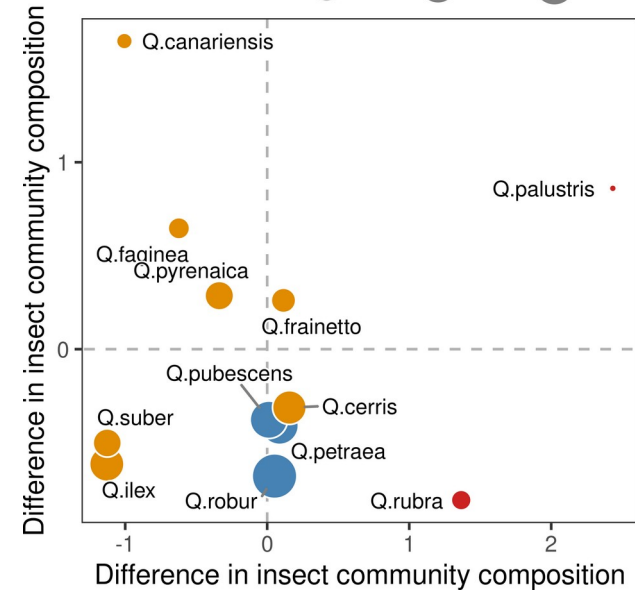


Comparison to a reference native tree

Within a genus, both richness and similarity often decline quickly away from the native reference tree

Example : *Q.cerris* and *Q.ilex* have higher known diversity than other non native trees but *Q.cerris* has an insect community more similar to native *Quercus* (but still rather distinct).

NB : beware of other factors like invasion risk !!



