Assessment of Matthias Hartmann's Ph.D. thesis on "**Geographical parthenogenesis: evolutionary and ecological significance of apomictic reproduction in plants**" provided by Christoph Dobeš

Overall assessment:

"Geographical parthenogenesis" (GP in the following) refers to the phenomenon that related sexual and asexual intraspecific forms or species differ in their distributions with asexuals typically covering larger areas located at higher elevations and latitudes compared to their sexual counterparts. Matthias Hartmann aimed to identify factors which underlay a stark pattern of GP using the species *Hieracium alpinum*, which shows differentiation into sexual and apomictic ploidy cytotypes, as a model. The candidate faced two main challenges inherent to the topic: 1. The complexity in terms of numbers of factors potentially explaining GP, and 2. the inevitable association of reproductive mode with ploidy level (sexual are di,- apomicts triploid) since both phenomena alternatively could explain the distributional pattern currently exhibited by the species.

I found the Ph.D. thesis very well written and pleasant to read. In particular the candidate mastered to explain and develop the theoretical background of his thesis which is also reflected in a good coverage of the available literature. The first two manuscripts written by Mr Hartmann as the leading author are quite concise meaning that the various chapters are consistent among each other, which is as basic requirement for a scientific manuscript. Also the English, except for some typos and missing words or phrases, is profound. The candidate based his work on a variety of characters (physiological, morphological, cytological, reproductive, sociological, DNA molecular, ecological) of his organismic model collected from throughout its distribution range, the amount of which I found impressive. He was able to answer a variety of hypotheses coined to explain GP, specifically the importance of reproductive assurance and dispersal abilities and the advantage of sexual recombination vs clonal stability to scope with biotically complex environments. These results are a valuable contribution to the topic. I have no major criticisms regarding these aspects of his thesis. However, there are also some weaknesses which mainly refer to some degree to the design of studies, to some extent to the interpretation of results, and finally sometimes difficult to follow reasoning. I exemplarily express my concerns in my second major question to the candidate. I thereby restricted myself to the first two manuscripts/articles.

Major questions:

1. The focus of your thesis was on unveiling the importance of factors or traits underlying GP in *Hieracium alpinum*, what implies that the observed distributional pattern can be explained by effects from reproductive mode (sexual vs asexual/apomictic). Unfortunately, in most sexual : apomictic systems, a shift from sexuality to apomixis involves polyploidization of the genome and sometimes in association with hybridization. These links between mode of reproduction and genomic and genetic constitution make the identification of factors / traits driving the distribution of sexual and apomicts notoriously difficult. Could you summarize from your results on *Hieracium alpinum* which of the studied traits (e.g. seed set, seed morphology, ecophysiological traits etc) potentially relevant for its distribution – geographical or ecological – relate to which of those three associates or, alternatively, cannot be unambiguously contributed to a specific one?

2. I wondered why (frequency and intensity of) seed predation, estimated in the natural population, was used as criterion to test the Red Queen hypothesis (RQH), a hypothesis which basically states that sexuality, despite of its costs, is required to win the evolutionary race against competitors or aggressors in biotically diverse habitats. Actually, the "degree of predation" is a response (!) to a biotic interaction, in the particular case the attacks by fruit-mining flies. Thus I would argue, that an independent measure of the biotic pressure on the *Hieracium* populations would have been needed. Couldn't it be, for instance, that the pressure (e.g. in terms of numbers or aggression of parasites) was much higher in the range of sexuals compared to that of apomicts but that sexuality (i.e. recombination) effectively saved the populations from more severe damages? Could you think of alternative approaches to assess the RQH in your model?

3. Regarding the eco-physiology study, i.e. the second paper: In this quite complex, multi-facetted study you established a variety of relationships like the effect of climate as well as biotic variables on leaf traits, or the relation between eco-physiological leaf traits and traits important for dispersal. However, what is the actual meaning of those results for the observed pattern of GP, the focus of your thesis? Can you conclude on the relevance?

Vienna, 28th of August 2018