

Thèse : ***Adapting and developing new biodiversity indicators from improved Joint Species Distribution Models (JSDM)*** (CESCO-MNHN. Paris-Concarneau)

Context and objectives

Abrupt climate change, land-use change and other human-made disturbances are triggering species extinctions and range shifts, and are altering ecosystem functioning. Effective conservation strategies to mitigate these threats should build on a good understanding of how global change affects biodiversity distribution and ecosystem functions. Their definition and effectiveness assessment must rely on relevant indicators of biodiversity. However, despite the importance of interactions between species in structuring communities and characteristic trait distributions, current indicators do not take them explicitly into account.

Recently, tremendous progress has been made in extending correlative species distribution models (SDMs) to Joint Species Distribution Models (JSDMs) to account for and estimate species interdependencies. As in SDMs, JSDMs can predict species (or traits) distributions based on environmental and spatial variables, but they can also discriminate their shared responses to these variables from additional ecological or evolutionary processes (e.g. biotic interactions). However, the practicality and efficiency of these recent methodological developments for conservation have not been properly tested and applied yet.

This project aims to investigate the use of JSDMs to adapt and develop biodiversity indicators able to account for these interactions in biodiversity states and trends assessments. It will especially focus on indicators that reflect the responses of communities (species, traits composition) to global change, especially the interactions among climate and land use changes. These indicators are key to document biodiversity trends and assess the efficiency of environmental policies, they are hence strongly requested by stakeholders at different spatial scales, part of different Observatories of Biodiversity (ONB, French environmental ministry / EBCC, Europe Environmental Agency). The PhD candidate will assess how JSDM could be used to ameliorate the relevance of already existing indicators, notably those facing climate change as the inter-annual variation of the average thermal index of communities (CTI) and the average distance moved to the north, which is equivalent to this community's re-composition. Currently, these indicators developed for communities are either mean traits or average species abundances, and do not take into account explicitly the interdependencies of species and traits. He/She will also investigate the relevance of JSDMs to propose novel indicators.

For this, he/she will mobilize cases studies that cover different ecological and biological contexts (number, rarity of species, traits) and encompass diverse methodological problems (high number of zeroes, high dimensional data) with the aims of the genericity of the results. He/she will use biodiversity data from large scale citizen monitoring programs (Vigie-Nature - MNHN) composed of standardized measures of species abundance at the community level across space and time. These data will be crossed with environmental data already available (climatic, land use, practices, protection databases). The PhD project is a main part of the WP3 of ANR GAMBAS, benefitting directly from outputs of WP1 and 2, collaborations, skills of the interdisciplinary team, including the development of novel statistical tools.

He/She will develop JSDMs to better understand which part of a species abundance, or of the community trait, is linked to features such as habitat, climate or species interactions, and will use model outputs to propose new approaches for community indicators. Firstly, our aims are to favor abundance data to the presence/absence data currently used in SDMs, as they are expected to be more responsive to environmental gradient (notably thermic affinity). Secondly, we will use data at a finer spatial scale to be able to account for habitat changes. It will be also important to pay attention to the shape of environmental niches (notably climatic) and verify the relevance of probability distributions for the data being analyzed. Finally, the PhD candidate will model potential changes within this niche in relation to climate change through two possibilities: by varying the shape of the niche (e.g. its extent or mean position representing adaptations, or by adding time or spatial lags in response to temperature change).

The spatial and temporal trends of this new generation of indicators will be confronted to previously developed metrics (e.g. community specialization, functional diversity, trophic level...) to evaluate their potential use for better biodiversity monitoring and conservation planning. They will be analyzed in close collaboration with stakeholders to implement user-friendly and appropriate indicators that better mirror biodiversity states facing pressures.

Conditions

Lab and supervisors :

Frédéric Jiguet (HDR) and Isabelle Le Viol.

CESCO Centre d'Ecologie et des Sciences de la Conservation. UMR 7204. MNHN-CNRS6SU. Museum national d'Histoire naturelle. Paris / Concarneau.

The PhD candidate will integrate a research team who has already worked on the topic and experienced collaborations and co-supervisory of PhD-master students. He/She will benefit from the work already carried out, but also from ANR Gambas outputs (GAMBAS started in 2019) and national and international collaborations. The PhD candidate will benefit from the strong collaborations with F. Gosselin, F. Laroche (INRAE, JSDMs, statisticians - ANR GAMBAS), and ecologists with strong skills in modelling as A.-C. Monnet, B. Leroy (MNHN). Given the subject, the datasets, the questions and cutting-edge methods, this thesis should result in publications in high-ranked generalist, methodological and/or conservation journals. The results will also be disseminated using various communication tools (congresses, GAMBAS website, annual newsletters, policy brief.)

Financial support:

This project already benefits from a financial support of ANR GAMBAS, Generating Advances in Modeling Biodiversity and ecosystem Services: statistical improvements and ecological relevance of joint species distribution models. This corresponds to a financial support for salary (1/2 grant) and functioning (work meetings, congress, publications...). The other half-funding must be obtained via the ED 227 doctoral school (1 to 3 july).

Candidate profile

Conservation biologists, ecologists, with strong skills, abilities and motivations for data analyses, modelling and research transfer towards stakeholders. Candidates with interdisciplinary profile in statistical-ecology are particularly welcome. Naturalist skills would be welcome.

Applications

Please send your application by email (as a single PDF by email) to isabelle.le-viol@mnhn.fr and Frederic.jiguet@mnhn.fr

Applications should include a CV, names and addresses of two references, a one page description of your research interests, motivations. Applications will be reviewed from 20 th May to 10 th June

For queries on the application process or more information on this position, please contact isabelle.le-viol@mnhn.fr