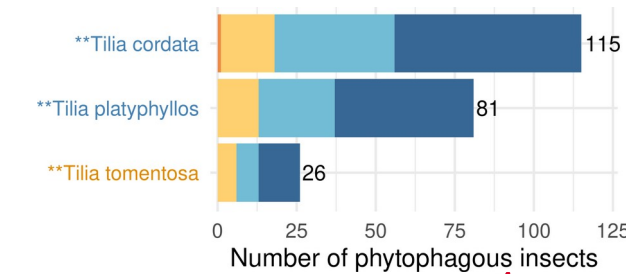
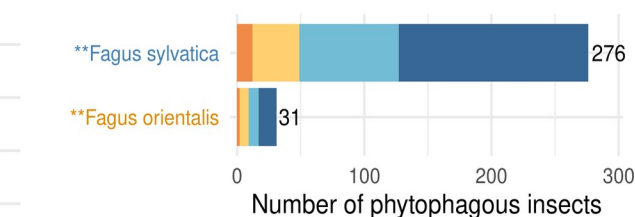
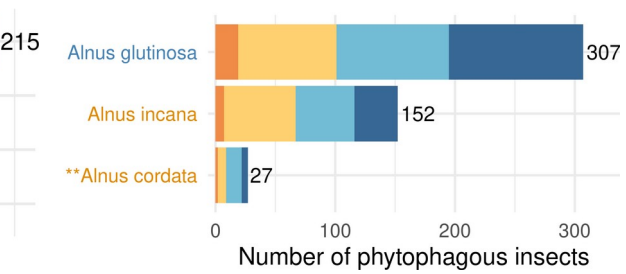
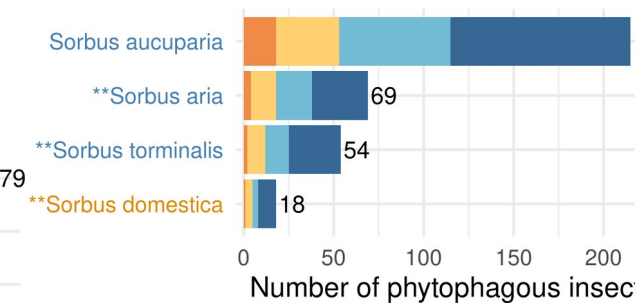
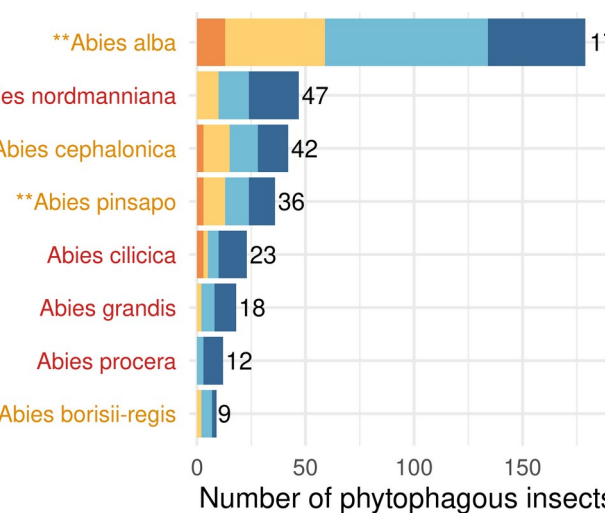
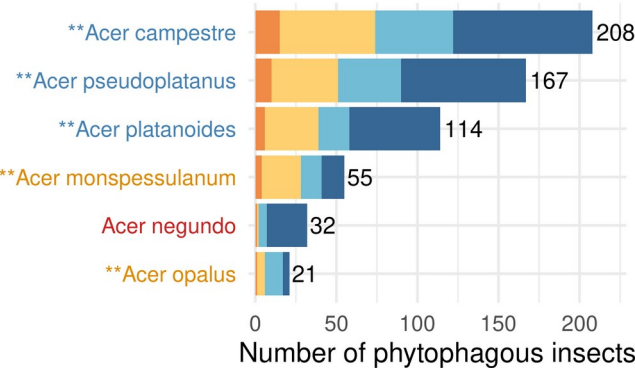
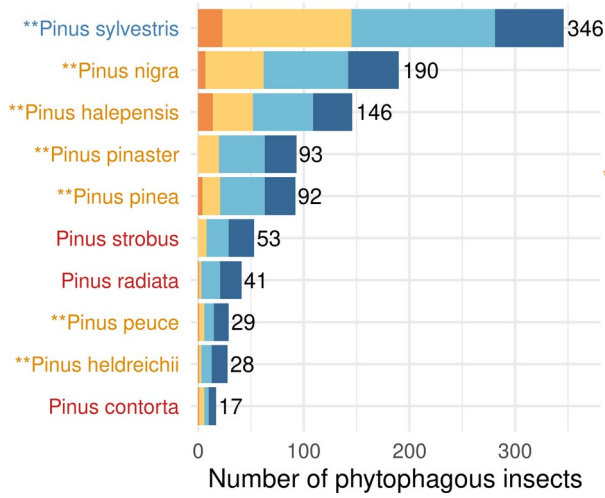
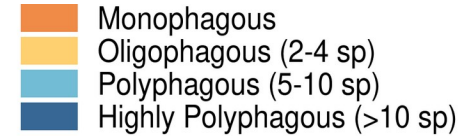
25% of the species are shared between *Q.cerris* and *Q.robur*
 75% are only on *Q.cerris* or only on *Q.robur*



