Hierarchies and overlaps between perspectives
Seminar 4

Metacommunity ecology: from theory to practical application
PhD-course, SLU 2010

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Introduction

• The 4 metacommunity perspectives – a single model can not explain an entire community?

• Deviding the data depending on the property of organims or habitat
Dendritic network structure constrains metacommunity properties in riverine ecosystems

B.L. Brown and C.M. Swan

Aim of the study

• Determine metacommunity structure in riverine networks

• Evaluate the relative importance of local (environment) and regional (dispersal) processes in headwaters vs. mainstems of the river network

• Better understand the role of dispersal by using ecological species data
Study system

- 91 (52) sites in three river drainages (MD, USA), first and third order streams
- 21 environmental variables
- Data on macroinvertebrate community structure
- Data on species dispersal ability (5 traits)
Analysis

Distance-decay relationships (DDRs) for headwaters and mainstems:

- Community similarity with distance
- Environmental similarity with distance
- Dispersal limitation in low- and high-dispersal communities
Results

Environmental variables:
hydrology, land-use and water chemistry most relevant,
headwaters and mainstems significantly different

DDRs:
Significant for mainstem communities, not headwater

Dispersal limitation:
In mainstem low-dispersal communities (5 traits) and high-
dispersal communities (3 traits)
...Environmental factors control the community structure in headwaters (species sorting), while both environment and dispersal are important in mainstem (mass effects) sites.
Discussion

• Position within the network strongly affects the relative importance of local and regional factors

• Different metacommunity patterns (species sorting and mass effects) can exist in the system at the same time

• Dispersal is important force shaping community structure only in mainstem sites

• Separating effects of environment and dispersal limitations can be done by analyzing species traits and responses of low- and high-dispersal communities
Discussion, questions...

• Only a snapshot in time... studying seasonal shifts and longer time series would be valuable

• Method of dividing whole communities in low- and high-dispersal... questionable?

• Trying to fit the data to the theoretical concepts of species sorting and mass effects... does it tell us anything? what about streams of second order that were not studied?
Contrasts between habitat generalists and specialists: an empirical extension to the basic metacommunity framework

S.N. Pandit, J. Kolasz, and K. Cottenie

Ecology 2009, 90(8): 2253–2262
Background and aim

- Few empirical studies and only associate one single model with the whole metacommunity
- Generalists species governed by other factors than specialists
- Dispersal and habitat properties have different impact on the two groups
Hypothesis

Environmental variables will account for more of the explained variation in the abundance and spatial distribution of habitat specialists.

Spatial variables based only on site location will explain relatively more of the variation in habitat generalists.
Study system

- 49 rock pools
- Surveyed ~1/year for 9 y
- 500 mL water
- Invertebrates counted
- Environmental variables
- Spatial variables
Methods

Biotic samples
• 24 common invertebrate species
• Habitat specialization (niche breadth)
• 5 "species" generalists
• 5 species specialists

Graph:
- Linear regression line: $y = 1.96x + 46.16$
- $R^2 = 0.47$, $p<0.001$
Statistical analysis

- Redundancy analysis (RDA)
- Variation partitioned into [E], [S], [E|S], [S|E]
- Monte Carlo permutation test
- ANOVA (years as replicates)
Results

\[ E|S: F_{2,24} = 26.73, P < 0.001 \]
\[ S|E: F_{2,24} = 7.18, P < 0.003 \]
## Environmental variables

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*Note: Only P values ≤ 0.05 are reported.*
Conclusion

• **Generalists**: Spatial variables (PD & NM) in 6 years

• **Specialists**: Environmental variables (SS) in 6 years

• Previous studies in similar systems have drawn different conclusions – differed in generalists/spatialist ratio?
Discussion

• Specialists vs. Generalists
  – Is that what they measure?

• Specialists should only appear in a few of the pools
  – hard to detect spatial patterns?

• The 5 specialists used are not determined to species level
To conclude...

Using ecological data and incorporating properties of individual species and species groups into metacommunity studies brings them closer to describing the natural world...

... But the currently existing theoretical models fail to describe and predict patterns of **entire** metacommunities and need to be revised and developed as increasing amounts of empirical data become available.