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Evaluation of Ph.D. thesis submitted to Charles University in Prague:

Petr Šípek: Immature stages of Pleurostict Scarab Beetles (Coleoptera: Scarabaeidae: Pleurosticti): morphology, biology and phylogenetic implications

The scarab beetles represent a megadiverse beetle superfamily with about 35 000 known species classified into about 14 families. Out of this number, approximately 20 000 species belong to a group commonly referred to as pleurostict scarabs, which includes very familiar groups, such as chafers, jewel scarabs, fruit chafers or rhinoceros beetles. The group is defined by a very distinct synapomorphy: the placement of abdominal spiracle on the upper portion of the sternites. Nevertheless, relationships among particular groups within the pleurostict clade are poorly known.

The Ph.D. thesis is well structured and clearly written with good English. It consists of 121 pages subdivided into 5 chapters – introductory literature review, three already published papers and an unpublished manuscript.

Specific comments:

Chapter 1.

This chapter is an introduction to the research work undertaken. It represents a comprehensive overview of the state of the art, which in a logical manner informs first about the phylogeny of Scarabaeoidea and then in detail about scarab immature stages. All facts are supported with references, including both older and recent works. This clearly documents deep knowledge of the whole topic. I did not find any major problem in this chapter, except for a few minor remarks. Reading this chapter is indeed enjoyable.

Petr cited Kohlmann's paper (2006, *Coleopt. Bulletin*) as a comprehensive overview of historical classifications of Scarabaeoidea. This 2006 paper is only a strongly shortened and translated version of the original huge Spanish paper published by Kohlmann and Morón in 2003 (*Acta Zoologica Mexicana*).

On page 15 Petr listed several less known members of Scarabaeoidea. Some of them (like Glaphyridae, Orphninae, Aclopininae, Phaenomerinae, Pachypodinae) were from time to time treated as pleurostict scarabs or *incertae sedis* within Scarabaeoidea. What about larvae of these less known groups? Are they known and available for at least some of these taxa?

Because of Petr's deep interest in fruit chafers, all three already published papers are cetonine-biased. The subfamily Cetoninae is a group of phytophagous beetles in the family Scarabaeidae with approximately 4000 described species and placed in 107 genera. The monophyly of Cetoninae is not controversial and many studies support this hypothesis using both morphological and molecular data. The Cetoninae appears in the pleurostict clade, but its relationship to the other subfamilies is still under debate. Similarly, the relationships inside the Cetoninae are little known. And the monophyly of most cetonine tribes has not been examined yet.

Chapters 2 and 3.

These two chapters deal with phylogenetic analyses of groups within Cetoniinae and are based on adult and larval morphology. Both contributions supported monophyly of Cetoniinae, but did not correspond with traditional concepts of its tribal classification. The tribe Trichiini was found paraphyletic.

Unfortunately, larvae of two crucial groups – Microvalgina and Platygeniina are still unknown and/or unavailable for the study and hardly be available in the near future. Do you plan to incorporate at least adult characters into your data matrix to resolve their position within cetoniine clade? Oriental Microvalgini were rather recently revised by Antoine, and adults are not so rare in museums. And what about molecular data?

Chapter 4.

This contribution is based on description of larval stages of *Dicronocephalus wallichi* and observation of its life-cycle under laboratory conditions. Recognition of combat behavior in males and construction of provisional burrow by female just before oviposition are of particular interest.

Chapter 5.

The last part of PhD thesis is an unpublished manuscript dealing with detailed description of euchirine larvae and phylogenetic position of the subfamily Euchirinae within pleurostict scarab clade. Based on larval characters, Euchirinae are regarded as monophyletic group, while any synapomorphy was found in adult data matrix. Although larvae of the type genus *Euchirus* are unknown, the monophyly of Euchirinae will hardly be suppressed in the future, because of quite similar adult morphology of all euchirine taxa. On the other hand, discovered phylogenetic position of Euchirinae within pleurostict clade (a sister group of Melolonthinae + Rutelinae + Dynastinae) should be regarded as very preliminary. Mainly Melolonthinae is currently a mixture of many poorly defined tribes, and its monophyly is very dubious.

From the formal point of view, there are some unfortunate typing errors, which should be corrected before the submission of the manuscript: e.g., coauthor of *P. cypriacus* is Makris (not Markis).

In two of four presented papers, Petr used in the analyses of data matrices also very new characteristics: Relative support value and Relative resolution value. Both of them were introduced by Grebennikov and Newton a year ago. Can you briefly explain the principle and calculation of both of them?

Final recommendation on the thesis:

The Ph.D. thesis clearly shows that the candidate is very capable to perform research work of a high international standard and present it in an appropriate form. Using a wide spectrum of techniques, like rearing cetoniins under laboratory conditions, morphological description of larval stages, creation of data matrices and their analyses by various methods, Petr obtained original results and new findings for our understanding of phylogeny of pleurostict scarab beetles. **I rank this Ph.D. thesis above average and recommend it for successful defence.**