

## **Forming multi-species indices: behind the scenes**

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Multi-species indicators of abundance across large geographical scales play a vital role in the assessment of changes in biodiversity. For instance, examples can be found in *The State of the UK's butterflies, 2015* and *The State of the UK's birds, 2017*.

The indicators combine individual species indices, which arise from appropriate analyses of abundance data or citizen science presence data. For seasonal insects examples are provided by the UK Butterfly Monitoring Scheme and the UK Butterflies of the New Millennium data bases, respectively, and we use illustrations from these data bases throughout the talk. We shall describe details of the relevant models described by Dennis et al (2016, 2017).

A set of indices may be investigated for possible outliers and/or structure using functional principal components (Dennis et al, 2018).

Finally, we show how hidden Markov modelling may be used efficiently to fit a new multi-species indicator proposed by Freeman (2016), using classical inference.

### **References:**

Dennis et al (2016) A generalised abundance index for seasonal invertebrates *Biometrics*, **72**, 1305-1314.

Dennis et al (2017) Efficient occupancy model-fitting for extensive citizen-science data PLoS ONE. <https://doi.org/10.1371/journal.pone.0174433>

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Freeman, S. N. (2016) A generic method for estimating and smoothing multi species biodiversity indices, robust to intermittent data. Technical report, Centre for Ecology and Hydrology, Wallingford.