Tartu, 17.06.2021

To: Charles University, Prague

Opponent's evaluation statement of **Zuzana Štípková**'s doctoral thesis
" Determinants of orchid species diversity".

The doctoral thesis is based on six publications, each prepared with co-authors. Five papers are publications in journals, and one paper is a book chapter. Contribution of the PhD candidate is clearly shown. In five of them the candidate is the first author. The topic of the thesis is very important.

Thesis has a nice logical structure and it is compact. Literature review gives enough information of the knowledge gaps in the field and the four research aims are clearly set although the title of this paragraph is Main questions and hypothesis but the wording does not support that. Structure of conclusions could have followed these four aims, in current version they are more focused on paper numbers (yes, sure connected to aims).

Species richness and distribution patterns of orchids, the rate and causes of their decrease and extinction, and factors influencing their occurrence have been analysed thoroughly in Czechia and one paper deals with Greek orchid diversity. A lot of MaxEnt modelling has been used that is a powerful tool in these kinds of studies. Also, different aspects of species biology have been included as structure of underground organs and pollination system that is very nice. All the results are well discussed.

In the following I would discuss some of the results from the thesis in the order I reached them while reading:

The result that the most widely distributed orchid group in Czechia are the rhizomatous orchids, and tuberous orchids are the most widely distributed orchids in Greece, is very interesting. Sure, the trend might be based on the orography of the country, distribution of suitable habitats and types of bedrock. You also state that the large number of species of tuberous orchids recorded in Bílé Karpaty could be attributed either to the presence of calcareous substrates, the extensive distribution of grassland communities or the higher temperatures there than in other areas in the Czech Republic
Do you think that moving further north from Czechia, the trend will increase and that there are less and less tuberous orchids due to lower temperature?

You say that *Anacamptis pyramidalis*, *Ophrys insectifera* occur more frequently in southern Europe. It is certainly true for *Anacamptis* but they both occur as far north as in Estonia and *O. insectifera* is widely spread most of the country living in calcareous fens that are not warm sites at all. So, I suspect that the main reason why tuberous species are less spread is still land management, and especially agricultural intensification.

You found that the general distribution patterns for nectariferous and nectarless species are similar throughout the Czech Republic, with the greatest number of species in both groups

recorded in the south-eastern part of the country. Despite similarity, the Mann-Whitney U test indicated significantly higher number of nectariferous than nectarless orchids in your country.
How much the analysis might have been influenced by the fact that half of nectariferous species come from one genus Epipactis (taxonomically difficult)?

You found that the mean species specialization index (SSI) of the nectarless orchids does not change with altitude, whereas that of nectariferous orchids has a unimodal trend. This is a very nice result but could you depict a bit more detail how did you get the tolerance percentages?

The highest decline in orchid distribution during the time periods studied was recorded for critically endangered taxa (Paper III)
What are the criteria to define a species as critically endangered C1?
Why agricultural intensification has killed more orchid sites in Czech Republic than in any other (neighbouring) Central European countries?

You state that *Gymnadenia odoratissima* is extinct but on Figure 7 in Paper IV it looks different?
Orchis mascula and *Anacamptis morio* are doing well why *Anacamptis pyramidalis* not? Don't these *Anacamptis* species share habitats?

The most important types of habitats for orchids in Czechia are oak and oak-hornbeam forests, followed by agricultural meadows – what is the definition of the last one?

The case of *Platanthera chlorantha* was really interesting in this study. In northern part of the distribution area the species seems to behave differently. It is occurring only up to the southern part of Finland (probably due to cold not further) while *P. bifolia* reaches much further north and in Estonia it is more frequent in western Estonia where annual precipitation is much less than in the eastern part. Any comments on that?

My last question would be which of your results you think is most interesting/important for science?

Given the contributions of the dissertation and the role of the Doctoral Candidate in the preparation of the thesis, my evaluation is that Zuzana Štípková's thesis fulfills the requirements set for a doctoral thesis and I warmly recommend to deliver the PhD degree in environmental sciences.

Sincerely,

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