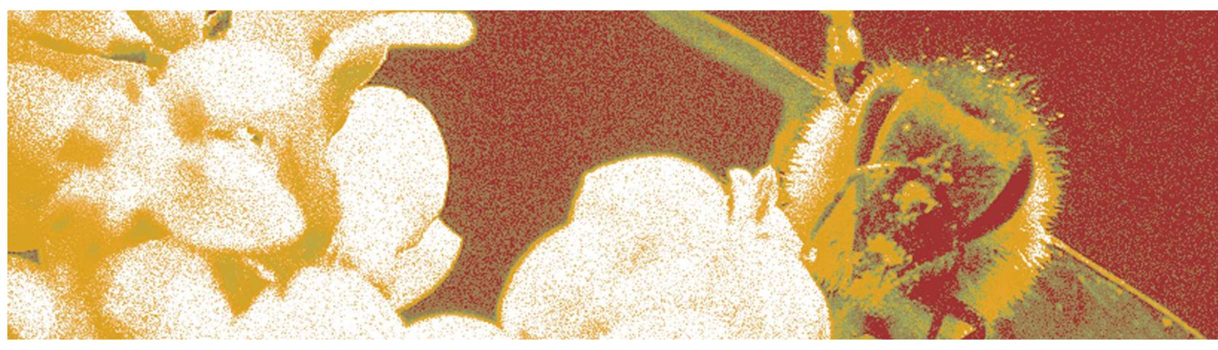


Using nutritional ecology as driver of pollen preferences in the ApisRam honey bee model

Nuno Capela[1], Elżbieta Ziółkowska[2,4], Michał Filipiak[3], Soraia Sousa Santos[1], Xiaodong Duan[2]

[1]Centre for Functional Ecology, Department of Life Sciences, Associated Laboratory TERRA, University of Coimbra, Portugal
[2]Social-Ecological Systems Simulation Centre, Department of Agroecology, Aarhus University, Aarhus, Denmark
[3]Institute of Environmental Sciences, Faculty of Biology, Jagiellonian University
[4]Institute of Geography and Spatial Management, Faculty of Geography and Geology, Kraków, Poland

INTRODUCTION

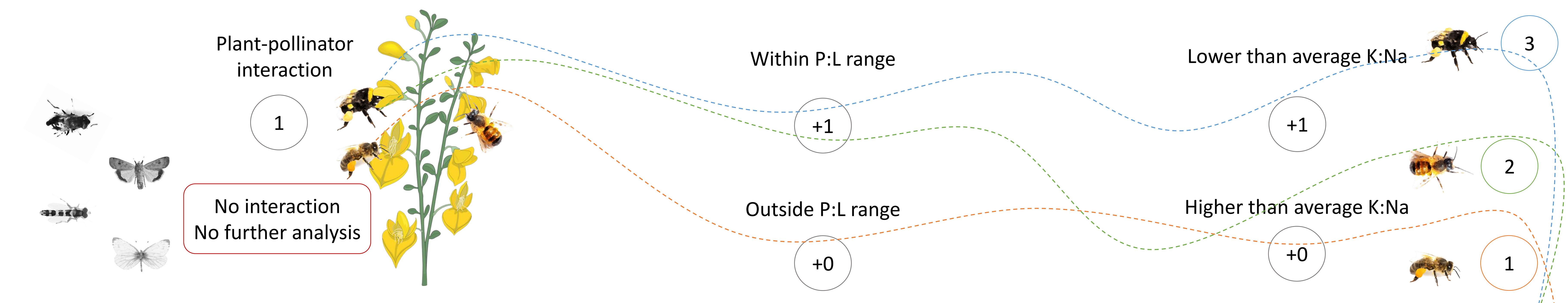
The European Food Safety Authority (EFSA) aims to increase the complexity and realism of the Environmental Risk Assessment (ERA) of bees, to better protect these pollinators and their services. To achieve this goal, there is a need to develop models that capture our landscapes spatial and temporal heterogeneity. The ALMaSS is a system of spatially explicit agent-based/subpopulation-based models with a landscape simulation model for use in predicting the effects of human landscape management on a range of key animal species, including pollinators. In the system, several landscape layers are created based on ecological data. For pollinators, one of the most relevant layers is the food availability over time. At this moment, the system already integrates data on the amount of pollen, nectar and sugars produced by a single flower/inflorescence of a given plant species with information on flower/inflorescence abundance (i.e., density of flowers/inflorescences per unit area), flowering phenology, plant composition of the flora/habitat and flora/habitat composition and configuration within the ecosystem/landscape. This approach enables the spatio-temporal availability of floral resources to be predicted within different flora/habitat types and across different ecosystems/landscapes. Nevertheless, to predict landscape-specific pollinator carrying capacities, the pollinators' (agent) behavior and interaction with the virtual landscape also needs to be considered. In here we present a framework to drive these interactions based on the pollen quality for some model species and discuss its implementation within the ApisRam honey bee colony model, which is under development to be implemented by EFSA to increase the ERA realism.

METHODS & RESULTS

A **semi-qualitative scale from 0 to 3** was created to infer the pollinator pollen preference for each plant species that is currently in ALMaSS (total of 408 plant species). The scale follows a stepwise approach based on their possible interaction, and on their nutritional needs and preferences. Each plant species can have a score from 0 to 3, which determines the level of preference of the pollinator: 0 = no interaction, 1 = poorly preferred, 2 = moderately preferred and 3 = Strongly preferred.

Model species

Plant-pollinator interaction | Protein:Lipid ratio preference | Sodium:Potassium ratio



1. If a pollinator has never interacted with the plant species, a preference score of 0 is set and no further analysis is performed. If a pollinator interacts with a particular plant species, a score of 1 is assigned.

