

Master thesis proposal

Comparing resource abundance and intake at the Reda and Wisła river estuaries

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Background

The Reda and Wisła river estuaries are important stopover points for migrating birds across the Baltic. They remain here for a number of days to rest and replenish their energy resources. Current knowledge suggests that the Reda river estuary is much richer in resources. Since 1983 both places have been closely monitored and a dataset containing measurements on over 30000 individual birds is available. For a large number of them measurements of fitness values are available from different time points. How a bird's fitness increases over its stay at the estuary is taken as a proxy for the place's resource abundance.

Thesis project

The aim of the thesis is to develop a statistical estimation procedure that is able to compare the two estuaries and find variables that influence a bird's fitness change. However, the modelling part should take into account knowledge about the birds' behaviour, some of which is at the hypothesis stage that requires testing.

The vast majority of the birds were never recaptured. Hence, these individuals we cannot be used to look at fitness changes. However, throwing them away would mean wasting about two-thirds of the data. Therefore, one possible way to use them is to estimate an initial fitness level with which the birds arrive. This leads into the direction of non-linear models. There is a minimum and maximum value of fitness that an individual can have. Current modelling approaches are predominantly linear—hence such natural effects cannot be included.

Secondly it is suspected that birds have an initial drop in fitness on arrival—they need time to adjust to the new place. On the other hand as the date of arrival is never observed, only the day of the first capture, it is also hypothesized that the stress due to the first handling and possibly ringing causes a drop in fitness. Therefore, models should be developed that allow for including both mechanisms and (if possible) seeing which one is more supported by the data. As birds are rarely recaptured within a 24-hour period, a related to this issue will be measurement error and using predicted measurements for parameters estimation under the chosen models.

The thesis will be done in collaboration with the Department of Vertebrate Ecology and Zoology, University of Gdańsk, who will provide support from the “biological” side and a file with the measurements.

Goals

1. Development of stochastic models and statistical approaches for the biological problem.
2. Carrying out the analysis, including a study if some variables have non-linear effects.
3. Developing approaches for the first-day problem.
4. Providing all the methodology in an R package on CRAN that the biological community can easily use.

Data

The topic can be illustrated with both real and simulated data. The Department of Vertebrate Ecology and Zoology, University of Gdańsk will provide a data set with measurements on various birds.

References

- [1] A. Sikora and G. Neubauer. Body mass increase before an oversea jump in a short-distance migrant, the White-throated Dipper *Cinclus cinclus*. *Ardea*, 106:105–117, 2018.
- [2] A. F. Zuur, E. N. Ieno, N. J. Walker, A. A. Saveliev, and G. M. Smith. *Mixed Effects Models and Extensions in Ecology with R*. Springer, 2009.
- [3] A. F. Zuur, A. A. Saveliev, and E. N. Ieno. *A Beginner’s Guide to Generalised Additive Mixed Models with R*. Highland Statistics Ltd., 2014.