Review of a PhD Thesis
Author: Leroy, F
Title: Spatial scaling and decomposition of macroecological changes

This thesis deals with biodiversity changes across space and time. Its main focus is how to properly analyze biodiversity changes when faced with the issue of spatial and temporal scale that often obscures ecological patterns. The problem of scale is persuasive in ecology, and it has been tackled numerous times with varying success. This thesis sets to contribute to solving the problem of scale by connecting patterns across scales using innovative statistical and computational techniques.

1) The first chapter sets the stage by reviewing existing published trends in bird diversity. An innovative aspect of this chapter is that the authors applied a criterion of spatial replication that ensures reliability of the identified trends. That is probably why they identified only 59 trends in such a well-studied group as birds. The finding that many studies did not report information necessary to assess the grain, extent, and lag on which they were conducted is alarming. The authors give guidelines on what to report so that future studies can be effectively summarized.

2) The second chapter focuses on species richness changes of Czech birds over several decades, using both Czech Breeding Bird Survey data and Czech Bird Atlases. I particularly liked how the authors set the stage for their work by showcasing some possible scenarios of cross-scale changes in species richness that are biologically plausible or were identified elsewhere previously. Then they analyze data and link their results back to these scenarios. This is very pedagogical and illustrative. I was also impressed by an analytical apparatus used in this study. The authors first "cleaned" the available, very heterogeneous, data using several ML approaches, predicted values for any combination of variables of interest, and then used these predicted values in downstream analyses. This approach is novel, and I have not seen it used previously. Although it is an interesting approach, one wonders how the propagation of error in data is managed, especially given lower Rsq values in some of the response variables (e.g., probabilities of colonization, extinction, and recurrence). However, overall, this chapter is persuasive, creative, and provides original insights into the patterns and drivers of species richness change in Czech birds.

3) The third chapter adds to the team's long-term efforts to analyze the scale-dependence of processes driving biodiversity. This time, the authors focus on individual-based underpinnings of extinction rates, using two modeling approaches, namely point patterns and Lotka-Volterra systems. The hypotheses that the authors put forward have been partly supported. It turned out that species rarity was necessary for the expected patterns to emerge. As always in this kind of exercise, the models are extremely simple. The tradeoff between realism and generality is inescapable. The most persuasive results were obtained for the very simplest imaginable situation, whereby a community is visited by a tornado that selectively kills individuals that occur isolated or in groups. This works independently on all species. More complicated dynamic simulations that make a number of assumptions, some of which are not described in detail, generate more complex results. It is then, of course, difficult to see what is the effect of parameter values and what is the effect of a particular structure of the dynamic model. In this respect, the point pattern simulations are very transparent, but also quite unrealistic.

The set-up of the study was very clear and understandable (more so for point patterns, less so for Lotka-Volterra). The only information I missed was probably to somehow plot SAR curves for individual parameter values, because SAR combines with PxAR to generate ExAR. A very apparent pattern in the results is a U-shaped pattern of PxAR and ExAR slopes with the changing sign of the density-dependence of death. This was not discussed in the MS and I am curious about the thoughts of the candidate on that pattern.

4) The fourth chapter of this thesis is focused on analyzing decadal trends in bird abundances in North America using the BBS monitoring data. It is very ambitious in its scope and approach. The two key innovations include modeling abundances using open N-mixture models and decomposing growth rates into loss and recruitment. This allows for the insight into local abundance trends across North America, and their underlying ecological processes.
The chapter itself is not yet written with a detail required for a fully-fledged manuscript ready to be submitted to a journal but serves well as a thesis chapter. I lacked some descriptive information on bird abundances across BBS routes. For example, the average loss of 1190 birds per route means 24 individuals per census point, which seems a lot. Also, abundance of 5417 individuals per route in 1987 means 108 individuals per census points. I am surprised by such high counts of individuals per one census point. On the other hand, estimates using deltaN and deltagt1 are very similar, which probably lends robustness to the results obtained. I also lack y-axis labes in inset plots in all figures.

Overall, the two most creative and innovative are, in my opinion, chapters 2 and 4. This is mainly due to them being based on large and high-quality datasets, their comprehensive and cutting-edge analyses, and the decomposition of overall trends into their underlying ecological processes. Also, using conceptual figures and then mapping the results on those figures is a feature that I like and recommend to use.

It is always a joy to review a PhD Thesis of such a high quality. I am sure that this thesis is more than enough to fulfill the creative part of PhD studies and the title Ph.D. can be safely awarded to Mr. F. Leroy on its basis.

Prof. Vladimír Remeš, Ph.D.
Dept of Zoology, Palacký University in Olomouc & Dept of Ecology, Charles University in Prague

Olomouc, 20 September 2024