Reviewer's comments on the PhD thesis of *François Leroy* entitled "Spatial scaling and decomposition of macroecological changes"

The thesis, comprising 136 pages, includes an Introduction, four Main Chapters, and a Discussion. Two of the chapters have already been published in prestigious ecological journals—*Basic and Applied Ecology* and *Ecography*—while the other two are presented as finalized manuscripts. The structure of the thesis is both conventional and unique. I particularly appreciate how the common themes across the chapters are explicitly identified, a practice that is often overlooked but effectively demonstrates the thesis's coherence.

I must also commend the aesthetic quality of the booklet and the thoughtful integration of ecological theory with practical conservation insights, which I believe is both crucial and timely. The work skillfully combines key elements of ecological theory, positioning them effectively within the flow of information. As a result, the thesis is engaging to read and prompts the reader to reflect deeply at certain points. The opening quote from Loreau was particularly enjoyable to read, especially since I currently have the same book on my nightstand.

The overall scientific focus of the thesis is ambitious, general, and broad, which is evident even from the title. To be honest, I would suggest narrowing it down slightly, as the current scope feels more suited to a dissertation assignment than to the final detailed work. Nevertheless, the text clearly conveys what François aimed to unravel over the past few years—specifically, how spatial scales influence estimates of diversity changes.

Now, let me go through the specific chapters. In the first one, the authors analyze temporal trends in bird diversity across three spatial scales: local, regional, and global. I appreciate the choice of model taxa, as it ensures a large and high-quality dataset. The thoroughness of their work has already been validated by reviewers and editors. It is certainly important to investigate these trends across different scales, even if not all findings are surprising. For instance, observing an increase in diversity at the global scale would be remarkable, especially since the 1900s. Additionally, the variation in trends at the local scale is understandable. For me, the most significant takeaway is that the absence of a decline at the regional scale highlights important narratives about community homogenization or potential invasions. I would have liked to see more distinction made regarding the importance of different findings. Moreover, it's crucial to recognize that not all scales are necessary for conservation decisions; rather, the correct scale must be chosen for specific measures in particular locations.

The second chapter is a truly theoretical and analytical exercise, addressing a fascinating issue: decomposing diversity change into colonization and extinction. I appreciate the clarity of thought and the quality of visualizations used in the analysis. The Czech bird data employed here is an excellent dataset. However, Czechia itself is not an ideal location for this study, as it is spatially small, located in the heart of Europe, and lacks significant ecological gradients for birds. Consequently, on larger scales, it represents an environmentally homogeneous territory within the "range space" of European bird species. This homogeneity explains the high probability of colonization at larger scales, as well as the low probability of extinction, since it's difficult for a species to go extinct in the middle of its geographical range. Given that the extinction rate in Czechia is quite low, local variations in diversity easily overshadow it. As a result, low extinction signals can be detected more effectively at local

scales. I believe the European context of the study site has a strong influence on the observed patterns.

The third chapter presents an interesting comparison of the Allee effect and the Janzen-Connell effect in relation to density-dependent mortality. The simulation, which is analytically robust, concludes that both effects are at play, but only when species-abundance distributions are sufficiently uneven. However, I'm unsure if I fully understand the context, as it seems problematic to directly contrast the Allee and Janzen-Connell effects (for example, in the abstract). At higher population densities, mortality increases due to factors like carrying capacity, making everything relative. When densities are very low, an increase can reduce mortality, while at high densities, mortality rises due to resource depletion, predation, or parasitism (as predicted by Janzen-Connell). In reality, both processes likely operate simultaneously - rare species may suffer from the Allee effect, while common species are impacted by overpopulation. It can even act simultaneously within the species at different locations of its range. So why should the probability of death for rare species be higher than that for common species (Hypothesis I)? This raises the question: is the simulation overly simplified?

I liked the final chapter, as it attempts to untangle the mechanisms driving bird population trends in the USA, with a focus on the acceleration and deceleration of population decline and its geographical patterns. Notably, the study makes a valuable effort to distinguish between the effects of increased mortality and decreased recruitment, which is a crucial detail in this context. However, I may have missed it in the manuscript, but how were data on individual loss and recruitment obtained? I'm sceptical that such detailed information is available in a nationwide dataset.

Before I conclude, I have two additional questions. First, in the context of nature conservation, we often consider both species diversity and abundance. When should diversity be our primary focus, and when should we prioritize the abundance of, say, common species? Second, why do you suggest that speciation indicates that a species is thriving (page 104)?

It was a real pleasure for me to read François's thesis. It focuses on a fascinating topic, is analytically robust, and the introductory text and discussion are thoughtful and demonstrate intellectual breadth. I have no doubt that this work clearly proves François deserves a PhD; the thesis fully meets the necessary criteria.

In Prague, 23rd September 2024

David Hořák