Relative contributions of climate, land-use and soil in shaping invertebrate distributions

Marianne Tzivanopoulos*[1], Laure Gallien[1], Tamara Münkemüller[1], and Wilfried Thuiller[1]

[1]Laboratoire d'Ecologie Alpine – Université Grenoble Alpes – France

Résumé

Invertebrates constitute a major facet of biodiversity, participating in multiple biotic interactions and serving as vital resources for many other species. They often fulfil roles as ecosystem engineers and provide key nature contributions to people, such as pollination, decomposition, and pest control. As ectotherms and sensitive to environmental changes, some invertebrate groups have seen their abundance and distribution already affected by recent climate change and land-use intensification. Yet, not all groups are equally sensitive to the same drivers of change, making it challenging to derive general recommendations for their protection.
Here, we provide an overview of the most important drivers of invertebrate occurrence at the European scale. To be as general as possible, our study covers a large range of species (_˜6000) encompassing several trophic groups, including predators, herbivores, pollinators and detritivores. More specifically, we harnessed multiple invertebrate datasets together with state-of-the-art climate, soil and land-use intensity data within a consistent modelling framework (ensemble machine learning models), to contrast driver importance within and among trophic groups.

We found that, although climatic predictors are generally the most important drivers of invertebrate distributions, soil and land-use drivers have a substantial impact on invertebrate distribution. Interestingly, the magnitude and direction of the impact of climatic factors, such as temperature or precipitation, on invertebrate distributions varies across European biogeographic regions but also between the different trophic groups. Similarly, we clarified how variations in land-use intensity can alter invertebrate preferences towards specific habitats. Using machine learning interpretability tools, we also highlight important spatial variation in variable importance across trophic groups and between regions.
To conclude, our study, which covers a wide range of invertebrate species and groups, paves the way to better understand how the environment shapes invertebrate presences and to predict their distribution in space for conservation purposes.

Mots-Clés: Invertebrates, ecological niche, land, use intensity, biogeography, species distribution modeling

*Intervenant