

B. Désy

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Title : *Complex network analysis of birds co-occurrence patterns in boreal forest*

Northern ecosystems are complex and evolve under climatic, natural and anthropogenic influences. It is therefore a significant challenge to tackle ecosystems' structure and identify accurate biodiversity indicators. In this regard, our aim is to make the most of the numerous tools of network science to shed light on prominent interrelations between species using available datasets.

In this project, we analyze the co-occurrence patterns of birds species of Quebec's northern forest, using data generously provided by Daniel Fortin and colleagues [1]. Species co-occurrence patterns are described by a presence/absence binary matrix of species versus sites of observation. Network measurements can be made directly on this matrix, for instance correlation between species, characterization of types of observation sites and grouping between species. These measures arise solely from the structure of the underlying network. However, to detect key ecological interconnections requires pruning the co-occurrence data from spurious interactions that can simply be explained by chance. To do so we first generate a null model, namely an ensemble of random graphs with a set of fixed properties based on the observed dataset. It serves as a benchmark to distinguish the significant co-occurrences between bird species. These stronger links are then used to infer a network of significant connections distilling the structure of the initial data. This allows the characterization and identification of indicator species, a subset that is directly related to the biodiversity of a larger group of species.

Our results demonstrate that a combination of direct network measurements with null model analysis is an efficient strategy. We have recovered results obtained by statistical analysis of the same dataset [1,2], whilst developing analytical network tools to enrich our understanding of various ecosystems properties. In summary, the complex network approach appears promising for the analysis of co-occurrences of species in northern regions.

We are grateful to Daniel Fortin, Frédéric Maps and Louis-Paul Rivest for useful discussions and for sharing with us their experience with the treatment of available datasets.

References :

- [1] | Zhao Q. et al. *Robust predictive performance of indicator species despite different co-occurrence patterns of birds in natural and managed boreal forests*, Forest Ecology and Management, 397 (2017) 108-116.
- [2] | E.E. Sergio *Les "null models" et la détection des modèles de regroupement dans les communautés écologiques*, Master's thesis, Université Laval, Faculté des Sciences et de Génie (2017).