

SAFEGRAPE: leveraging citizen science to monitor endemic and emerging pests in French Vineyards

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Context and motivation

- Arthropod pests are major threats to global crop production, destroying one-fifth of global crop production
- Climate change, globalised trade and landscape homogenization increase this threat and favor invasive species
- Vineyards now face highly complex, multi-origin pest assemblages—making large-scale monitoring essential to untangle the ecological drivers of tomorrow's outbreaks.
- Based on a nationwide participatory science network, the **SAFEGRAPE project** aims at understanding the drivers of pest establishment and dynamics in vineyard-dominated landscapes in order to forecast future risks (Fig. 1).

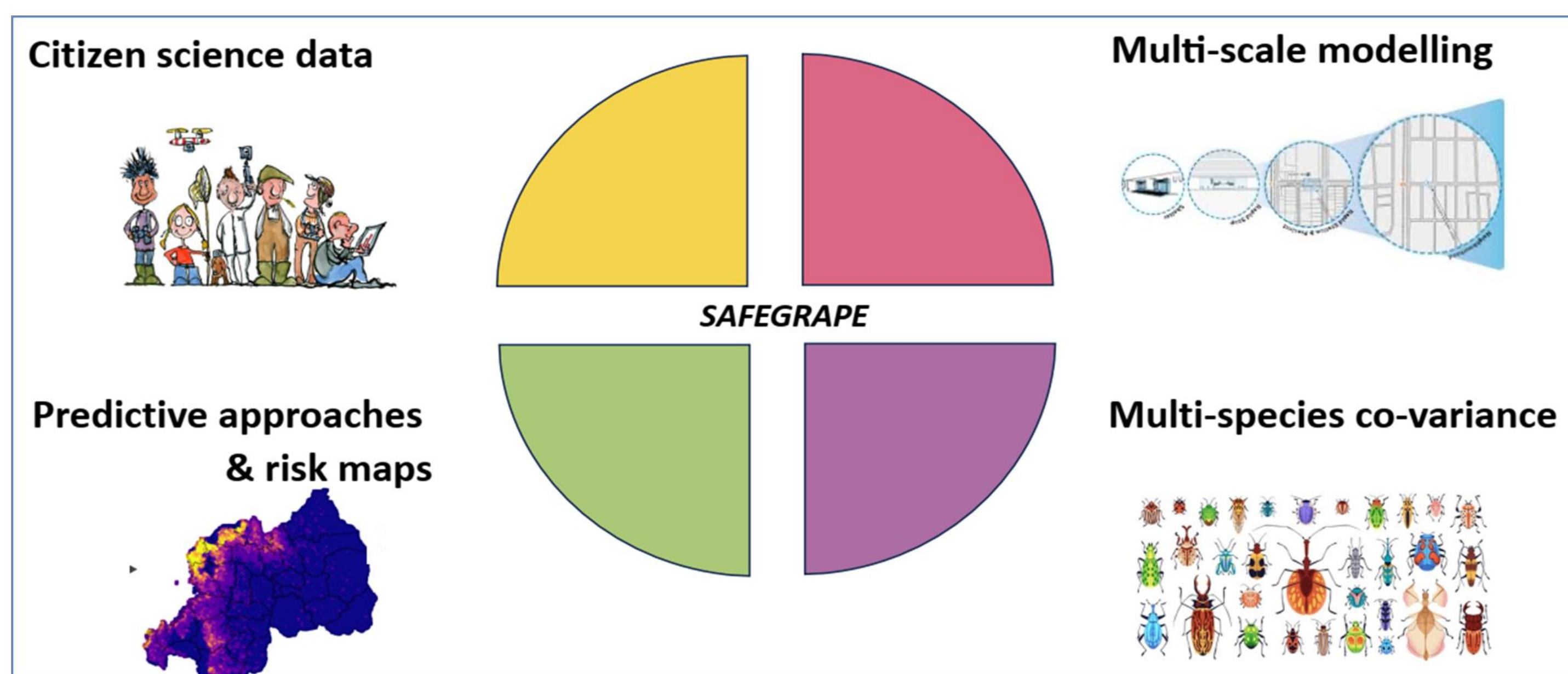


Figure 1. Schematic representation of the key activities of the SAFEGRAPE project