** Species considered in MigFoRest project

Comparison to a reference native tree

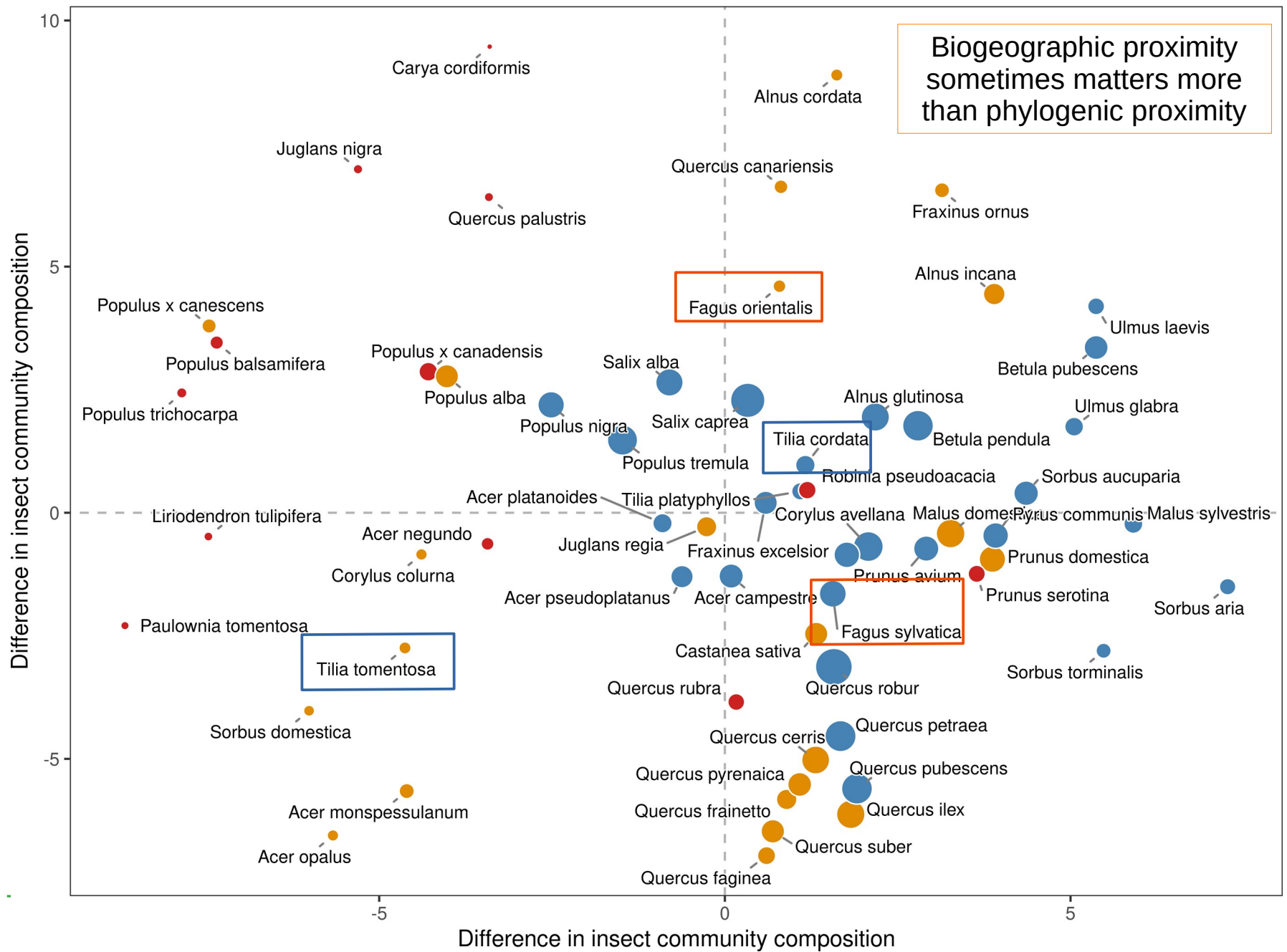
This rapid decline away from the native reference is not specific to oaks. Similar patterns appear across several genera relevant to the project.



** Species considered in MigFoRest project

Native status ● Native ● European ● Non European

Number of phytophagous insect species ● 10 ● 100 ● 300 ● 500



Different components

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Intrinsic properties of the candidate tree

Host capacity

How many insect species are associated with this tree?

Specialisation

How many specialised insects does it support?

Species composition relative to a reference native tree

Substitution / refuge potential

How similar is the insect community to that of a native reference tree?

Complementarity

Does this tree add novel host-associated diversity not otherwise present?
(and hopefully not problematic)

Context matters

It is not only the tree species you chose to import that matters but also the local trees/ecosystems that you replace/modify

How ?

Clear cuts + large scale plantations

VS

Small groups of trees “reinforcing” an existing stand

Where ?

In species-poor mono-specific production stands

VS

In native ecosystems with high richness or very distinctive communities

+ to be balanced with other criteria not considered here

Invasion risk, patrimonial/cultural value, economic objectives, ecosystem services ...



