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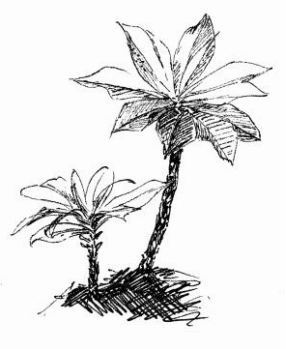


Stockholm, 20th November 2024

Review of the Ph.D. thesis by Matej Man titled "Forest bryophytes and microclimate"

In the recent decades, microclimate ecology and biogeography have emerged as an active research field, and Matej's work provides significant contributions to this field, both in terms of ecological insight and in terms of developing new tools and thus facilitating open science, code and data sharing, syntheses and collaborative knowledge building. Specifically, he (with his team) developed a national species observation database for lichens and bryophytes (Dalibor), created an R-package for microclimate data compiling, cleaning and aggregating (myClim), proved that in-situ measured microclimate explained more variation in bryophyte community composition and richness than what could be explained by other environmental proxies alone, and, finally, he demonstrated the important role of vapour pressure deficit in shaping bryophyte communities.

The research questions are well motivated and the four chapters of the thesis are well integrated in the summary. The four papers are diverse in methodology, approach and style and show that Matej has established a broad foundation as a scientist. This is also evident in his general publication record, his scientific network and engagement in furthering open, reproducible science.

I would have liked to see a generally deeper and more critical discussion about the underlying assumptions, the limitations of the studies, as well as about the possible future steps that can be taken to develop this work further (e.g.: What are the open questions in your field that we still need to solve? What are future challenges and possibilities when it comes to, e.g., method development to monitor microclimate and biodiversity while also reducing bias?).

In particular, I miss the acknowledgement of other environmental factors driving bryophyte richness and composition (such as substrate, regional species pool, species traits, biotic interactions). Further, there is no outline theory behind how microclimate exactly is expected to shape community composition and richness. The introduction explains how bryophytes and lichens are physiologically dependent on temperature and moisture, but how does individual performance link to community composition and species richness?

Having said that, I fully acknowledge that ecologists need to make simplifications and zoom in on one variable of interest.

The language is clear and concise. The author is not a native English speaker – neither am I – so I appreciated the straightforward language. There were some small formatting mistakes in the thesis, e.g., paragraphs were doubled (Paper 4, p. 79 and 81), and tables were missing (Paper 3), but as those papers are already published in peer-reviewed journals without the formatting errors, I do not consider this to be a problem.

Below you find detailed comments and questions regarding each chapter/paper.

Paper 1: Bryophytes and microclimate

This is a very original paper and has answered a big question, that many of us microclimate ecologists were asking ourselves (is the logger fieldwork worth the effort?). Although there are some shortcuts made in the paper, I think this work is a great contribution to the field.

1. What would convince you to disregard microclimate as an important driver of biodiversity patterns? And concretely regarding this paper: What overlap of microclimate and topography/vegetation would make you consider in-situ microclimate measurements as irrelevant (considering also the immense resources that go into logger production and fieldwork?)
2. What about substrate? Did the bryophytes grow only on the ground or also on rocks, deadwood and trees? You highlight the importance of substrate in Dalibor (Paper 4) but ignore it completely in Paper 1. Can substrate, soil pH, canopy cover (light!), litter type and amount also drive community composition and richness patterns?
3. What about other drivers shaping communities and richness patterns such as chance/founder effect, dispersal, or biotic interaction (competition, facilitation)? What is your theory behind why microclimate should drive richness and composition?
4. What is your theory behind each of the microclimate variables (FDD, soil temp, annual Tmax/Tmin)? Why/How should it affect bryophytes? This links also to the bigger question of when (during the day and year) they actually grow.

