

What drives bat activity along hedgerows?

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CONTEXT → Need to reconcile agriculture & biodiversity

- ▶ France has lost 70% of its hedgerows in 40 years (agricultural intensification)¹
- ▶ Hedgerows provide food, shelter, facilitate landscape connectivity for wildlife², provide ecosystem services which improve agricultural outputs (e.g. pollination, pest control)³.
- ▶ European bats : key players in agroecosystems (mostly insectivorous, pest control agents, potential bioindicators), greatly benefit from hedgerows⁴.
- ▶ Few studies have investigated the **relationship between specific hedgerow features × bat activity** across a variety of landscapes ...

AIMS & QUESTION



Which structural & compositional hedgerows characteristics influence bat activity ?



- Improve bat conservation in agricultural landscapes
- Make recommendations for hedgerow management to enhance biodiversity gain × pest-control

MATERIAL & METHODS

1 Bat acoustic monitoring (★) × Hedgerow typological surveys (♣)

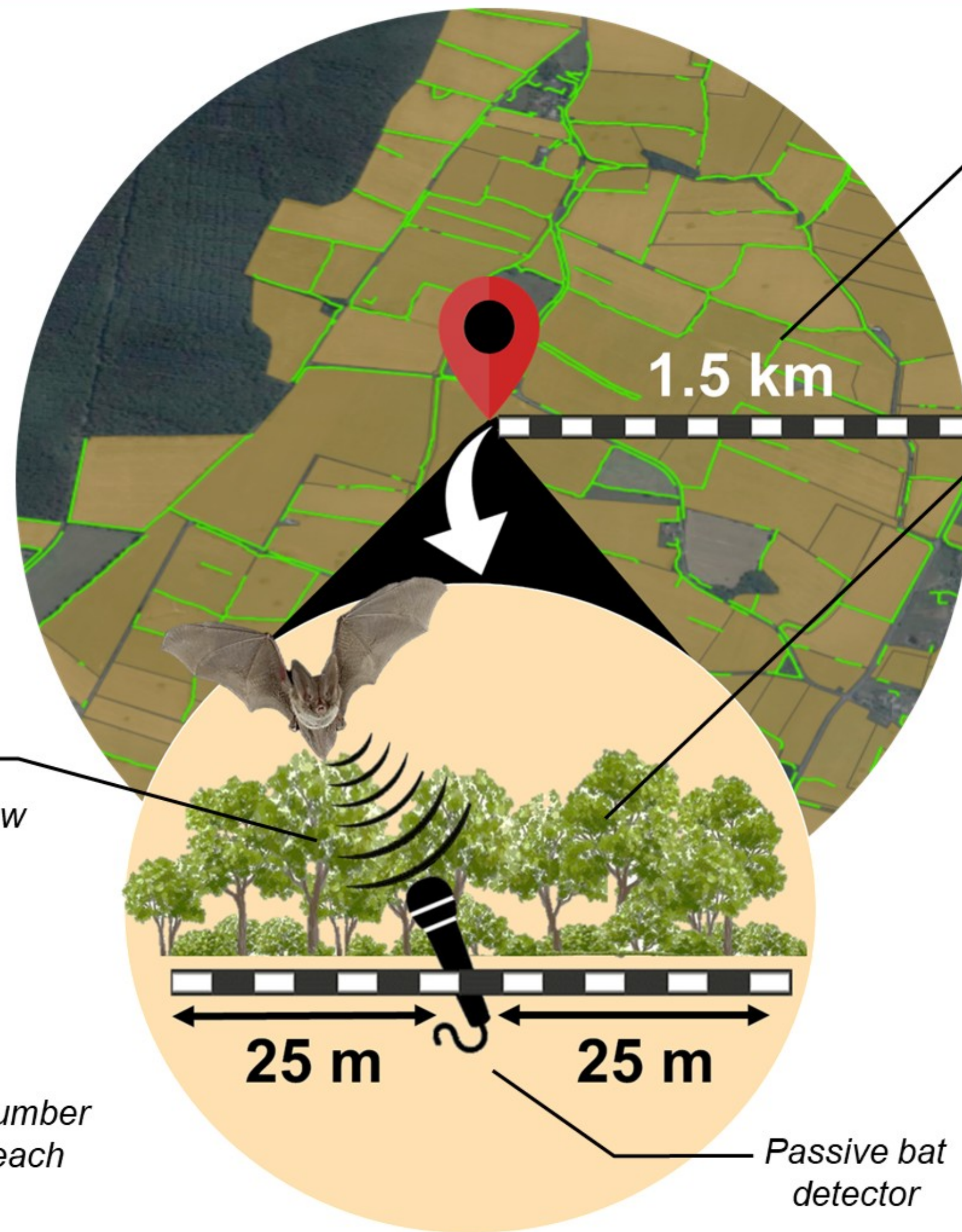
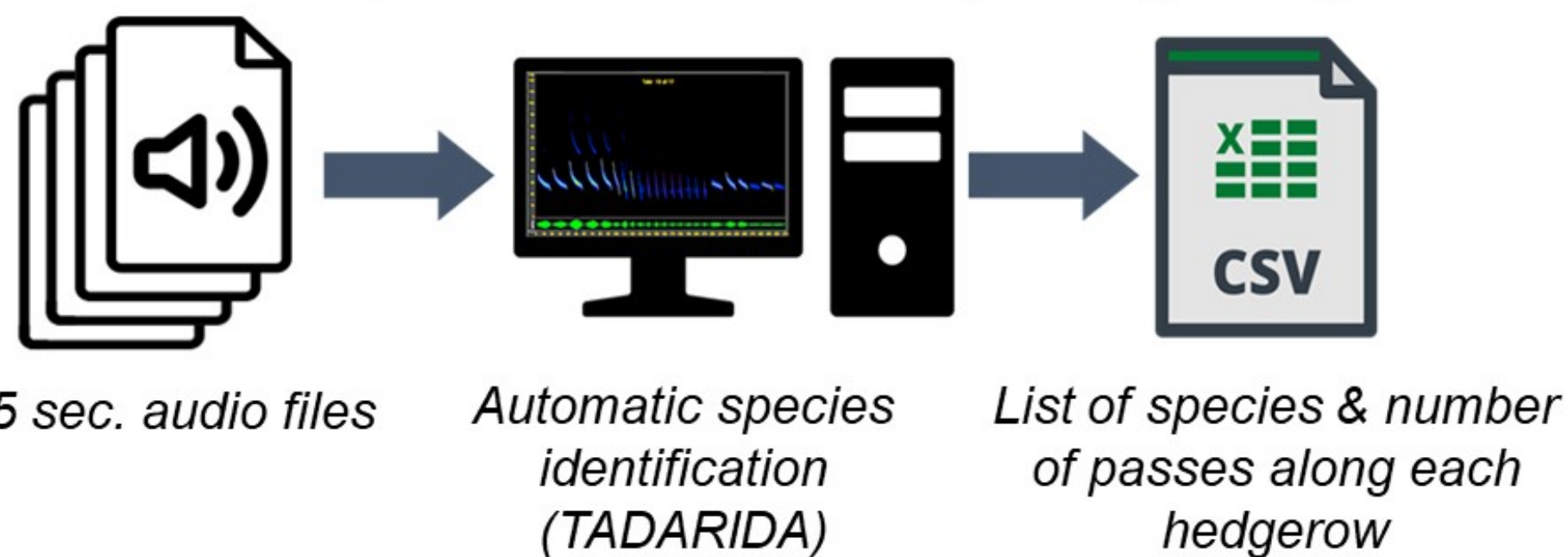
May to September from 2020 to 2023.



448 hedgerows / 1484 recorded nights

2 ★ Bat acoustic activity

i.e. number of bat passes recorded in one night along a hedgerow



Landscape covariates (1.5 km)

