Course and Lecture:

**Community and gradient analysis: Matrix approaches in macroecology.**

Lecturer: Werner Ulrich

Address: Dep. Animal Ecology, UMK Toruń; Gagarina 9, 87-100 Toruń

E-mail: ulrichw@umk.pl

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Schedule: 15h (6h lecture, 2 h seminar, 7 h practical part)

Lecture outlook

1. Part (2 h)

Ecological matrices are widely used in the study of biogeographic, time series and food web patterns. The present course introduces into recent techniques for assessing community and food web structure based on biogeographic and mutualistic interaction matrices. A biogeographic matrix is a species x sites matrix whose entries are either presences and absences or quantitative data like abundance or biomass. A mutualistic interaction matrix describes species interactions as a species x species matrix. Examples are pollinator x plant, parasite x host, predator x prey, or social contact matrices. Recent work has shown that the internal structure of such matrices is in most cases not random but tells something about species interactions and the influence of environmental gradients and constraints that influence the entries in such matrices.

The lecture will first introduce into the basic principles of ecological matrices and possible ecological application. I will then discuss observed patterns, particularly segregation, species turnover, boundary clumping, and nestedness. For each pattern I will present respective examples to show possible causes.

2. Part (2 h)

The second part deals with metrics to assess species segregation (C-score, checkerboard score), turnover (reciprocal averaging), aggregation (nearest neighbor metrics, C-score partitioning), nestedness (temperature, discrepancy, NODF), and indiosyncrasy (temperature, NODF). I will exemplify the study of ecological gradients in presence absence matrices using random skewer and response analysis. Of course quantitative matrices can be analyzed by CANOCO or other common ordination techniques. Due to limited time we will not deal with these techniques. Recently, particular interest received species specific pairwise approaches. As an examples for the analysis of species pairs I will present a Bayesian approach for the identification of non-random pairwise species interactions.
3. Part (2 h)

The third part deals with null models and statistical inference. I will present randomization techniques for ecological gradient analysis and commonly used null assumptions (from most liberal to conservative) against which observed values of community metrics are tested. These include null models of presence–absence and quantitative matrices as well as neutral and metapopulation approaches. In a comparative approach I will present the behavior of certain null models and the implication for the power of statistical tests.

Seminar (2 h)

The third part of the lecture will be accompanied by a seminar where we discuss the rationale behind different null models and the implication for ecological theory. In particular we will ask when to apply a certain null assumption and how ‘null’ our null assumptions really are?

Practical part (7 h)

In the practical part we will analyze a large real world data set, the 1200 known species of 22 Islands in the White Sea. For these islands environmental data are available obtained from Ellenberg indicator values. Thus we first study patterns of species co-occurrence (matrix wide and particular species pairs) for different animal and plant taxa in a comparative way. Then we analyze species responses to environmental variables using a recently developed randomization technique. The practical part also introduces into the use of respective software for matrix analysis (NODF, PAIRS, CoOccurrence, ECOSIM, IMPACT) and into the construction of matrices (matrix format, size limitations).

Prerequisites

Prior to the lecture the students have to read the following literature


The literature (as pdf) is freely available in the internet on the home pages of the researchers.

Prior to the practical part the students have to read the manuals to the following software

NODF, PAIRS, CoOccurrence, IMPACT.

These are available at my homepage: www.umk.pl/~ulrichw