Nationwide network : a major tool to detect invasive species

- We first detected and tracked the continental leap of *Jacobiasca lybica* from Corsica (2023) across the southern coast (2024–2025).
- We captured the first French record of *Zaprionus tuberculatus* in the Landes (2024) before mapping its southern expansion, alongside the ongoing spread of *Cryptoblabes gnidiella* into the Gers.

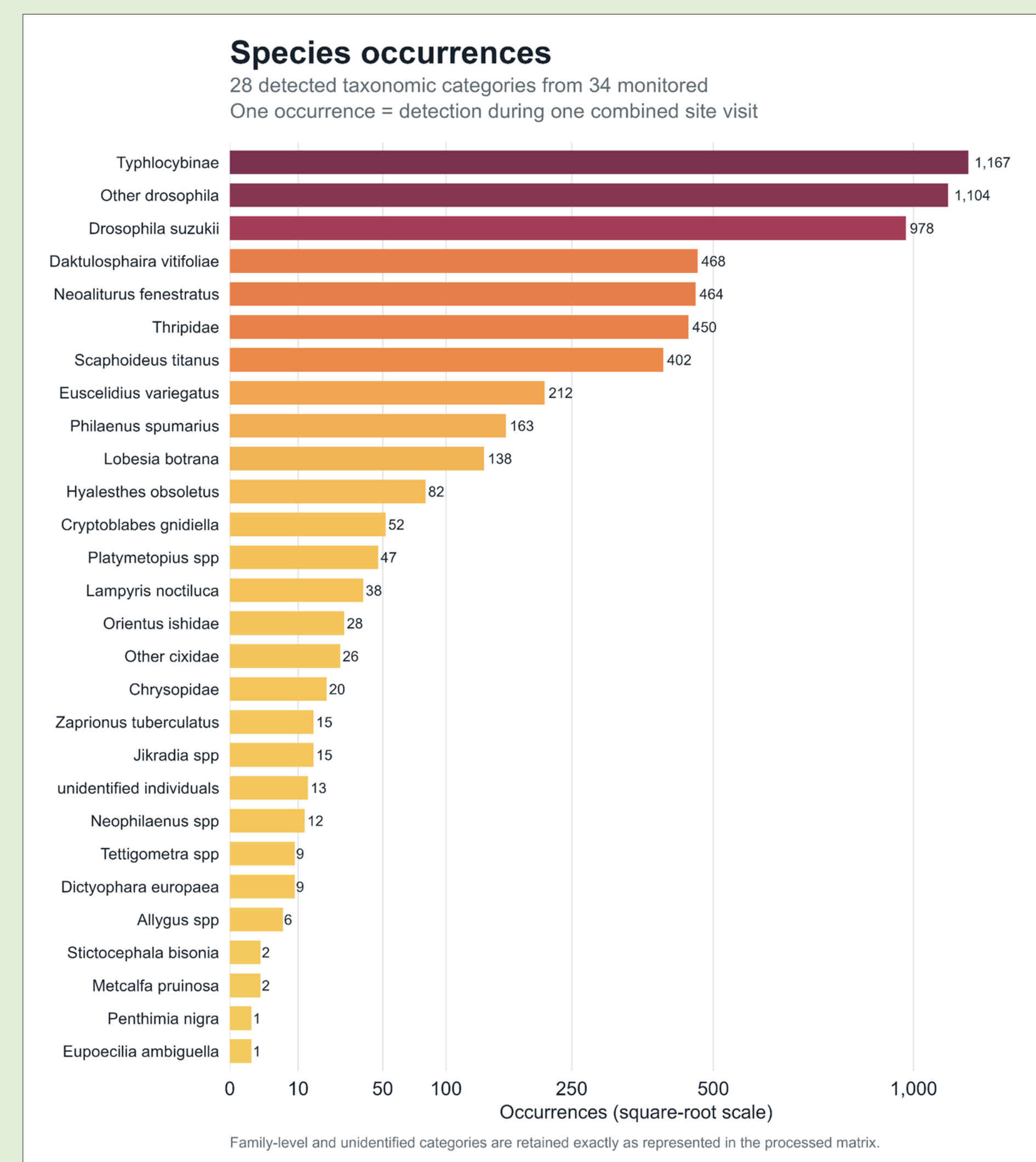


Figure 4. Occurrences of the sampled species across all plots from 2022 to 2025

Our approach

