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Davos, December 12, 2022

Evaluation PhD thesis Zuzana Chlumska

I evaluated the written thesis and I think the thesis is acceptable for the defence and for obtaining a PhD degree.

This thesis presents excellent and interesting work on plants at the highest elevation on earth. It was a pleasure to read about these interesting studies. The four thesis chapters are already published papers, which is a great achievement in a PhD thesis. In two papers Zuzana Chlumska is the first author, in one paper second author and in one middle author of 14 co-authors. Again, this is a great achievement. The chapters are in excellent shape, which is of course also a result of the review process through which the papers have already gone.

The chapters deal with four different topics, all of which are relevant for high-elevation plant ecology. Chapter 1 impressively shows upward migration due to climate change at extreme elevation of 6000+ m asl, and the ecological reasons for upward migration in this climate are discussed. Chapter 2 is about a transplant experiment where a number of alpine plant species are transplanted to higher elevations, some of which survived for three years until a year with unusual high snow cover. Chapter 3 provides a useful method to sample and store non-structural carbohydrates during field campaigns in remote regions. Chapter 4 reports about a study of NSCs of several high alpine plant species along an elevation gradient. This is interesting pioneering work showing a general increase in NSCs with elevation among and within plant species.
I find the work and the papers very convincing and would like to deepen the discussion of the findings with the following questions:

1. Chapter 1 shows very interesting but also complex (and partly contradicting) effects of climate (means and extremes) on upward migration and species turnover in permanent plots. What do your results mean for alpine plants and climate change in general? Do you expect a strong uphill migration due to climate warming, or a small effect (if not a reverse effect) due to extreme events like from, extreme snow years etc? What may the interactive effects be of warming, water, snow, extreme years, (land-use?)? It would be great to expand from your findings to generalisations of what we know (or don't know)

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about species turnover and uphill migration. The same question actually also applies to chapter 2.

2. In chapter 2, plants were transplanted instead of seeds (for very good practical reasons). Can you speculate how the results may have been different, had you seeded the species? How could an experiment set-up with seeds look like to study similar research questions?
3. In chapter 3 you summarize that the choice of the method should be based on the scientific question asked. But you do not really expand on what the criteria are to choose one or the other method. Can you expand? The question also applies to chapter 4, where you choose one method, but you also look at TNC as well as the individual types of NSCs (fructans, sugars etc.).
4. In chapter 4 you state argue that understanding NSCs can help understanding the mechanisms determining range. How exactly? We understand that NSCs might not be limiting at the upper range limit of the species (comparable to treeline). But how else could NSCs be decisive with respect to warmer temperature, precipitation changes, freezing events, snow cover etc?

Kind regards,

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