Conclusions

All trees are not equal

Tree species differ strongly in their potential to support insect biodiversity

Native and closely related trees (phylogeny + biogeography !)
generally **support richer and more similar insect communities**

Plantation context matters as much as the chosen tree species

Richness alone is not enough :

biodiversity value has several complex dimensions

Biodiversity metrics should inform decisions, not replace them

Main risk: optimizing a single simple metric and mistaking that for good
ecological management

Goodhart's law :

"When a measure becomes a target, it ceases to be a good measure"

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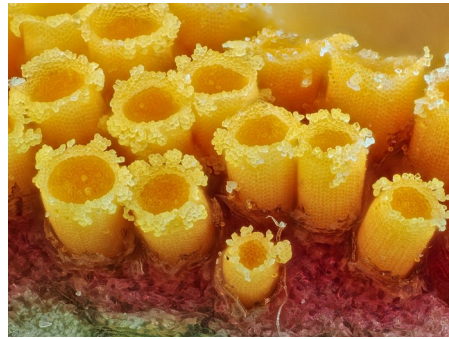


Wallonie

Thank you !

Special thanks to Willem Ellis for providing this masterpiece database !

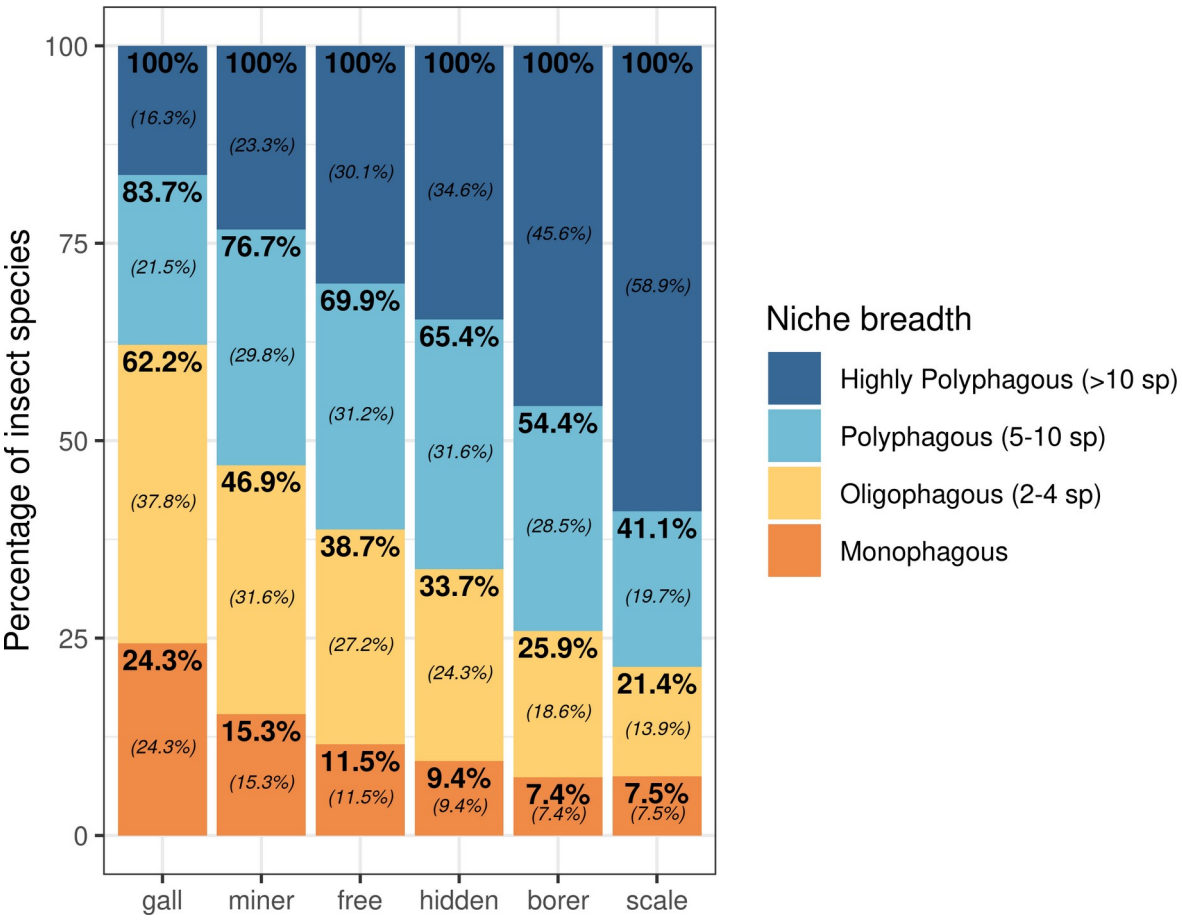
Thanks to the MigFoRest partners and steering committee for stimulating discussions