- We established **OVNI**, a nationwide network of technical and professional stakeholders who monitored specific plots across French wine-growing regions (Fig. 2). We target adult pests, capturing established species, pathogen vectors, and emerging threats like hemipterans, fruit flies, and pest moths.

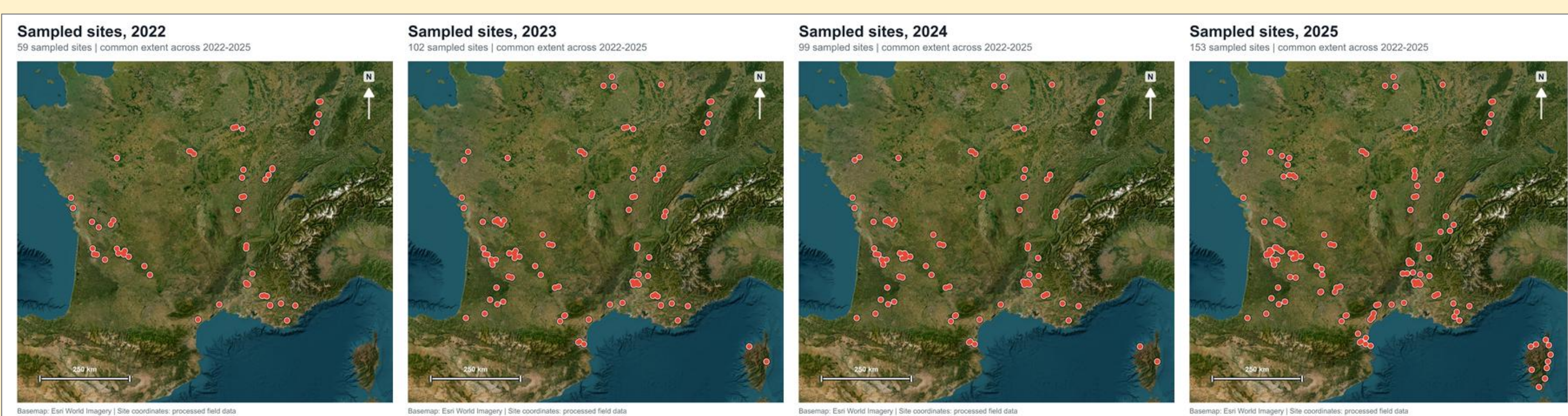


Figure 2. Evolution of OVNI plot network in French vineyards from 2022 to 2025

- We monitored pest species using sticky traps and bait traps (Fig 3).
- We apply Hierarchical Modelling of Species Communities (HMSC) to weigh the impacts of climate, landscape, and management.

