Opponency of PhD thesis

Ecology and evolution of mountain butterflies

Author of PhD thesis: RNDr. Irena Klečková

Presented doctoral thesis represents a complex of original scientific introduction (in the form of recherche) and four scientific papers – two of them published in prestige scientific journals with impact factor, one in review process and the last as manuscript which seems will be submitted in short time. Whole thesis – the introductory part and scientific papers – deal with general facts on ecology of selected model groups (genera) of diurnal butterflies living in conditions of mountain or arctic habitats. The author solved the theoretical problem by using modern methods based on molecular, ecophysiological and behavioural data. Using of such complex attitude the author was able to obtain robust basic information about evolutionary history and ecological traits both affected recent distribution of selected taxa. Main part of results were published and reviewed by objective reviewers and there is not necessary to prepare another detail revision. Presented work is excellent and my notes should be imagine as useful subjects to discussion. Below I wrote some notes and subjects to discussion:

The introduction part deals with knowledge of history, ecology and conservation of mountain butterflies. Whole text is properly divided to thematic sections. The recent distribution of taxa is explained as a result of interconnection of evolutional history (mainly caused by mountain orogenies and repeated climate changes) and specific biological traits. It should be noted, that such interconnection could be imagine mainly on the continental scale. In a case of regional or local scale we are not able or very hardly to detect the effects of biological traits because of stronger effects of local habitat characteristics and conditions on actual population viability. In a view of theoretical conservation of mountain habitats it should be necessary to solve different localities separately, which should suppose individual research.

Recent studies on mountain diversity and especially on its changes refers to relatively quick reaction on climate changes, e.g. in shifts of whole communities or populations to higher altitudes. In a case of European mountains, should we prepare some appropriate management which will count with such changes? How we are able to preserve the highest parts of mountain tundra (at which some studies species occurs) before processes caused by climate changes, especially by habitat shifts to higher levels?

As the whole thesis deals with ecology of mountain butterflies, the whole part (Chapter IV) focused on behaviour of lowland species adapted to much different conditions in contrast to cold mountain or arctic habitats. In introduction part is mentioned, that we have such outliers from studied genera - *Erebia medusa*, *E. aethiops*, but there should be also discussed species of very dry and warm mountains as *E. epistygne*, *E. palarica*, *E. zapateri* etc. Their ecology and ecophysiology should differ from the rest of species and this fact should be discussed in discrete introduction section. Are we able to adapt the findings from ecology of lowland species to mountain populations? Should we expected similar effects of local habitat conditions?

It was surprising to read about biennial dynamic of different populations of *E. euryale* and I agree with parasitic theory and explanation of such type of dynamic. If there are available detail information about population processes, there should be detected some time-delayed effects.

Finally I considered presented thesis as well prepared and perfect, which reflect the number of published papers and it is positive that there are some overlaps to, at least in theoretical level, the problems of conservation and active management of mountain habitats.

The work fulfils whole demands of PhD thesis and I should suggested it to successful habilitation.

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Kadlec

Mgr. Tomáš Kadlec, Ph.D.

Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Theodor-Boveri-Institut für Biowissenschaften
Lehrstuhl für Tierökologie und Tropenbiologie
(Zoologie III)

Zoologie III, Biozentrum, Am Hubland, 97074 Würzburg

Prof. Dr. Oldrich Nedved
Head of the Committee of PhD studies in Entomology
Faculty of Science
University of South Bohemia
Ceske Budejovice

PD Dr. Jochen Krauss

Department of Animal Ecology and Tropical Biology (Zoology III)
Biocentre
University of Würzburg
Am Hubland,
97074 Würzburg
Germany

Phone: 0931 / 31-83282
Fax: 0931 / 31-84352
Email: j.krauss@uni-wuerzburg.de

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Examination of the PhD thesis of Irena Kleckova

„Ecology and evolution of mountain butterflies"

In her PhD thesis with the title "Ecology and evolution of mountain butterflies" Mrs. Irena Kleckova discovered four rather different research questions, but all focusing on closely related butterfly species. Mrs. Kleckova focused her studies (i) on phylogenetic relationships between butterfly species, (ii) biennial life cycle strategies of one butterfly species, (iii) comparative thermoregulation of seven butterfly species, and (iv) finally the habitat requirements and protection of a butterfly species. She therefore had to deal with numerous different topics, which she did in an adequate way.

