Report on the PhD thesis of **Vojtěch Kolář**, University of South Bohemia in České Budějovice

Title: **Aquatic insect assemblages in littoral zones of ponds and other man-made habitats**

Examiner: Aleš Dolný, University of Ostrava

This "thesis with publications", by Vojtěch Kolář, has been submitted for consideration for the degree of PhD.

The candidate has presented a thesis comprising five research papers in the field of predatory aquatic insects (beetles, heteropterans and odonates) and newt assemblages in fishponds and other man-made standing waters, two of which have been published already, while three are under review or ready for submission. The important point is that the candidate is the first author for all of these papers.

In general, the studies are conducted in a well-controlled and scientifically robust manner. The approaches and methods the doctoral candidate has used are valid and useful. The conclusions presented in each of the papers are substantiated by the results.

In the introduction section to the thesis, the doctoral candidate has conducted a detailed literature review, and has presented the positioning of his PhD research work with respect to the background literature. The section on post-industrial sites as secondary habitats for freshwater species uses recent papers and up to date information. In sum, the accompanying text is well written and it provided a clear introduction to the context of the five published papers and the papers in preparation.

The main body of this thesis comprises five chapters. Chapter 1 covers the role of conservation status in protecting the area of littoral zones of fishponds in Czechia and long-term changes in these zones. Chapter 2 provides some background information on the ecology of the endangered diving beetle *Graphoderus bilineatus*, covering the habitat preferences, microhabitat associations, and guidelines for conservation management. Chapter 3 covers the role of the various man-made standing waters, with the influence of successional stages in maintaining freshwater (Odonate) biodiversity. Chapter 4 describes the effect of different restoration approaches on amphibian species in lignite spoil heaps. Finally, Chapter 5 evaluates the differences between freshwater communities developed under the two main restoration approaches (technical reclamation and spontaneous succession) at post-mining sites, using a comparative synthesis approach.

What I am missing in this PhD thesis is a brief conclusion that would bring the various strands of the thesis together and could draw some general conclusions on man-made standing waters with high conservation values across various habitat types, and on the strengths and weaknesses of reclamation approaches. I think that the PhD thesis should conclude with a final chapter synthesizing the major results, highlighting the major take home messages, and proposing future directions for the research.

On the other hand, the complete list of publications appended to the thesis attest to the quality of his research and the importance of the work to the scientific community. I commend the doctoral candidate for their contributions to the research on artificial freshwater environments, and the consequences for biodiversity conservation.

I recommend the PhD thesis of the candidate to the defence committee and, after the successful defence of the thesis, to award him the degree of Doctor of Philosophy (PhD).

In the thesis defence, I would ask several questions:

Chapter 1

Comments: There is a lack of data on diversity and analyses that would demonstrate changes in management between periods. You attributed the negative trends to some variables and made some conclusions about effective protection; however, these suggestions were not based on data. Do you plan to obtain such data? I am not familiar with the glmmTMB package, but for standard GLM or GLMM it is possible to set contrast for the levels of targeted explanatory variables (for your design maybe Helmert of user defined). As your comparison was planned a priori, from a philosophical point of view, maybe it would be a better choice (contrasts may reveal differences even in cases of absence of overall significance).

1. A significant decrease in vegetation cover is not necessarily a significant problem, it also depends on qualitative changes in the composition of the vegetation. In northern Moravia, the exact opposite problem is, i.e., excessive overgrowth of water reservoirs with reeds. Can you comment on this issue?
2. In Study 1, you claimed that "[the] conservation status of fishponds did not prevent habitat deterioration in most of the fishponds". However, it is possible that the changes in the second half of the 20th century were so significant that without the protection, the habitat deterioration would be much stronger. Did you think of a comparison with some neighbouring unprotected ponds?
3. Conversely, might your results be affected by any sort of phenomenon of regression to the mean? I mean: ponds that had some conservation value (probably with a well-

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developed littoral) were probably more protected (extreme values in pool of ponds). Where there is no trend of change in the environment, but only random deviations, you will likely observe the same trend as well.

Chapter 2

4. Do you know of any particular study in which aquatic beetles have been suggested as an umbrella species? For which kind of freshwater habitats has their potential or practical importance been shown?

Chapter 3

Comment: The authors have used the Dragonfly Biotic Index (DBI) as an indicator of freshwater conditions. The average DBI/Site (i.e., the total DBI score for a site divided by the total number of species) was used to compare sites. Nevertheless, I am convinced that the sum of the scores is the correct (better) approach.

These two approaches (Average vs Sum) are principally different and (could) lead to different results. Thus, it is likely that applying these different approaches to the same data set will produce different outcomes.

5. Do you really think that the presence of one or few ubiquitous species automatically indicates a lower quality of the environment, lower ecological integrity, or conservation status of a certain site?
6. Are aquatic beetles capable of effectively conserving the communities or ecosystems/habitats in which they reside, in accordance with the umbrella species concept?
7. A question about the diving beetle *Dytiscus latissimus*. The Czech Republic skirts the southern distribution limits for the species-distribution range. What is the Authors opinion on the role of climate change and warming influencing its distribution in the south, and a potential shift northwards? This species is possibly extinct in Croatia, Hungary, Romania, Slovakia, Switzerland, and disappeared also e.g., from southern Poland (Markowski et Buczyński 2020; *P J Entomol*. 89(2): 81–90). Can local extinction be indeed attributed only to the negative human impacts (water quality and aquaculture intensification)?
8. There is something important missing here. There is no explanation/justification for why sample-size-based rarefaction and extrapolation curves of species richness and value of DBI in each of the three habitat types is used. The analysis of community-

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weighted trait means should be described in much more detail, because the choice of analysis can significantly affect their interpretation. Can you comment on this issue?

Chapter 4

Comment: The authors conclude that the two studied newt species generally avoided the artificially established pools, and that observed habitat preferences fully concomitant with natural habitats. Here, the studied spontaneous to artificial spoil heaps were much smaller than some comparative fish ponds.

9. May the author tell us how to treat a theoretical parameter in the data set claiming that newts are potentially present in fish ponds but their dispersion over the large water body makes it difficult to trap them?
10. May the author summarize what was "wrong" with the artificially established pools (in its parameters) which led the newts to avoid this environment? Despite their artificial origin, one would expect some positive succession considering their age of 15 years and more.
11. The authors concluded that "Such habitat preferences fully corroborate with natural habitats". What would be a definition of a "natural habitat" for newts in the cultural landscape of the Czech Republic and do we have in fact such habitats at all in the Czech Republic?

Chapter 5

12. It is not entirely clear what was compared in the meta-analysis using t-tests. Were they species numbers or conservation value? In both cases, the probable nature of the data suggests that perhaps some non-parametric equivalent of a t-test (e.g. the Wilcoxon test) would be a better choice. I do not understand why Literature synthesis was stated. Can you explain it?

Sincerely,

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