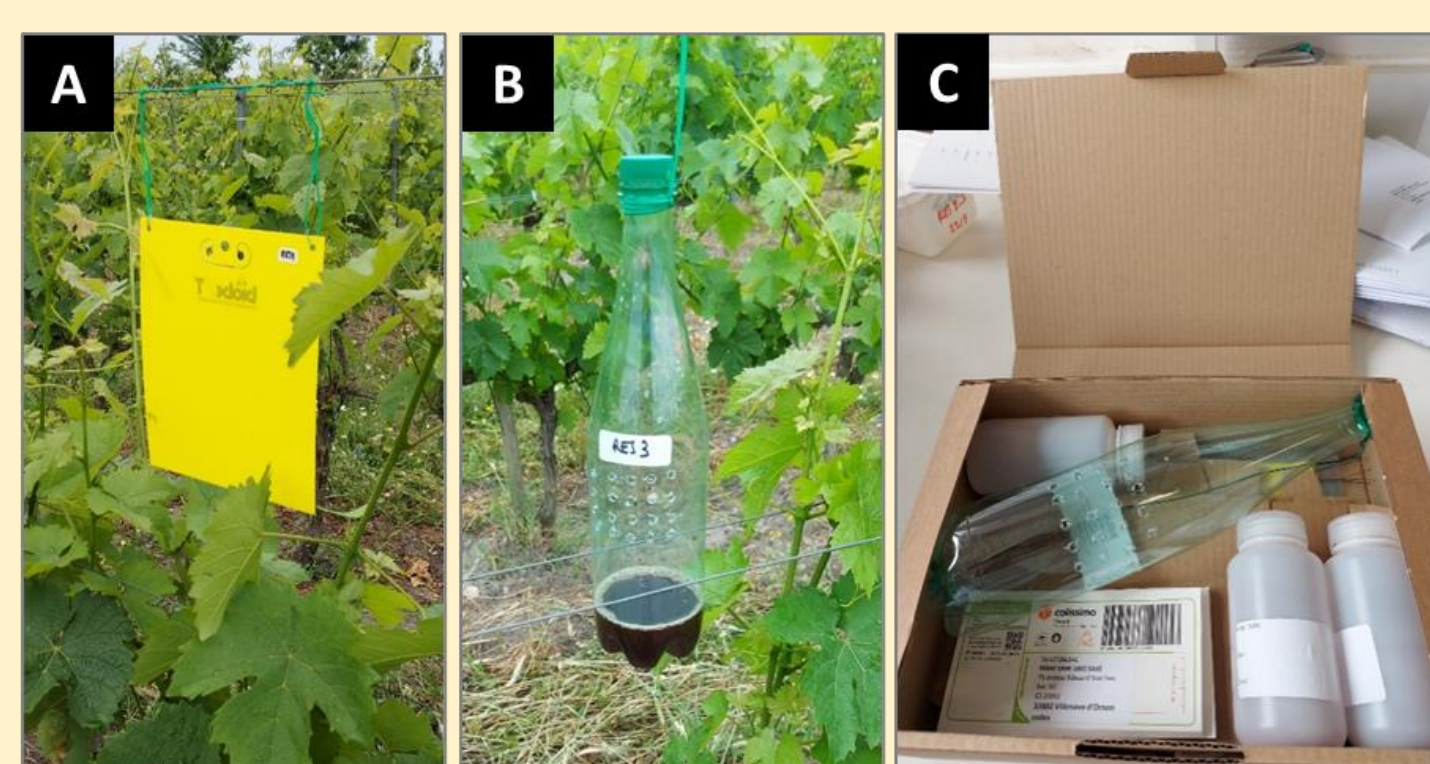


Figure 3. Types of traps used: A) yellow sticky trap, B) bait trap, C) trapping kit sent to partners, containing the traps and return packaging by post.

Filters across scales explain pest presence

- Variance partitioning (Fig. 5) shows a strict spatial hierarchy structuring the assemblage. Local farming practices act as the primary selective filter (34.6% variance), while regional climate (22%) and landscape composition (19%) function as broad-scale filters of the species pool.
- The moderate Tjur r^2 values highlight a key reality: our models successfully explain why pests occur today, but forecasting their future spread remains the network's next frontier.

