Biogeographical network analysis of plant species distribution in the Mediterranean region

Maxime Lenormand, Olivier Argagnon

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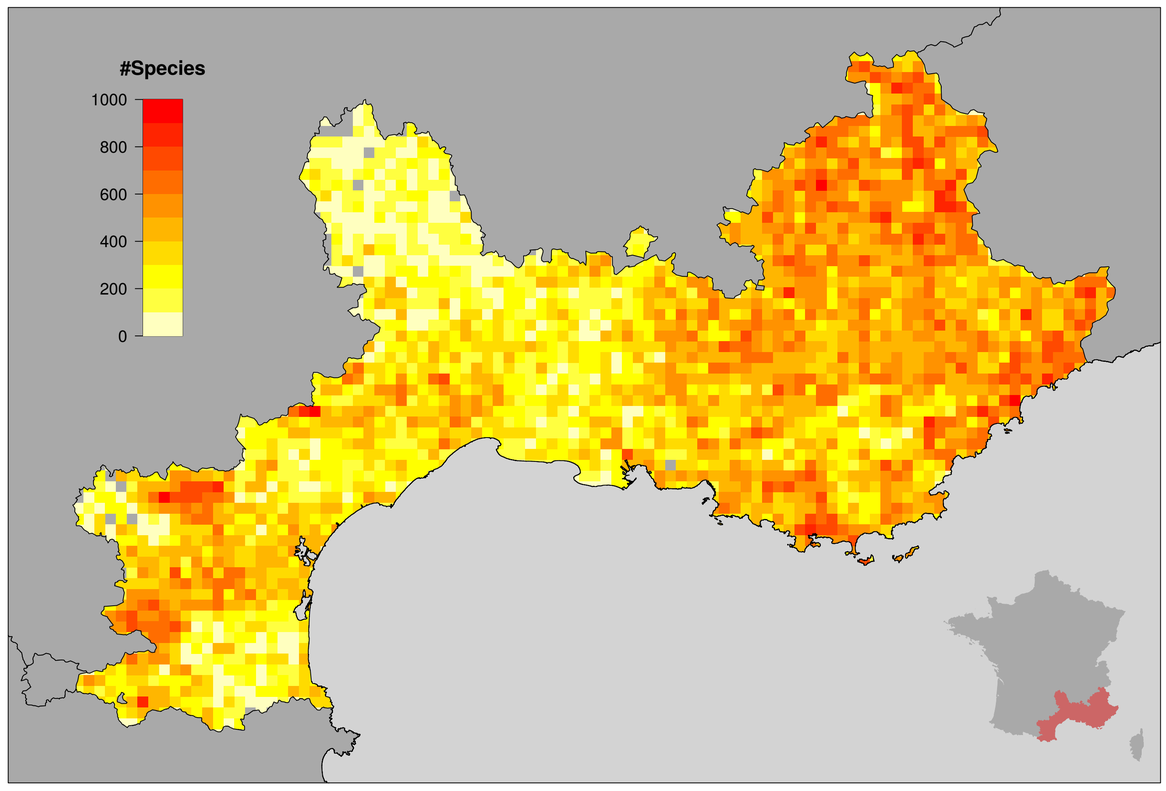
Abstract

The study of biotic taxa distribution on a territory represents a key step in the understanding, analysis and conservation of ecosystems, but often hindered by a level of diversity and complexity that may appear overwhelming at first glance. To better understand and visualize the biogeographical structure of a territory, it is therefore necessary to divide this territory into meaningful and coherent geographical regions, minimizing the heterogeneity in taxonomic composition within regions while maximizing the differences between them. While the delineation of biogeographical regions has been based for a long time on expert knowledge of qualitative data collection, the increasing availability of species-level distribution data and the recent technological advances have allowed for the development of more rigorous frameworks. While limited consideration is given to network approaches in biogeography, the generic nature of networks and the level of complexity that they can capture at different scale, make it a powerful tool for investing the interactions among species occurring on a territory. In this work, we used a network approach to identify and characterize biogeographical regions in southern France, based on a large database containing information on **millions of vegetation plant samples** corresponding to more than **3,500 plant species**.

