## Annex 6: Habilitation thesis reader's report

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| **Masaryk University** | |
| **Faculty** | Faculty of Science |
| **Field of Habilitation** | Botany |
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| **Applicant** | RNDr. Jakub Těšitel, Ph.D. |
| **Affiliation** | Department of Botany and Zoology, Faculty of Science, Masaryk University |
| **Habilitation Thesis** | Ecology of (hemi)parasitic plants |
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| **Reader** | Prof. Dr. Diethart Matthies |
| **Affiliation** | Philipps-University Marburg, Germany |

**Report Text (as large as the reader deems necessary)**

This habilitation thesis consists of two main parts that deal with (1) the evolutionary ecology of parasitic plants, and (2) the ecology of root hemiparasites. In the first chapter of the thesis, Těšitel analyses the major innovations during the evolution of the various groups of parasitic plants and their ecological significance, and presents based on this a classification of parasitic plants. The classification is presented clearly and supported by a lot of evidence. I enjoyed reading this chapter a lot, although I do not agree with all his conclusions.

Těšitel interpretes the fact that germination of the seeds of some parasitic plants (e.g. *Striga* spp.) require the very close proximity of a host root as an adaptation that improves the establishment of seedlings (Fig. 1C). I strongly suspect that establishment success, at least when measured as the proportion of seeds that successfully develop into a mature plant, is much lower in many of these species than in those that do no require a germination stimulus by a host plant. This is quite obvious in the case of *Striga* etc. with their minute seeds. I would suggest that the requirement for host induced germination of seeds has to be seen in the context of the evolution of dust-like seeds that many of the advanced parasites have. Their seedlings have no chance of survival without attachment to a host. However, the parasitic lifestyle has allowed them to reduce the size of their seeds enormously with positive consequences for the number of seeds that can be produced and their ability to disperse. A similar argument can be made for orchids which are all at least during the early stages of their development parasites of fungi.

The second part of the thesis is a review of the ecology of hemiparasite - host interactions, dealing both with the effects of the hosts on the parasites and the influence of the parasites on their host plants. This review is also clearly presented and based on a good knowledge of the

literature as well as a number of studies of the author himself. Most important in this respect is in my opinion the study by Tesitel et al. (2015b) in which it is shown that hemiparasites may do best when either water or nutrients are limiting. Based on the results of this and related studies, Tesitel develops a convincing model of the relationship between root hemiparasites and their hosts and how this influences the habitat preferences and distribution of this type of species. I have one minor critical comment: Tesitel states that there is no empirical evidence reporting unattached hemiparasites under natural conditions (p.13). However, such an observation has been reported, e.g. in *Castilleja* (Matthies 1997, Can. J. Bot.). I have also observed *Melampyrum nemorosum* growing without a host in hollows of rocks.

The last part of the thesis builds on the evidence and understanding of the influence that root hemiparasites can have both on individual plant species and whole plant communities and reviews studies that have used hemiparasites as a tool for ecological restauration. This is a field to which Tesitel also has made significant contributions and based on his expertise he gives a number of recommendations for the use of hemiparasites in the management of grassland.

Tesitel finally identifies future prospects for research on hemiparasites. His outlook shows that there are still many areas that could be explored more deeply, including the ecology of hemiparasites growing in forests, the interaction between hemiparasites and legume species, fine tuning the application of parasitic plants for restoration, and the effects of parasitic plants on communities, including trophic levels other than primary producers. Tesitel cites the study of Watson (2016) for the effects of stem-parasitic mistletoes on other trophic levels and suggests that more such studies are necessary, but I am missing a reference to the very broad and important study of Hartley et al. (2015, Ecology) that showed the diverse effects of the root hemiparasite *Rhinanthus minor* on four trophic levels.

In conclusion, Dr. Tesitel has used in his research an impressive range of methods which include DNA-barcoding, microscopy, manipulative experiments both in the field and the glasshouse, stable isotope analysis and the analysis of vegetation databases. The list of publications that form part of the habilitation thesis consists of ten papers published between 2013 and 2017. All of them are peer-reviewed and some of them were published in leading ecological journals. Dr. Tesitel has in addition published a number of other papers on hemiparasites which are not included in this list. Overall, Dr. Tesitel has made a very significant contribution to our understanding of the evolution and ecology of parasitic plants. The thesis and the papers included in it certainly fulfill the requirements for a habilitation.

Marburg, den 8.8. 2017

Questions:

(1) All shoot hemiparasites are necessarily obligate parasites. In contrast, many root hemiparasites have retained the ability to grow without a host, although usually a lot worse than with a host. What significance could this ability to grow independently have for root hemiparasites?

(2) If the main advantage of the root hemiparasitic lifestyle is an improved and cheap access to water and mineral nutrients, other resources will be limiting for their growth. What response of hemiparasites (in comparison to that of autotrophic plants) would you expect to (a) rising concentrations of CO2 in the atmosphere, and (b) global warming?

(3) You have interpreted the evolution of seeds that require a stimulus by a nearby host root for germination (e.g. in *Striga*) as a solution to the problem of light competition for the seedlings of hemiparasites, i.e. a way to improve seedling establishment. However, I would suggest that the requirement for host-induced germination of seeds has to be seen in the context of the evolution of dust-like seeds that many of the advanced parasites have. Their seedlings have no chance of survival without attachment to a host. What do you think of this alternative interpretation?