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PROJECT TITLE: Population-level consequences of social information use

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This project has two objectives: 1) to develop a new methodology of inferring biotic interactions from observational data, and 2) to test this methodology on an extensive dataset to show population-level consequences of social information use. The whole approach is based on the modern coexistence theory and focuses on the niche concept.
We propose a novel approach that makes use of under-appreciated, semi-experimental properties of co-occurrence data gathered through ongoing monitoring programmes.
For pairs of potentially interacting species, sampling plots of spatially and temporally replicated data exist for either or both species. Collation of such data sets produces a semi-experimental design offering an opportunity to measure the niche and demographic parameters in the case of either presence or absence of certain biotic interactions.
The newly designed methodology will be implemented in the form of a dedicated R library and tested using a study system constituting of a set of interacting species that were experimentally shown to be involved in information transfer among individuals.

We will test empirically the following hypotheses:

1. Heterospecific attraction, due to its facilitative effect, results in expansion of the realised, compared to the fundamental niche of an information user. Alternatively, the realised niche will not expand, but the frequency of habitat use within the fundamental niche limits will change. If either of above possibilities is true (i.e. niche expansion or niche shift), the realised niche of the information user will change toward the realised niche of the information provider. As a consequence, the realised niches of both species will converge and would overlap to a greater extent.

2. The consequence of increased niche overlap is increased interspecific competition. As a result, there will be a reduction of the relative importance of intra-, compared to interspecific density dependence.

3. A non-linear interspecific density dependence will emerge in such system, leading to a demographic Allee effect. This effect will vary according to environmental conditions.

We will use existing data from the Common Breeding Bird Survey in Poland and publicly available environmental databases originating from various sources. The niche parameters would be estimated, that allow the quantification of niche convergence (or divergence) by comparing niche overlap between conditionally fundamental and realised niches taking into account the coexistence status (i.e. the focal species with or without its competitor/facilitator). Additionally, a more sophisticated analysis would be applied by assessing habitat use in relation to habitat availability. Hypotheses on the impact of social information use on

population regulation and dynamics would be tested within the framework of the competition models parameterised with the Generalised Additive Mixed Models.

This proposal integrates the theory for species coexistence with long-term and large-scale data on species abundance to address fundamental questions about the mechanisms of species coexistence. Survey and monitoring data are widely available and have been shown to provide enough information to extract interesting ecological signals. However, there is an obvious drawback to the use of co-occurrence observational data to test biotic interactions: such analyses are correlative, and causality cannot be inferred even when using powerful statistical approaches. Here, we propose a semi-experimental approach, which is a way to overcome this shortcoming.

Social information use is a behavioural process and its consequences on population and community dynamics, although postulated, have rarely been tested empirically. Moreover, studies that have hitherto been published on this subject have focused solely on the numerical response, ignoring other populationlevel consequences, such as patterns of density-dependence. To fill this gap, our approach provides a link between behavioural and population ecology by looking at the information transfer between heterospecifics through the lens of the concepts of facilitation and competition. The framework proposed here is designed to facilitate the incorporation of the social-information-use paradigm into modern coexistence theory.