Database

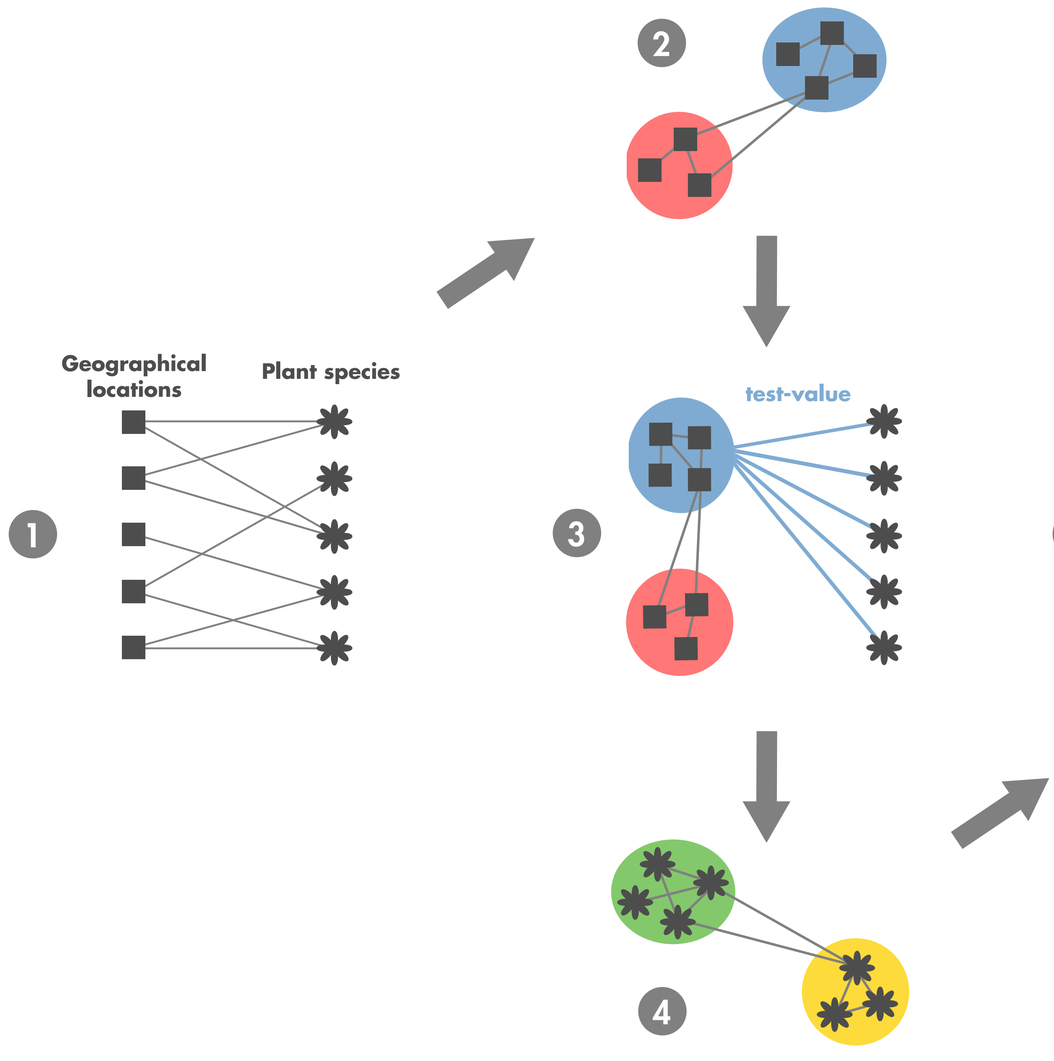


Biogeographical network analysis

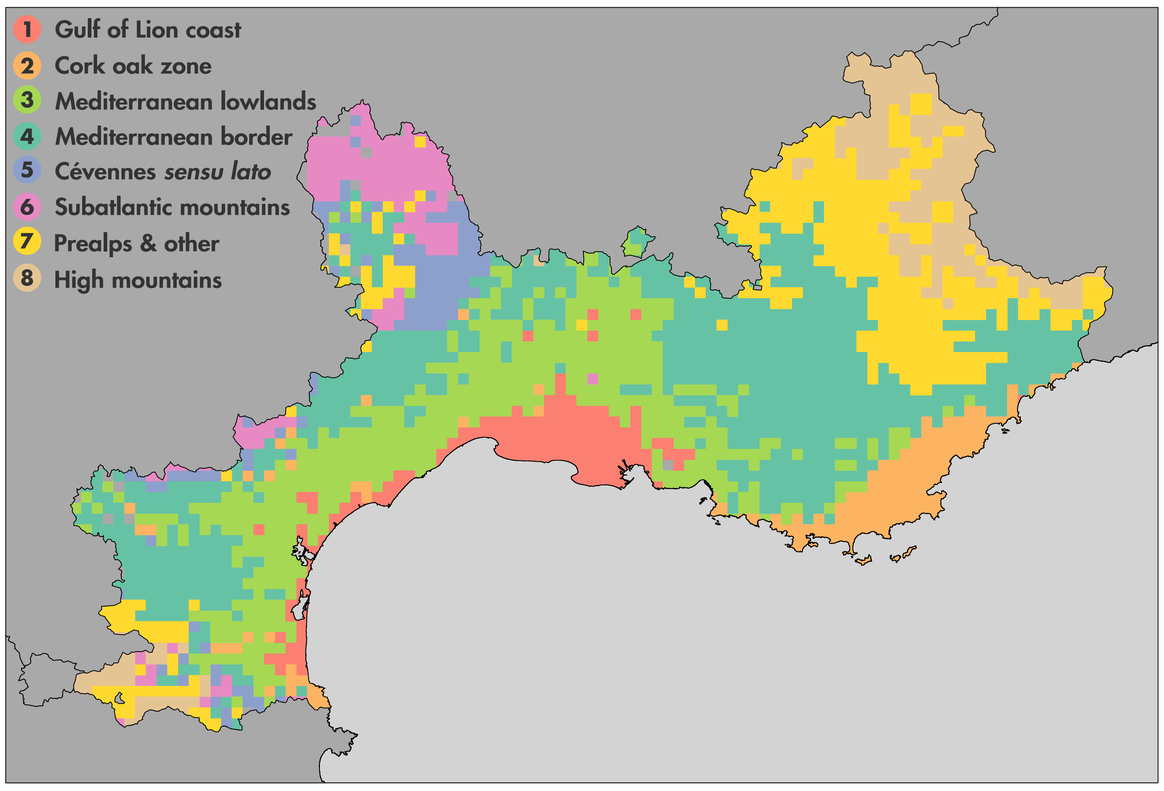
1. **Biogeographical bipartite network**
2. **Delineating biogeographical regions**
3. **Test-value matrix**
   - **n** geographical locations
   - species **i** present in **n** geographical locations
   - spatial community **j** composed of **n** locations
   - $\mathbf{n_{ij}}$ locations with species **i** in community **j**