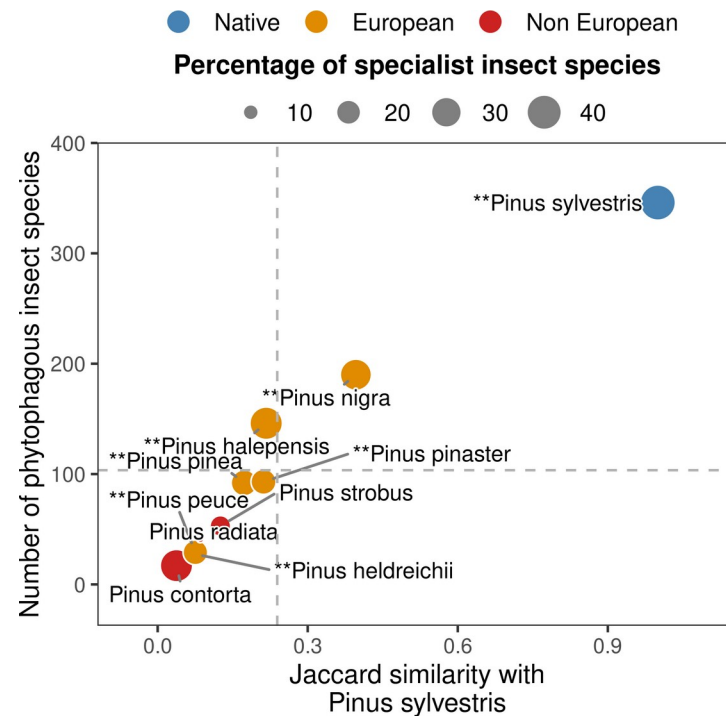
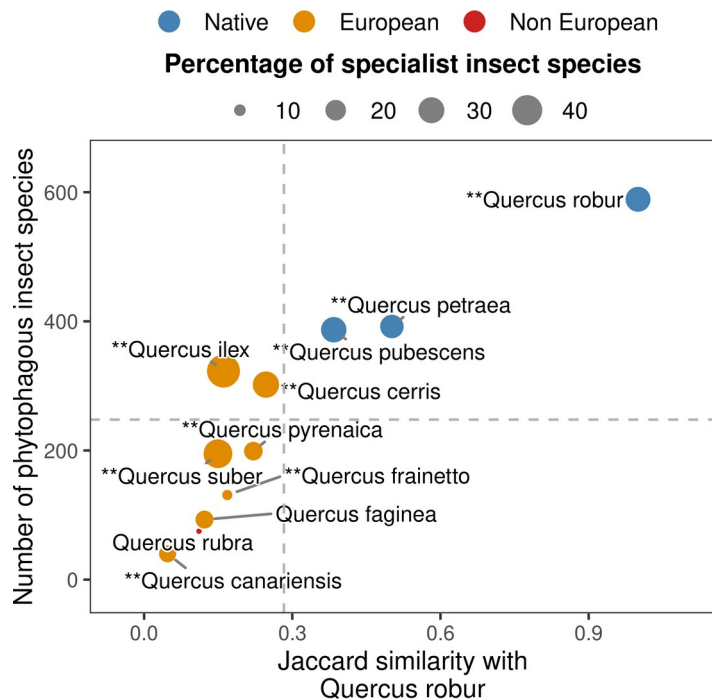
Specialisation matters

Specialisation is also highly dependent on life mode

Gall and miner insects are much more specialized



Comparison to a reference native tree



Upper-right: High richness, high substitution

→ best candidate trees if the goal is to retain native-associated fauna while keeping strong host capacity

Upper-left : High richness, low substitution

→ rich but compositionally different trees; likely better as complementarity candidates than substitutes

Lower-right : Low richness, high substitution

→ modest substitutes; they track part of the native fauna but support relatively few insects overall

Lower-left : Low richness, low substitution

→ weak candidates from the host-associated insect perspective

Comparison to a reference native tree

Various complex situations behind the same index

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