Nested pattern of land snail assemblages: a situation in the Carpathian fens

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INTRODUCTION

One of the main goals of community ecology is the identification and explanation of non-random patterns of species composition. One of the patterns is the nestedness: a group of species assemblages is said to be perfectly nested when each species is present in all assemblages richer than the most depauperate one in which that species occurs. The nested pattern was first proposed in textbook of Zoogeography by DARLINGTON (1957): …colonization of islands only by species with high dispersal capabilities. Now nestedness has proved to be a very common phenomenon in different taxonomical groups (e.g. mammals, births, frogs, fish parasites, plants, dragonflies…). What becomes relevant is what mechanisms promote nestedness in communities with different phylogenetic and ecological attributes (e.g. selective extinction and colonization, historical effects, habitat nestedness, nested habitat quality, human disturbances, and sampling artefact).

STUDIED AREA AND SITES

The study of 145 spring fen sites was carried out in the Western Carpathians (overall extent of study area was 12 000 km^2) (Fig. 1). The study area consists of two principal regions: the Outer Western Carpathians (***WR***) composed of flysch bedrock and the northwestern part of the Inner Western Carpathians (***ER***), which typically contains cores of Palaeozoic and crystalline schists overlaid by Mesozoic shale-sandstone and carbonate lithofacies (limestone, dolomite).

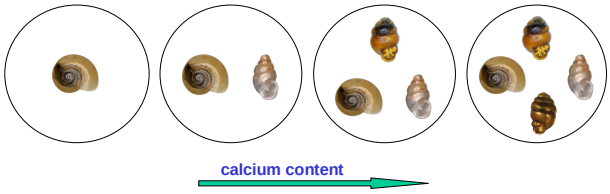
Figure 1

A large brown-moss rich fen with rich population of *Vertigo geyeri*.

The sites were treeless sloping spring fens, which covered the entire variability of fens along the mineral poor-rich gradient (sensu MALMER, 1986), from the extremely rich tufa-forming fens to poor acid Sphagnum-fens. Water conductivity, the best proxy of calcium concentration, in the studied sites ranged from 27 to 838 µS/cm. Water pH showed values from 4.2 to 8.2.

RESULTS

The distribution of species was significantly nested: T°$_{obs}$=20.57, T°$_{rand}$=75.93, SD=1.54, P<<0.001, using the Nestedness Temperature Calculator software by ATMAR & PATTERSON, 1995). I found that calcium content (estimated as water conductivity) significantly accounted for the nested pattern of the matrix (Spearman R=0.60, P<<0.001). When the whole data set was divided into two subsets, a) mineral poorer sites with conductivity below 300 µS/cm (42 sites) and b) mineral richer sites with conductivity above 300 µS/cm (103 sites), different results were observed. The species distribution of mineral



poorer sites was highly nested (T°$_{obs}$=14.68, T°$_{rand}$=63.50, SD=3.18, P<<0.001) and closely correlated with mineral richness (R=0.79, P<<0.001). In contrast, the matrix of mineral richer sites showed only low degree of nestedness (T°$_{obs}$=29.90, T°$_{rand}$=76.90, SD=1.68, P<<0.001) and no correlation with mineral richness was found. Surprisingly, the altitude appeared here as a new promoter of nestedness (R=0.46, P<<0.001).

DISCUSSION

Because of low competition within land snail communities, species with similar ecology tend to accumulate, rather than replace each other in favourable sites and in general a favourable sites is a calcium rich site. This feature of land snail communities was recently documented by HYLANDER et al. (2005) as an example of the nested habitat quality hypothesis.

The same feature of molluscs communities was documented also in fen habitats along the mineral poor-rich gradient. Species of mineral poor fens are subset of those living in mineral rich fens. Nevertheless, there were some species (*Vertigo substriata*, *Succinea putris*, *Perpolita hammonis*, and *Euconulus fulvus*), which were frequently distributed along the whole gradient, but they had their optima of realized niches shifted to the acid sites (HORSÁK, 2006). Thus, they were missing in many mineral-richer fens. This was one of the reasons why mineral poorer sites had a higher degree of nestedness. The second reason was the limiting role of calcium in mineral poorer fens, contrary to the mineral richer fens where other factors could be important (altitude).

Vertigo moulinsiana is an exclusive inhabitant of lowland tufa forming spring fens. Shell up to 2.5 mm.

Vertigo substriata occurs from tufa forming spring fens up to the sites with the occurrence of calcitolerant Sphagna; an ecological threshold for land snails. Shell up to 1.8 mm.

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