

Tracking Bees and Flowers networks at a national scale: The potential of Joint-Species Distribution Models

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Abstract: Wild bees provide essential ecosystem services such as food production and pollination of wildflowers. Studying Bees and Flowers's relationship with the environment and with each other is key to tackle the collapse of those communities. Species Distribution Models (SDMs) have been used to estimate the ecological niche of a species by correlating their recorded occurrences with environmental variables such as climate and land use. Joint-Species Distribution Models (J-SDMs) on the other hand take also into account the biotic niche by correlating each species recorded occurrences and supposed absences with each other's. In this work we compared for each species the output of a J-SDM including 462 plant species and 249 Bees species recorded in the Netherlands with the output of a standard SDM. For both models we used hundreds of thousands of occurrence records coming from an opportunistic dataset including citizen science data and research samplings. We run the model at a 1Km spatial resolution and a 2010-2023 temporal resolution using fixed uncorrelated environmental variables for every species. The resulting predictions on the whole territory of the Netherlands were compared between J-SDMs and SDMs. AUC, TSS and Boyce Index were calculated and compared between the J-SDMs and SDMs for each species. The interaction matrix resulting from the J-SDMs was analysed to understand if co-occurrence patterns might be a good proxy for Bee-Flower interactions. We also tested the hypothesis that the importances of species interaction is more important for oligolectic bees than for generalist bees. We found that J-SDMs consistently predicted a larger suitability area for the tested species. J-SDMs did not perform significantly differently on the quality measures index calculated in this study. The resulting interaction matrix was strongly affected by sampling biases and was not correlated with the lectic status of a bee species.