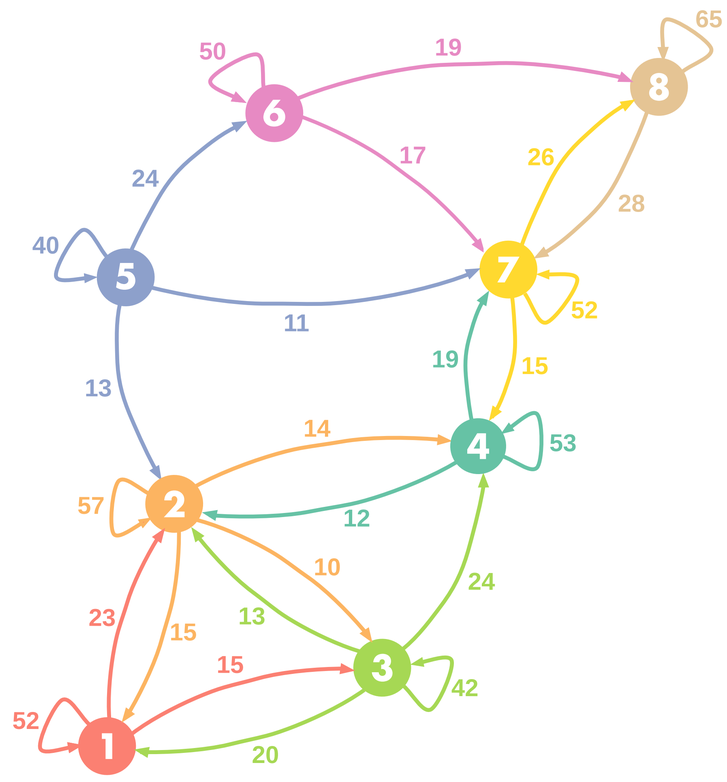
$$\rho_{ij} = \frac{n_{ij} - \frac{n_i n_j}{n}}{\sqrt{\frac{n-n_j}{n-1}\left(1-\frac{n_j}{n}\right)\frac{n_i n_j}{n}}}$$

4. **Clusters of species**
5. **Coarse-grained biogeographical network**



Unveiling multiscale biogeographical structure





Lenormand M, Papuga G, Argagnon O, de Barros G, Alleaume S & Luque S (2018) Biogeographical network analysis of plant species distribution in the Mediterranean region. arXiv preprint arXiv:1803.05275.