Paper 2: VPD

I really liked this paper, as it takes on the difficult challenge of disentangling VPD effects from temperature effects across a landscape using only observation data. And although the puzzle can still not be solved in the end, it contributes to the literature that highlights the (potential) importance of VPD which was long obscured by strong correlations with (easy-to-measure) temperature. I think, the paper could benefit from developing the introduction and underlying assumptions as well as the discussion including:

1. Why are you so certain it is not temperature that is the ultimate driver here, instead of VPD (and its “temperature component”)? When microclimate variables are so correlated, how do we disentangle the dominant driver of species performance?
2. Which species drive the patterns? Is it only a handful of common species with strong abundance gradients? What do we know about these species? Can their performance be linked directly to VPD?
3. How were plots selected? Even if you used already established permanent plots, provide some info on how they were selected – at least in the appendix.
4. How did you record composition? Was it just presence/absence or abundance? How did you measure abundance? Is this measure the same for all species?
5. Where are the places with low VPD and high bryophyte richness? How do those places look like? What can we learn for conservation or forest management from your results?
6. Discuss other drivers of composition and richness (also those that may be linked to VPD), such as forest age, structure, and composition (which can directly impact VPD), substrate availability, light, and disturbance. You explain 11-14% of variation but what about the rest?

Paper 3: myClim

The third paper is rather technical and hard to evaluate within the framework of traditional scientific publication. Having said that, it is clearly structured and well-written. I also participated in the beta-testing of the package and received generous and fast feedback and help from Matej, whenever I posted a question or a comment during this process. He has also organized training workshops for this package (e.g., at the MEB conference in Antwerp, Belgium 2022) which shows how engaged he is in science communication, community support and in facilitating data sharing and improving data and analysis quality. Creating an R-package is one thing. Maintaining and debugging it and providing continuous support is another and to my mind, he has mastered this challenge excellently. This kind of R-package has been demanded for a long time by the microclimate-sensor community and I am convinced it has made life of many microclimate scientists much easier.

1. Are there any developments in myClim that you have been working on or are working on that are not reported in the original publication? (sensor calibration, detection of office temperatures, snow cover estimation, …)
2. Why do you think, not everybody is using myClim (yet)?

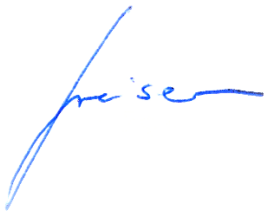
Paper 4: Dalibor database

This last paper was probably written first, reflecting the likely early stage of Matejs' academic writing experience. I appreciated the example analyses (including additional fieldwork to validate occurrences!) to demonstrate the usability of the database, although they suffer from different sources of bias inherent in the data. Still, I respect the enormous effort that the author and his team have taken on to compile various datasets into one accessible open database and would like to discuss more how the quality of those data can be improved, how such databases can be integrated with national and international databases and how to make use of the data in a wise way that accounts for all potential biases. Here some questions that can spark the discussion:

1. Out of interest: How has the database been used so far by others (scientists and laymen)? Is it integrated with GBIF? How does the syncing with other databases work? Who maintains it? Who pays for the maintenance? What are future plans?
2. In the abstract it says "[we] confirmed the importance of protected areas for biodiversity" => But there were generally more observations in protected areas, so this result may as well be an observation effort bias?
3. P.80: "To reduce spatial bias, we removed duplicates" => But that does not remove bias, does it? Why did you not remove duplicates completely from the database?
4. SDM: The predictors were at 10m resolution, but observations were used with position error below 50 m – isn't that quite a spatial mismatch? (On the other hand, I understand that there is a tradeoff between small position error and number of observations)
5. Fig. 5. Do you know anything about the overlap of species pools in these habitats? It would be interesting to see, which habitat has the most "endemics" (as in the species occurs only in this type of habitat). Sometimes, mere comparisons of species richness across habitats can be misleading, especially when some habitats are relatively low in richness but high in habitat specialists/endemics.

Finally, I would like to repeat that the thesis is of high quality and Matej Man has proven to master a diversity of methods and skills that qualify him for a PhD degree. I fully recommend the thesis for the defense.

Best wishes,



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