2. The P:L ratio is then applied according to the literature data on pollinator preferences. If the P:L ratio is within the range of pollinator preferences, a score of 1 is added and the plant species will have a higher preference value (2). If not, it retains the same score as before (1).

3. The minerals content is then used by giving preference to lower K:Na ratios. Considering that bees prefer to visit plants with a lower K:Na ratio, plant species with K:Na ratio lower than the mean are given a score of 1. Plant species with higher than the mean K:Na ratio do not receive any score.

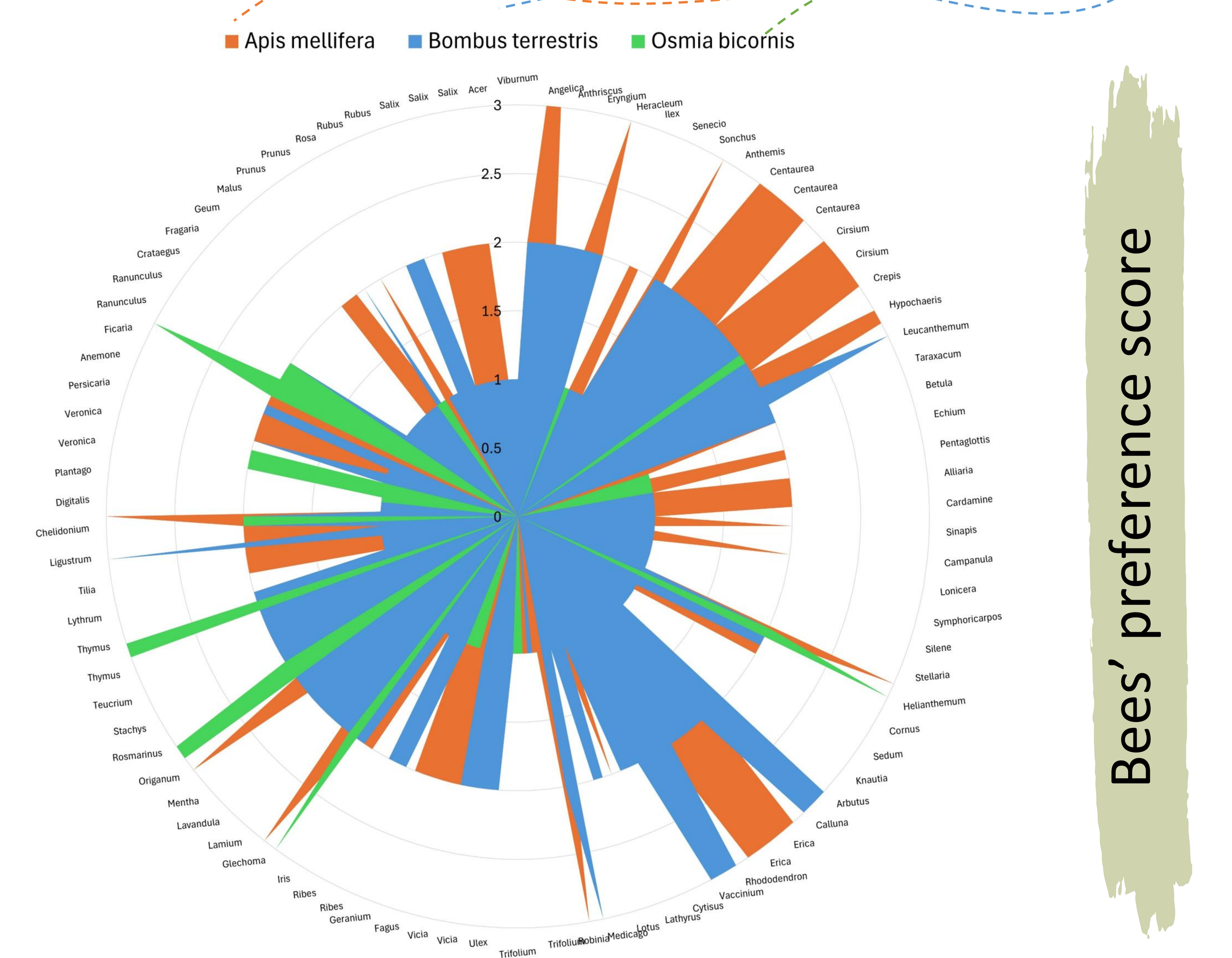
KEY MESSAGES

It is not possible to use the pollen quality strategy to set preferences for syrphids, butterflies and moths. Only for bee species, which collect pollen to feed their larva.

There are plenty of data on plant-pollinator interactions for most of the model species. The exception is *Noctua pronuba*. The organism's nocturnal behaviour makes it harder for researches and citizen scientists to register their interactions.

When considering only bees, 37% of the coded plant species are not visited by any of these pollinators, while 19% of them are visited by only one species. **Thus, possible competition** events between bee species can occur on the remaining **44% .**

Of the 230 species visited by *Apis mellifera*, a preference score of 3 was attributed to 32 species, a score of 2 to 118 species, and a score of 1 to the remaining 80. The implementation of these metrics in the ApisRam honey bee colony model can help to stir the bees (agents) interaction with the landscape.



WEBSITE
www.better-b.eu
info@better-b.eu

LinkedIn
Better-B Project

Get Involved
Join our Multi-Actor Forum

This work was supported by the Better-B project, which has received funding from the European Union, the Swiss State Secretariat for Education, Research and Innovation (SERI) and UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee (grant number 10068544).