

PhD Thesis Acceptance Report
Institute of Environmental Sciences
Jagiellonian University

Candidate's name and surname: Agnieszka Gudowska

PhD Thesis Title: "Metabolic rate and respiratory patterns in ground beetles (Carabidae): the effect of feeding, temperature and parasites."

Thesis Supervisor: prof. dr hab. Jan Kozłowski

Assistant Supervisor / ~~Second Supervisor~~ / ~~Co-supervisor~~ (if applicable):

Dr Ulf Bauchinger

Reviewer: Prof. dr hab. Paweł Migula

THESIS EVALUATION

1. **Scientific merit of the thesis**

a. Originality of the research (25-200 words):

The results of the dissertation are very well placed on the issues of long-term discussions on understanding various ecological, physiological and evolutionary aspects of arthropod respiratory metabolism. The thesis is fully original and innovative. The subject of the study is adequate to the title of the dissertation. The results of experiments carried out on 20 species of the ground beetles (Carabidae) were presented in four main chapters. Although the papers are of joint authorship, in all of them Ms Agnieszka Gudowska is the first author. Her contribution to the study design and data acquisition, interpretation of the data, drafting the manuscript and critical revision accounts for 50-85% and a 100% in the remained sections. The input of co-authors was 4-20%.

Prudent research hypotheses were the basis for reliably performed experiments. The results were always preceded by insightful statistical elaboration of data, leading to well addressed and valuable discussions. Conclusions resulting from intra- and inter-specific analyses, concerning e.g. universal allometric scaling of metabolic rates (MR) in carabid beetles or the effects of temperature on MR of larger or smaller insects are novel - sometimes were surprising, such as in the statement on the heterogeneity of the scaling exponents which should be "*treated as a rule rather than an exception*".

b. Scientific merit of the chapters / articles (25-200 words):

The main core of the study is four chapters: 3 papers and 1 journal submission. They follow a valuable, well-designed general introduction, containing clear aims and hypotheses of the study, a general discussion and conclusions. The papers were published in well recognized journals - J. Experimental Biology, J. Thermal Biology, Evolution (IFs: 3.32; 2.16; 4.20). The fact of their publishing testifies to their high scientific value, which was ensured by the anonymous reviewers.

All chapters indicate scientific maturity and very good substantive knowledge of the candidate within the topics covered in each publication. Their quality is high and did not

raise any objections. The goals required the use of a variety of procedures and research techniques. All objectives are well linked to the overarching goal expressed in the title of the dissertation.

The results of each chapter are based on experiments carried out on the ground beetles. Ch. I: MR studies brought a new light for promoting the existence of different scaling exponents depending on grade shifts, specificity of respiratory patterns and phylogeny. Ch. II: proved that the thermal effect on MR is weaker in larger than in smaller insects. Ch. III: documented that discontinuous gas exchange can reduce the risk of tracheal infestation by mites. Ch. IV: showed the benefits and limitations of energy expenditure of *Carabus nemoralis*.

2. **Substantial merit of the thesis**

(ability to introduce the research topic and clarity of research hypotheses, the choice of research methods and statistical tools for data analysis, presentation and critical analysis of the research data, the ability to discuss research data and the theoretical background, clarity and quality of the conclusions) (25-200 words):

The author browsed exceptionally rich literature, selecting controversial and unexplained problems focused on ecophysiology and micro-evolution of insect energy processes in relation to a set of abiotic and biotic factors, as the temperature, oxygen supply, body weight, food availability or species diversity (Carabidae) at the individual level. The description of the scope of research in particular tasks is clear, both in a wide, well-planned introduction of the current state of research and existing in literature contradictions which were diminished thanks to the studies of the candidate. In the introductory section, she formulated four main goals of the work which she develops in the research presented in Ch. I-IV. She described in details all results necessary to understand the scientific sense of a given publication.

The author has applied a well-chosen methodology and constructed adequate set-up of the equipment. Especially, respirometric measurements were adapted to the purposes of the projects. She also gave special care to properly maintain, time-consuming, rearing of beetles used in experiments. The accuracy of statistical analysis, their clear presentation, and interpretation of results is extremely careful. The form of conclusions is not concise. They appear in a right place in each of the chapters. They also appear in 2 large paragraphs at the end of the general discussion. This section is rather a broad summary of the important achievements of the whole dissertation.

3. **Layout and register**

(layout, register and the clarity of the language, the quality of the visual material etc.) (25-200 words):

The dissertation has been prepared in a compact professional form. The text is not exceeding 80 pages. A well-designed general introduction to the study preceded the main chapters, showing arguments which clarified the necessity of searching the responses to four main research questions. The format of the dissertation is concise, clear and reader-friendly, with very few inclusions of improper terminology. All chapters have been prepared in the

form typical of a presentation of experimental results in scientific journals, maintaining a sequence of individual parts in accordance with editorial requirements.

Visual documentation was very carefully prepared, and clearly presented in each of the chapters. Tables, figures and charts are very well-developed, often innovative in form, legibly signed and described. They are matching the texts in a proper manner. The appendix is a valuable part of chapter III. It was split-up, probably due to the fact that the paper appeared in *Evolution* (2016) in the "Brief communication" section.