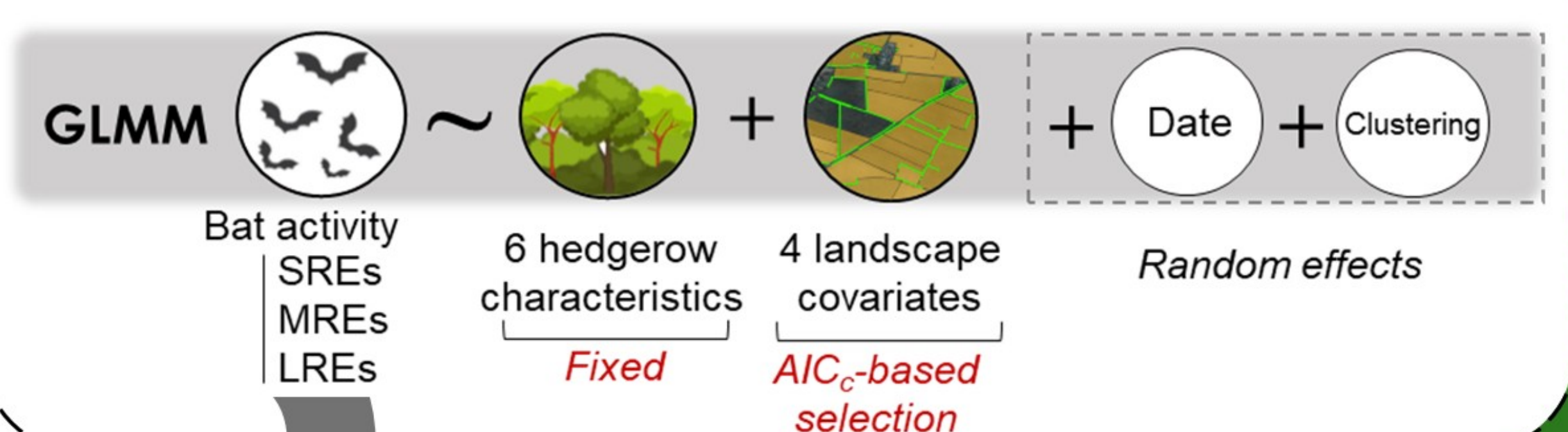
- ▶ Hedgerow network density (km/km²)
- ▶ Distance to forest (m)
- ▶ Forested land (%)
- ▶ Cultivated land (%)

♣ Hedgerow characteristics (50 m)

- ▶ Height
- ▶ Width
- ▶ Structural connectivity (continuity)
- ▶ Foliage density
- ▶ Management method
- ▶ Woody plant diversity

3 Statistical modeling

Model averaging within a set of candidate models ($\Delta AIC_c = 4$)



MAIN RESULTS & DISCUSSION

1. Connected hedgerows are more attractive across all guilds

- ✓ For narrow and edge-space foragers + open-space foragers
- ✓ Hedgerow connectivity linked to prey abundance⁶ + commuting behaviors⁷

2. Higher tree-filled hedgerows are generally more attractive

- ✓ Higher insect abundance & diversity⁸
- ✓ Substitute habitat for forest species?
- ✓ Better acoustic landmark?
- ✓ Enhanced wind-break effect: less energy expenditure in flight (especially for smaller species)?

