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Review of PhD thesis of Jatishwor Singh IRUNGBAM

This doctoral dissertation presented by Jatishwor Singh Irungbam, elaborated under the directorship of dr Zdenek Faltynek Fric, consists of a series of four published papers, three of which in peer reviewed journals (two in an IF journal), as well as four submitted manuscripts (with, however, no information about three out of four target journals) concerned with different areas of entomology, biogeography and ecology, with Indian Lepidoptera as the most important model group, and preceeded by an introduction on the study area, the studied taxonomic group, the aims and the scope of the dissertation.

The first manuscript is focused on testing three different hypothesis on elevational patterns of diversity of a vast array of organisms, ranging from plants, vertebrates to insects, in the Himalayas, based on a compilation of 65 published articles. The second manuscript is also concerned with the analysis of elevational patterns but its focus is restricted to the moths (Heterocera). Various indices of diversity are used and discussed. It is based, this time, on author's personal data obtained during several years of field work in Shirui Hill in NE India. It also contains, as an appendix, a check-list of 449 species distributed in nine nine families obtained during the aforementioned sampling. The third and the fourth contributions are taxonomic papers, and report several new records for the Indian fauna, including the descriptions of three new species of Limacodidae and one species of Notodontidae. All other papers and submitted manuscripts are entirely faunistic, and are concerned with different families of Lepidoptera, fifth, sixth and seventh discuss, in turn, Lasiocampidae, Sphingidae and Notodontidae, while the last one is an updated and commented check-list of butterflies of the Indian State of Manipur.

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The undoubted value of this dissertation is that it has mostly been elaborated based on author's data obtained during several years of sampling for butterflies and moths in the mountains of Manipur, and it can certainly be considered as an important contribution to the overall knowledge of the fauna of this Indian state. It also discusses some important aspects of general ecology, biogeography, Lepidoptera taxonomy and systematics.

The author masters well different techniques of field research, as well as analytical methods related to the understanding of the patterns of elevational (or altitudinal - in my opinion both terms are correct) diversity, one of the most intriguing aspects of global biogeography. He shows a fair knowledge of general aspects of Lepidoptera ecology. He also demonstrates a good understanding of taxonomy and systematics of the studied families of Lepidoptera which shows, in particular, in the descriptions of the new taxa. They are well-elaborated, according to the standards of modern integrative taxonomy and include, apart from morphological descriptions with good illustrations of genitalia of both sexes, also molecular data, and COI based preliminary phylogenetic hypothesis. Faunal surveys elaborated during the prepration of this dissertation certainly help emphasizing the great potential of Manipur biota, an area under severe anthopogenic pressure, and of its Lepidoptera in particular.

Some results of the dissertation are of general interest. The unveiling of the prevailing unimodal (hump shaped) gradient of altitudinal diversity in the Himalayas, and demonstrating that the steady increase or decrease patterns resulting from some of the studies are mostly artefacts of too narrow elevational band covered, although predictible is nonetheless a valuable discovery based on a comprehensive set of data. The evaluation and interpretation of different variables of diversity, and community structure along an elevational gradient in the mountains of Manipur can also be considered of scientific value, in particular from the perspective of carrying out future meta-data analysis.

Faunal data are invariably interesting contributions from a general point of view, but especially when they concern little sampled areas of high potential from the perspective of biodiversity, such as Manipur, and point out the presence of sensitive species, either endemic or endangered / vulnerable.

In my opinion, the quality of the introduction to this disseration is not on a par with the following manuscripts. It contains numerous flaws. Among others, although I am not a native speaker, its English language, both orthography and syntax, should have been significantly improved. There are several typos and a number of other, simple mistakes which could have been easily avoided. In terms of content, several relevant citations are missing. The titles of a few chapters (in particular 3rd and 4th) should be, in my opinion, rephrased. Also, some statments are arguable. All these issues of concern are underlined (in green) in the attached, commented pdf file.

Nonetheless, despite the above reservations, the thesis can be accepted.

Questions:

1. Can the doctoral candidate briefly discuss the reliability and the limitations of barcoding as a method in alpha taxonomy and phylogenetic studies?

2. Can the doctoral candidate explain whether there is a correlation between the mid-domain effect (MDE) hypothesis and the unimodal distribution model of elevational/geographical patterns of diversity?