The thesis contains also an appropriate summary in English and Polish language, and a valuable list of used abbreviations. Unfortunately, graphic documentation was not proposed in the introductory section and in the general discussion. The candidate inserted also the copies of appropriate authorship statements about the engagement in publications, signed by all contributing scientists.

4. **Critical notes**

I consider that Ms Agnieszka Gudowska made all experiments well designed, results are sound and discussion addressed all important issues, making the dissertation an important contribution widening the knowledge in ecophysiology and evolutionary sciences. I do not have any criticism in case of three articles already published in highly respected scientific journals. I do hope that the fourth article will appear soon.

Please find below some minor comments or questions:

Page 8. In the section "Gas exchange patterns" in General Introduction, the candidate stated after Suarez (2000) that : "*Insects maintain the highest mass-specific rates of oxygen consumption found in the animal kingdom, and they do so without the aid of the circulatory system used by most other animals*".

The sentence will be true only if the word "Flying", is added as in the quoted reference: "*Flying insects achieve the highest known mass-specific rates of O₂ consumption in the animal kingdom*".

Page 10. I am asking for a clear explanation of how the author defines the term "organism model". I would like to understand the multi-species approach. Some of the experiments were conducted on 20 species from the Carabidae family.

Pages 11-12. The links to individual chapters are misleading. The author points to Chapters II-V. instead of Chapters I-IV.

Page 43. My question for the candidate based on the chapter IV is: Why did the authors decide to carry out experiments using only males of *C. nemoralis*?

Pages 55/56. Unclear is the last sentence: "One of the most ubiquitous consequences of feeding in all animals is SDA, indicating that food processing typically decreases the total energy budget by up to 48%." The SDA is a significant part of the total energy budget. The word "*decreases*" is, in my opinion, improperly used.

The cited references are listed in 6 places (4 in publications, 1 in the appendix and one at the end of General discussion and Conclusions.) The lack of a unified and common census can be explained by savings, time and paper, but in the Ph.D. dissertation such a chapter seems to be necessary. I also think that some references, especially those that appear along with other citations, can be subtracted from the text, without loss for the entire dissertation.

5. **Final grade** (justification 25-200 words):

The dissertation of Ms Agnieszka Gudowska is fully academic, and well-prepared paper, contributing to our better understanding how intrinsic and extrinsic factors decide on the insect metabolism rates. The basis was a thoroughly prepared series of experiments on carabid beetles. The added values were the mass scaling of Standard Metabolism Rates, types of gas exchange patterns related to the temperature range and body size; differences in respiratory responses of several Carabidae species which hosted the mites or were free of these parasites. She experimentally proved that in carabids a discontinuous gas exchange is an evolutionary example of defensive mechanism against carrying mites. Explained also differences in the energetics of carabid beetles in case of reduced or unlimited access to food under hypoxic and normoxic conditions, proving that in case of larger meals insects under hypoxia reduce food consumption.

The candidate is capable of conducting, analyzing, interpreting and presenting original scientific research. I consider important her ability to synthesize the problems, searching the way of solving them and discussing the results obtained, maintaining the consistency of the content of individual chapters that were already published or submitted for printing.

I, hereby, declare that the reviewed PhD thesis by Agnieszka Gudowska meets the criteria pursuant to art. 13.1 of Act of 14 March 2003 on Academic Degrees and Academic Title and Title in the Arts (O.J. no 65 item 595 as amended) and request that the Council of the Institute of Environmental of Sciences of the Jagiellonian University accepts Agnieszka Gudowska for further stages of doctoral proceedings.

YES/~~NO~~

I, hereby, request that the thesis is accepted with distinctions. Justification (25-200 words)

All the analyzed elements of the Ph.D. dissertation, presented by Ms Agnieszka Gudowska, are highly appreciated. The project is well thought, of outstanding scientific value. The author used a multi-species approach to investigate relations between biotic and abiotic factors and the respiratory metabolism and gas exchange patterns carrying out experiments on Carabidae beetles. She easily combined ecophysiology and evolutionary biology research using carefully prepared methodology. Ms Agnieszka Gudowska is a person who is very well and thoroughly prepared for laboratory and field work, can skillfully deal with research material used for laboratory experiments, uses different measuring techniques freely, prepare advanced databases that enable conducting in-depth statistical analyzes and obtaining valuable results.

She has mastered very well the intricacies of preparing and smooth writing scientific papers, evidenced by her already published, significant part of the results, presented in the dissertation. Three articles appeared in journals from the JCR indexed list: Journal of Experimental Biology, Journal of Thermal Biology and Evolution, reaching the total IF score = 9.68, and a total MNSiW score = 100 points. The fourth paper was submitted, and I hope to see the printed material soon.

YES/NO

08.01.2018

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date



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Reviewer's signature

INFORMATION FOR THE REVIEWER:

A digital copy should be sent to:

sekretariat.inos@uj.edu.pl

A duly signed original should be sent to:

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