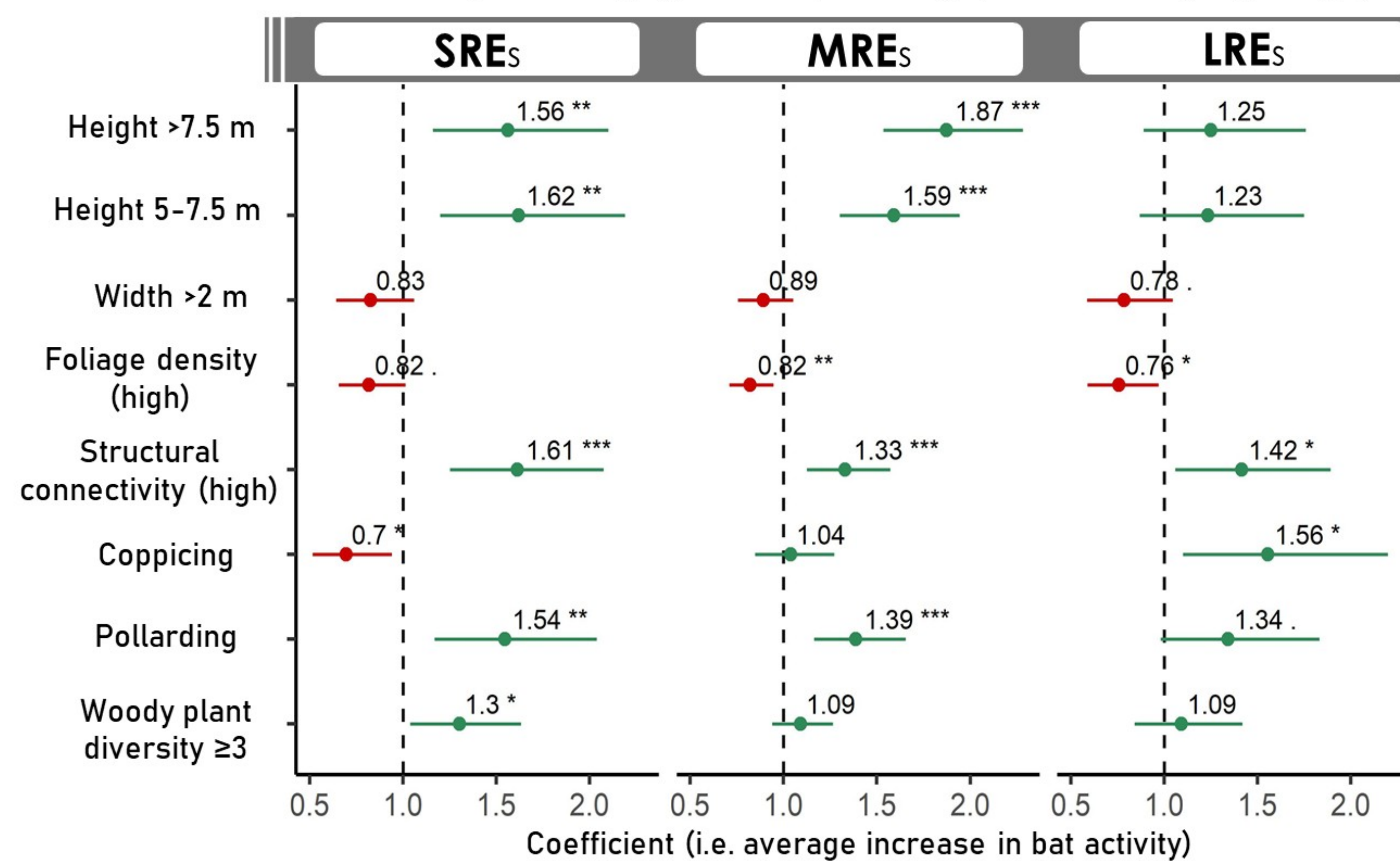
3.A. Presence of pollarded trees in hedgerows boosts bat activity across all guilds

- Generally associated with ...
- ✓ Older trees: complex micro-habitats beneficial for insects⁹ + higher diversity of roosting sites (cavities, cracks, etc.)
- ✓ Longer cutting cycles: higher insect abundance¹⁰

3.B. Presence of coppiced trees in hedgerows can deter and attract bats based on guild

- ✓ Creates open/light habitats (lower sub-branching density) while narrow-space species (SREs) seek thick vegetation (protection from wind, predators¹¹)
- ✓ Shorter cutting cycles: lower insect abundance along the hedgerow¹⁰

3 groups of species (acoustic guilds) based on their echolocation range: SREs (short-range), MREs (mid-range) and LREs (long-range).