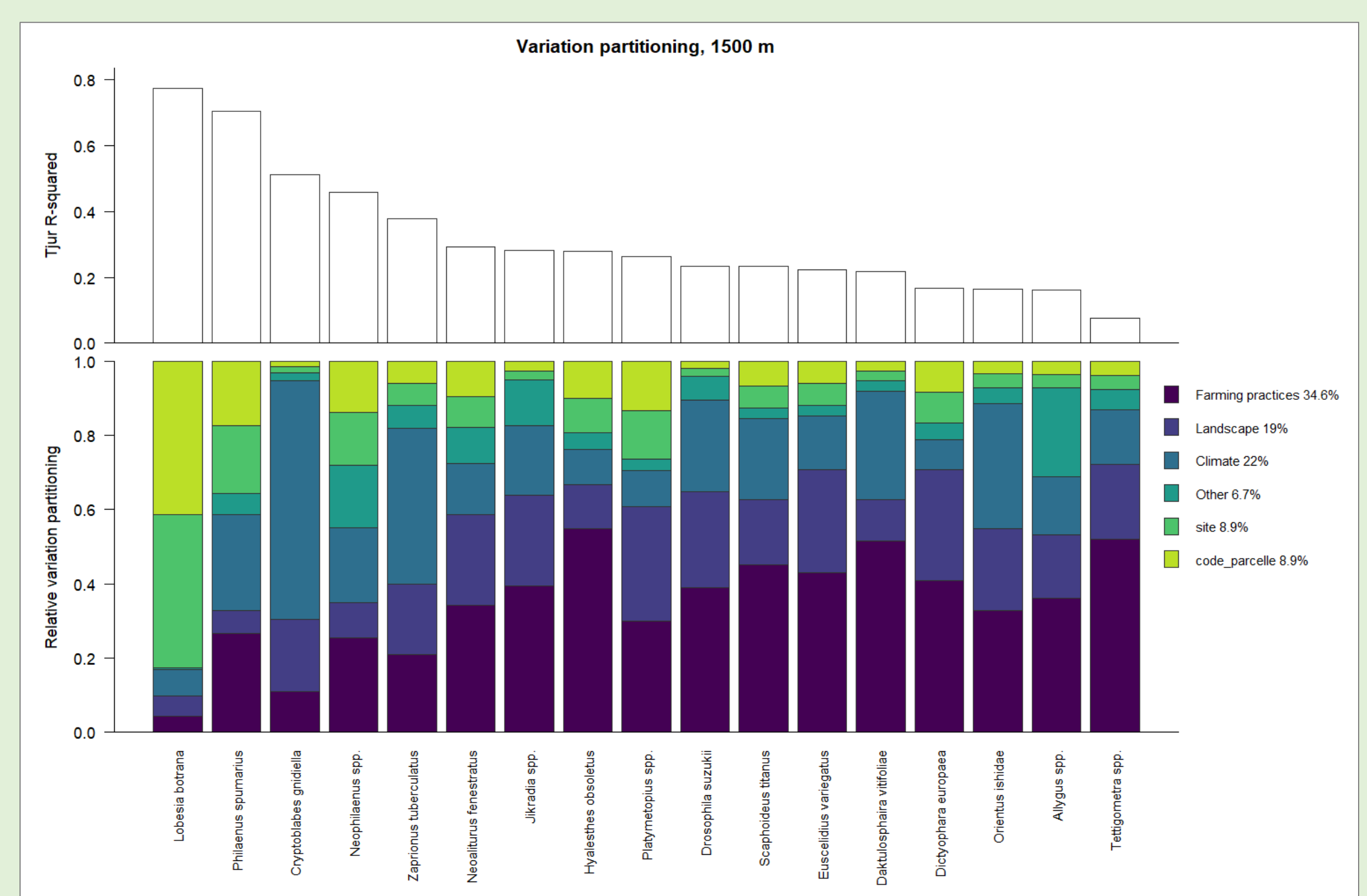


Figure 5. Variation partitioning for selected species and the contribution of explanatory variables, particularly regarding landscape composition, within a 1,500-metre buffer zone around each plot

Conclusion

Empowering the Frontline : SAFEGRAPE demonstrates the potential of participatory science for national-scale species monitoring, generating a unique multi-species dataset while enhancing awareness and early detection of invasive species among winegrowers.

From Observation to Prediction : We are now moving beyond mapping the present. The next step is to use machine learning to forecast pest dynamics under shifting climate, land-use, and management scenarios.

Acknowledgments

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