3. Can the doctoral candidate discuss the basic assumptions of Fisher's alpha index and discuss the situations when it is considered to be a particularly useful method in evaluating diversity?

4. Can the doctoral candidate discuss whether current status of Bhutanitis liderdalii as a protected species meets its actual population status in natural habitats?

Faculty
of Science

Opponent Review of Doctoral Thesis

Author: **Jatishwor Singh Irungbam MSc.**

Title: **Lepidoptera of Manipur, India: its formation and determinants**

Opponent: **RNDr. Tomáš Kuras, Ph.D.**, Department of Ecology and Environmental Science, Palacký University in Olomouc

Topic & objectives

Presented PhD thesis comprises the study of Lepidoptera in the region of Northeast India, Manipur. The Manipur Region belongs to the eastern Himalaya Biodiversity Hotspot. From the view of nature conservation, this is one of the best-preserved continental areas of tropical Southeast Asia (see India-Myanmar-China border region). At the same time, the area is zoologically relatively underexplored area (especially in the field of entomology). Natural history surveys in the Manipur region were mostly carried out during the period of British colonial dominion in the early 20th century. Subsequently, these were curtailed and have started again as late as in recent decades (the studies presented by Mr. Irungbam are significant in this context). Author has focused, and rightly so, on the study of an ecologically important group of butterflies and moths; this choice is well backed up by arguments in the thesis. The main objectives of the thesis include (i) study of altitudinal gradient, (ii) basic faunal survey of Macrolepidoptera and (iii) compilation of a list of butterflies of Manipur.

The thesis consists of an introductory part followed by 8 articles to illustrate author´s research activities. The first two articles (unpublished so far) focus on ecological phenomena associated with altitudinal gradients. The others (mostly published) deal with basic faunistic research in the area and include also descriptions of several new species discovered by the author.

I consider the choice of the topic, study group (Lepidoptera) and study area appropriate, especially regarding the low level of knowledge of the local fauna, the biogeographical importance of the region and the consistent anthropogenic threat to the fauna of the Indo-Malayan Region.

Questions and comments

The thesis includes two main thematic parts, i.e. the ecological part (altitudinal gradients) and faunistic surveys of the area.

I. Study

The main result of the first presented study is the conclusion that the long elevational gradients of species richness show a general unimodal pattern. There is a number of hypotheses to justify this unimodal trend (from statistical to ecological and biogeographical). It is obvious that the species richness-altitude relationship will be a specific for individual mountain ranges. Further research should probably be focused on interpretation of highest species richness at mid-elevations phenomenon.

Could the author speculate on which parameters will shift species diversity maxima along the gradient upwards and which downwards? In a given context, how will species richness probably change as a function of the area (A) of the mountain range? Finally, especially the southern slopes (incl. study area) of the Himalayas and the entire foothills are substantially deforested and biodiversity at lower altitudes is significantly reduced in this zone. Have the authors also considered anthropogenic influences to interpret the unimodal response of species diversity along altitudinal gradients?

II. Study

The second paper focuses on the distribution of species along the altitudinal gradient in the Shirui Hill area. The authors sampled moths at five sites. However, note that all 3 lower sites represented secondary forest. Is it relevant to compare moth community parameters among these sites?

Secondary forests have inherently reduced species diversity. What is the significance of such results then?

Nevertheless, I consider the work fruitful, especially thanks to the basic faunistic survey of moth species.

Before submitting the manuscript, I recommend checking the targeting of the figures in the text (I found some inconsistencies). On the other hand, I did not find an explanation of the * and + symbols in the Suppl. species list.

III-VIII. Studies

Papers III-VIII have mostly been already published (apart from paper III and VII) and include extensive annotated checklists (I particularly appreciate Chapter VIII, Checklist of Butterflies of Manipur) and descriptions of new species (see III and IV). I have no need to ask for any adjustments in the study III and/or to request additional information related to both works. I highly appreciate the effort the author must have put in.

Conclusion

The submitted PhD thesis is a set of 8 articles (published and unpublished), focusing on ecology, faunal survey and systematics of Lepidoptera with emphasis on Manipur State, India. However, the author's list of publications is much broader and includes many other related papers (see author's CV). The present Ph.D. thesis, as well as the other activities of the author, represents a considerable contribution to the understanding of the Lepidopteran fauna of the north-eastern region of India. I find the thesis to be of good quality and recommend this for defence.

I wish the candidate much success in his future research!

10 January 2022

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