These guilds have different foraging behaviors near hedgerows⁵

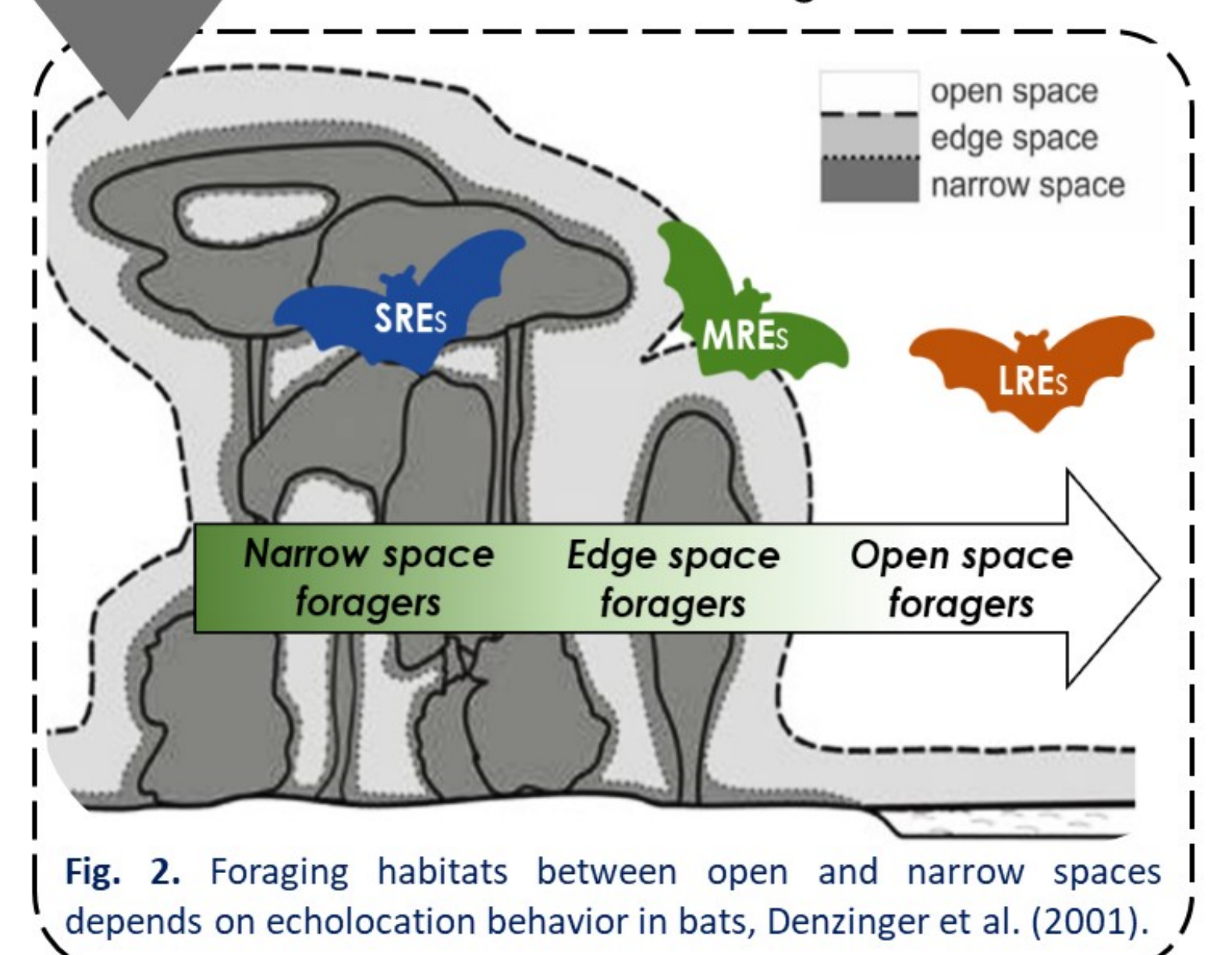


Fig. 2. Foraging habitats between open and narrow spaces depends on echolocation behavior in bats, Denzinger et al. (2001).

Fig. 1. Coefficients of hedgerow characteristics obtained from the averaged models of each guild. Model baseline (intercept) are hedgerows with height <5 m, width <2 m, low foliage density, low structural connectivity, no particular management method and woody plant diversity <2. The 95% confidence intervals are represented by horizontal red bars (coefficient>1: positive effect) or green bars (coefficient<1: negative effect). The level of significance is represented by ****<0.001; ***<0.01; **<0.05; *<0.1; †>0.1.

RECOMMENDATIONS

- #1 Focus efforts on preserving **connected hedgerows** → facilitates commuting behaviors in both narrow and open-space bat species
- #2 Develop **tall, outgrown and tree-filled hedgerows** → facilitates foraging behaviors (perspective : enhanced pest control outcomes ?)
- #3 Promote **hedgerow diversity**:
 - Incentivize pollarding in young trees for tree-roosting bats
 - Incentivize complex floristic composition (3 or more woody plant species)



ACKNOWLEDGEMENTS

This work was conducted during a final year internship (MSc) with ESA (Ecole Supérieure d'Agricultures, Angers) and coordinated by OFB & Auddicé biodiversité.

We thank Jérémy Froidevaux and Christian Kerbiriou for sharing data and supporting us in statistical analyses. We also thank Théo Dokhelar and Sophie Morin for their counsel. Finally, we thank Vigie-Chiro for allowing us to use citizen-science data and all the farmers & land-owners for granting us access to their land.

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