Smithsonian Environmental
Research Center

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Dear Ms. Tymichová

As requested by email on May 17, 2021, I am providing the following evaluation of the chapters of a Ph.D. thesis submitted by Zusana ŠtÍpková. I have also mailed a copy of the evaluation.

Overall Evaluation

Zusana ŠtÍpková has presented a thesis composed of six chapters, all which have been published in peer-reviewed journals or, in one case, a book chapter. The research efforts that she employed focused mostly on the acquisition of existing data on orchid life history strategies, climatic, and geomorphic data. The data were used to address issues ranging from how the distribution of species changed over time in the Czech Republic in association with socioeconomic and geopolitical issue to factors related the extinction of orchid species. The analytical aspect of each chapter involved spatial and correlation analysis using a variety of accepted analytical procedures.

The publications were all multi-authored. The publications are all well written, including an introduction to each topic, descriptions of the methods applied, clearly presented results and – in most instances – a clearly presented Discussion.

The research is a valuable contribution to our understanding of patterns of distribution and abundance and the techniques applied can be used in other locations.

It would have been interesting to focus the Discussion of some chapters on specific issues that need to be addressed to bridge the differences between the larger spatial scales used in these studies to more site specific focused issues that need to be understood in order to manage species at smaller scales. The research, however, sets the stage for further research.

I have evaluated Ph.D theses for more than 40 years for students in the U.S. and other areas of the world (e.g., The Netherlands, Estonia, Australia, Great Britain, Japan) and conclude the products of Ms. ŠtÍpková are completely worthy of awarding her the degree. The number of publications is higher than the number of chapters in most of the theses that I have evaluated.

Comments on specific chapters.

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Chapter 1. Distribution of orchids with different rooting systems in the Czech Republic. Published in *Plants*

This study is a companion study that one of the co-authors conducted in the Mediterranean. The focus is on the relationship between the life history categories of orchids and their distribution in the Czech Republic. The main finding was that most orchids have a rhizomatous root system and that the distribution patterns (mostly related to elevation) varied among floristic areas. This is an original contribution and furthers the understanding of orchid distribution and life history strategies.

The only question that I had was the potential importance of anthropogenic impacts on the results. Many of the landscapes have had significant human impacts for centuries, especially areas that are lower in elevation. I wonder if observed distribution patterns would be different if the landscape was pristine?

Chapter II. Pollination mechanisms are driving orchid distribution in space. Published in *Scientific Reports Nature Research*

This chapter is closely related to Chapter 1 and focuses on the issue of the relationship between orchids and possible pollination mechanisms (whether or not they provide nectar rewards) and the distribution of the different pollination mechanisms in six floristic areas in the Czech Republic. The logic behind the research is clearly presented and justified.

Results are also clearly presented and the differences between the two groups of orchids is clear. Somewhat differing patterns were found for the two groups regarding their altitudinal distribution in the different floristic regions of the country.

I wonder what the reasons might be that the distribution of orchids that don't produce nectar with altitude is not hump-shaped as it was for the species that produce nectar.

Are there data that identify the pollinators of specific orchids species and the distribution of insects (those that would pollinate orchids) in the Czech Republic? If those data exist for all orchids, or a subset, that would have provided an opportunity to provide more insight into the needs for management in the country.

I disagree with the title as the authors did not demonstrate that pollination mechanisms are driving orchid distribution. They demonstrated a possible link between pollination mechanism and the distribution of orchids.

Chapter III. How did the agricultural policy during the communist period affect the decline in orchid biodiversity in central and eastern Europe? Published in *Global Ecology and Conservation*.

This interesting contribution documents changes in the distribution of orchids in the Czech Republic during different time periods. The authors conclude that a decline in species distribution and abundance occurred during the Communist area where there was a marked

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increase in agricultural intensification. The observed pattern, with some species, increasing is complicated because of several factors. The main factors that influence the results were the scale of sampling and, to a lesser degree, the focus on nature conservation following the end of the Communist era.

The contribution is a valuable addition to efforts to understand the past and present distribution of orchid in Europe. The Discussion related to sampling scale is especially useful.

Chapter IV. Orchid extinction over the last 150 years in the Czech Republic. Published in *Diversity*

This contribution focuses on the decline in orchids in the Czech Republic over that past 150 years. The research relied on existing records that apparently are not available to the public. The analysis focused on the presence of species in 1 X 1 km grid cells.

The results show that orchids have declined during the 150 years but what I found most interesting is that there is no general pattern across species but an almost steady decline across all species even though the pattern may differ from one species to another.

The authors attempted to attribute declines to different factors that include social changes an climate change.

This study seems to be an ideal precursor toward a more focused effort to identify areas species of special concern and areas where management efforts might be directed toward assuring the survival of species. It also provides the framework for ecological research. As an example, because the species occur in a range of sites, it would be interesting to use that framework to sample orchid populations to evaluate levels of genetic diversity of species that have declined compared to species that are relatively stable.

Chapter V. Which environmental factors drive distribution of orchids? A case study from South Bohemia, Czech Republic. Published as a book chapter in: *Orchids Phytochemistry, Biology and Horticulture*

This is the only part of the thesis that involved field-related research and that aspect of the study was essential to development and application of the MaxEnt models.

In the analysis did they authors consider creating a variable that included the amount of arable land within some standard distance of the area in which they sampled the orchids. This would be a landscape-metric and it could be quantified in a variety of ways. An example of where this might be important is in the presentation of factors related to the distribution of *A. morio.*

Was soil type (at least the major unit of soil that would indicate characteristics such as pH, calcium, etc.

With the exception of *P. chlorantha*, habitat was the main factor related to the presence of the orchid species. This is not a surprise but it provides valuable information that the relationships between the orchids and the habitat types that they occur in is important to understand; especially

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what factors or ecological variables are absent or declining when the abundance of species begins to change.

The contribution would have been more valuable the authors have included a Discussion on how the results of this work could have been used to provide directions for management of species.

The only other element that could have been improved would have bene a field test of the models for each species, especially if the factors that were of secondary importance would have been evaluated.

Chapter VI. Role of way of life, latitude, elevation, and climate on the richness and distribute of orchid species. Published in *Biodiversity and Conservation*

The authors used a combination of information on life history strategies (type of belowground morphology) and environmental data associated with different elevation zones.

The authors present a very nicely presented analysis of factors related to the distribution of orchids in Greece, a country with a complex geology and geography. The result provide insight into the key variables that are related to orchid life history strategies. Altitude and substrate are most important predictors of orchid diversity.

The main factors used in the analysis (species richness, mean niche breadth and mean distribution were significantly related to elevation, latitude, and longitude but they accounted for only 50% of the variance. As the authors noted, the results of the project are informative but there is a need for finer scale research that is species specific and focuses on key factors that determine whether or not a species will be successful in a given area.

Sincerely

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