Her thesis is subdivided in a general introduction followed by four chapters (manuscripts), and ends with a summary and specific future perspective. Two of the manuscripts are already published in international ISI-ranked journals. Chapter III is published in the *Journal of Thermal Biology* (impact factor: 1.4, journal ranking 54 out of 151 in Zoology). Chapter IV is published in the journal *Insect Conservation and Diversity* (impact factor: 1.9, journal ranking 18 out of 87 in Entomology). A third manuscript (chapter II) is in revision in a lower ranked

entomological journal *European Journal of Entomology* (impact factor: 0.9) and one chapter is presented as a finalized manuscript.

The introduction of the thesis gives some background on the biology, biogeography and speciation of butterfly species and cites the relevant literature in these fields. The introduction ends with the objectives of the four chapters. In general I think the introduction is a bit too biased on butterflies with few examples for example for plants. E.g. Weber et al. 2003 is cited as a refuge for alpine biota as a consequence of fragmentation events in the past. Similar ideas have been described for cichlid fish evolution in African lakes. What is the difference and what is similar? Similarly the ecological speciation in butterflies is explained via species traits, host plants, thermal limits and habitat affiliation. But why should this only be specific for butterflies. Have other insect taxa different ecological speciation?

Chapter 1 is a manuscript describing the speciation of the *Oeneis* butterflies. Several phylogenetic trees are presented for the species group, resulting from analyses of four genes. It is concluded that from the 30 species existing today, and the 19 species analyzed, at least five times the artic and America were independently colonized. Mrs. Kleckova shows with her manuscript advanced skills in systematics based on genetics. I have only two questions, perhaps because I am not an expert in this field. Are 19 analyzed individuals enough to draw such detailed conclusions on phylogeny and colonization events? As the tested specimens were also dry, was there a problem with degraded DNA?

Chapter 2 focuses on the life cycle of one *Erebia* butterfly species. This species often shows a biennial larval development. Mrs. Kleckova found in this interesting manuscript that *Erebia euryale* shows peaks in even years, in odd years or no fluctuations depending on study region. I was surprised about this result and like to know more about the possible mechanisms, which are already shortly presented in the discussion.

Chapter 3 is a published paper on thermoregulation and microhabitat use of seven closely related *Erebia* butterfly species. Mrs Kleckova found that species inhabiting rock habitats, which occur at higher elevations, maintain higher body temperature than woodland species. Also larger species and young individuals had higher body temperatures. Rock and grassland species preferred warmer microclimates within their habitat. Measuring body temperature is an interesting and appealing method in behavioral studies in insects and the publication is of high value for the butterfly community. I am interested in some more details on the temperature measuring procedure.

Chapter 4 is a published paper on the habitat requirements of a lowland *Erebia* butterfly species. Data were achieved with intensive mark-recapture recordings. Mrs. Kleckova (formerly Slamova) shows that *Erebia aethiops* prefers open woodland habitats and abandoned grasslands. She concludes that sparse woodland habitats containing open habitats should be restored to protect the species. This study is a classical single species conservation study, which lead to clear management recommendations for this species. The mark-recapture study also showed a maximum detected trajectory of approximately 2.2 km. I would be interested to know the pros and cons of this method to detect dispersal abilities.

The thesis ends with a summary and future perspective where I would be happy to discuss if different butterfly species are indeed competing for nectar.

Overall this is a very nice PhD thesis; which is internationally competitive and I therefore clearly recommend the defense of the thesis.

PD Dr. Jochen Krauss

PD Dr. Jochen Krauß
Lehrstuhl für Tierökologie und Tropenbiologie
Universität Würzburg
Biozentrum, Am Hubland
97074 Würzburg