Outline for elements of metacommunity structure (EMS)-occupancy model paper

Authors: JR Mihaljevic, MB Joseph, PTJ Johnson

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Title: *Improving inference of metacommunity structure using multi-species occupancy models*

(Other suggestions?)

I. Introduction

A. Metacommunity Theory

1. Mechanism-based approaches (e.g. patch-dynamic modeling).

2. Pattern-based approaches (e.g. metrics of nestedness, EMS framework).

3. Presley et al. 2010 attempts to extend pattern-based to infer process

from pattern.

4. Still, the method has not been widely utilized…more improvement needed

B. More improvement needed

1. There are various ways to improve upon relating metacommunity patterns to

structuring mechanisms.

2. Much head-way has been made to develop multi-species occupancy models,

which can estimate covariate effects on both occurrence and detection

probabilities. These models can also be used for longitudinal data. (mention that Dorazio et al. 2010 identified a closer union w/ metacommunity theory as a priority)

C. Introduce motives/structure of the paper

1. The problems with EMS and how occupancy modeling can help resolve these

2. Unique advantages of occupancy modeling that complement EMS

3. Structure:

a. Highlight a problem/advantage

b. Example (with brief methods) w/ a figure to illustrate

4. Motivation is to highlight this method’s breadth of utilities, rather than

to explore any specific question/topic in great detail.

II. EMS framework

A. Brief overview of EMS and structure metrics

B. How process is inferred from pattern

C. How covariate effects are explored

III. Occupancy Model:

A. Introduce the model structure and general methods

1. Metacommunity hyper parameters -> species-specific parameters

2. Occurrence versus detection probability

3. Bayesian advantages:

a. Z-matrix posterior

b. Posteriors of species-specific covariate effects

IV. Problems with EMS and how occupancy can help

A. Detection probability

1. Influences ordination of incidence matrix

a. In turn, this influences the magnitude and accuracy of EMS metrics (e.g.

the calculated number of embedded absences might be overestimated)

b. Example: simulate an observed matrix and show the estimated z-matrix

of “true” occupancy.

2. Influences statistical power of null matrices

a. If true occurrence fills in more of the matrix, this would increase power

b. Talk about type I and type II errors – how this affects quasi-structures

c. Example: simulate an observed matrix and show the Bayesian posterior

distribution of EMS metrics, rather than a single estimate for each

B. Exploration of covariate effects

1. Relies on ordination scores which can be flawed because of detection (above)

2. Typically, multiple correlations are calculated, rather than an omnibus test (i.e.

inflating type I error)

3. Covariate effect estimation is embedded within the occupancy model and is

used to estimate true occupancy for each species (z-matrix)

4. Disentangle effects of covariates on detection and occurrence (e.g. what if it

has opposing effects?)

V. Unique aspects of occupancy modeling that can complement EMS paradigm

A. More informative exploration of structuring mechanisms

1. Mechanisms can depend on species-level responses to environmental gradient

a. Gleasonian: idiosyncratic species responses

b. Clementsian: multi-modal responses

c. The distribution of species-level responses can be estimated w/ occ. modeling

d. Example: simulate one Gleasonian and one Clementsian community,

then show the estimated distributions of species-level responses to dominant covariate.

2. Occupancy modeling can estimate species-level responses to continuous and

factor-level (e.g. ecotones) covariates simultaneously.

a. This could help understand mechanisms structuring nested communities

b. Example: Show how clumped losses can arise from a combination of

responses to a continuous gradient and an ecotone

B. Occupancy modeling can be dynamic (over multiple time periods)

1. Better understand how structure changes through time (e.g. due to changes in covariate at each site over time)

b. Example: Show change in structure due to change in dominant covariate

values at each site over time (e.g. changes in the variability in the

gradient over time)

2. Dynamic multi-species models can estimate colonization rates and persistence

probabilities (i.e. inverse of extirpation probabilities) over time periods.

a. This will help to disentangle the influence of local and regional

covariates.

b. Help disentangle the timescales of immigration and local dynamics.