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<u>Thesis by Aleš Lisner</u>

(1) General evaluation

This thesis consists of five chapters that comprehensively explore the factors that determine biodiversity and ecosystem properties in grassland communities. This includes studies on the species richness – productivity relationship (Chapter 1), the effects of non-random biodiversity loss on biomass (Chapter 2) and stability (Chapter 3), traits as determinants of abundance (Chapter 4) and the role of measurement errors in influencing vegetation assessments (Chapter 5). Impressively, four of the five chapters are already published in respectable journals, with one of the chapters (Chapter 2) published in one of the most choosey journals in plant ecology. This level of publication at the time of thesis submission is in my experience quite unusual.

There is no doubt in my opinion that this thesis is substantially above the bar for what is expected for awarding a PhD degree. Perhaps unsurprisingly given that most of the thesis has already undergone the journal peer review process, the text is very well written, data thoroughly and correctly analyzed, and with each manuscript appropriately placed within the context of the published literature and current theory.

Although all chapters are at or above the standard that one would expect for a PhD thesis, in my opinion Chapter 2 is particularly outstanding, and it significantly moves forward fundamental understanding in the topic of how biodiversity loss drives community biomass. Specifically the candidate set up a biodiversity loss experiment that contained much more realism than most other experiments claiming to address this topic, and ran it for four years to provide results that are contrary to current dogma on this topic (and to the results of many other experiments that involve less realistic extinction scenarios). Chapter 1 offers some interesting insights about the species richness – productivity relationship, a topic about which there has been much recent debate – I do have some questions about this but I will save them for the oral defense. Chapter 3 breaks new conceptual ground in aiming to disentangle for the first time the relative influence of three distinct components of community stability and their response to biodiversity loss. I do have some queries about the distinction between 'asynchrony' and 'statistical averaging', and about the experiment used to test the ideas, but will save these for the defense. Chapter 5 is especially intriguing and provides robust quantitative data on an issue that is often overlooked, namely the impact of measurement error on the interpretation of plant community data.

This is a comprehensive and thorough thesis, which is well integrated and with some studies that contain a great deal of originality. It is really interesting and it was a pleasure to read it. On balance I would place this in the top 10-15% of the theses I have read this far in my career, and have no hesitation in recommending the defense of this thesis.

(2) Comments and questions to the candidate

I have enjoyed reading the thesis – it clearly represents a great deal of work – in the set-up of a large experiment, in data collection, and in data analysis and interpretation. Impressively four of the five chapters have already survived the peer review process with various journals and are already published. As requested, I will share a small number of questions with the candidate now and in advance. I therefore list the following three questions as these might require more thought than my other questions:

1. One body of literature that is very relevant here (and especially in the contexts of Chapters 2 and 3) involves the debate between Vellend (2013, *PNAS*; 2017, *Ecology*) and Gonzalez (2017, *Ecology*) about whether biodiversity loss experiments in small plots are relevant for understanding biodiversity loss in the real world given that at local spatial scales biodiversity is often increasing not decreasing. In particular Vellend (2013) concludes: '*We find no general tendency for local-scale plant species diversity to decline over the last century, calling into question the widespread use of ecosystem function experiments to argue for the importance of biodiversity conservation in nature*'. What is your view on this statement (and more generally, on the debate), and what are the implications of this for the relevance of small-scale experiments, including yours, for understanding the consequences of biodiversity loss in real ecosystems?

2. I am trying to understand more about the soil fertility of your experimental site in Chapter 2. You describe your site as 'oligotrophic'. But I wonder what you base this on because plot biomass (averaging about 200g/m^2) is not low by global grassland standards, and the nutrient contents you describe as 'rather low' (P83) seem not that low (many grasslands have much less %N than the 3.33% you present here). Also, the total %C value (60.77%) seems strange – even peat only has 35-40% C and dead leaves and wood about 45-50% C. And importantly, because the remaining species more or less fully compensate for the removed species, the intensity of competition must be fairly high (meaning that resource use complementarity is minimal or non-existent), which is something that you would expect for a fertile site. This is important, because diversity effects (and specifically the resource use complementarity that underpins it) vary a lot with environmental context (and notably soil fertility), with infertile sites likely to show bigger diversity effects which is in contrast to what you found. It would be good to get your own thoughts and clarification on this.

3. In Chapter 3, it would help if you could clarify in very simple terms precisely what is the difference between 'asynchrony' and 'averaging' as mechanisms in determining stability. Are they entirely distinct from one another and therefore entirely independent, or do they covary to a certain extent? More generally, is there likely to be

much shared covariance between the three stabilizing mechanisms (because they may share some of the same drivers) and should that be considered somehow?