THE REVIEW (EVALUATION) OF THE PHD THESIS OF MR. ROY E. GEREAU AT ADAM MICKIEWICZ UNIVERSITY IN POZNAŃ

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PhD Candidate:
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PhD Thesis' Title: CONSERVATION OF THE EASTERN AFRICAN FLORA: THE IMPORTANCE OF PROTECTED AREAS

Based on 6 research items:

Paper 1- co-first author

Raven, P.H., **R.E. Gereau**, P.B. Phillipson, C. Chatelain, C.N. Jenkins & C. Ulloa Ulloa. 2020. The distribution of biodiversity richness in the tropics. Science Advances 09 Sep 2020: Vol. 6, no. 37. DOI: 10.1126/sciadv.abc6228.

Paper 2 - co-author (conceptualisation, data curation, formal analysis, Investigation, methodology, resources, supervision and validation)

Ract, C., N.D. Burgess, L. Dinesen, P. Sumbi, I. Malugu, J. Latham, L. Anderson, **R.E. Gereau**, M. Gonçalves de Lima, A. Akida, E. Nashanda, Z. Shabani, S. Tango, S. Mteleka, Dos Santos Silayo, J. Mwangi, G. Lyatuu, P.J. Platts & F. Rovero. 2024. Nature Forest Reserves in Tanzania and their importance for conservation. PLoS ONE 19(2): 1-18. e0281408. https://doi.org/10.1371/journal.pone.0281408

Paper 3 - (planning and designing the research, fieldworks, developing the ex situ collection, editing and approving the final version of the manuscript).

Linan, A.G., **R.E. Gereau**, R. Sucher, F.H. Mashimba, B. Bassüner, A. Wyatt & C.E. Edwards. 2024. Capturing and managing genetic diversity in ex situ collections of threatened tropical trees: A case study in *Karomia gigas*. Appl. Pl. Sci. 12(3): e11589: pp. 1-14.

Paper 4 - (conceptualization, diagnosis in Latin, writing, final review, editing and red list assessment)

Gavin-Smyth, N. & **R.E. Gereau**. 2022. Two new species of Impatiens (Balsaminaceae) from the Eastern Arc Mountains of Tanzania. Novon 30: 122-127.

Paper 5 - (field works, conceptualisation, Latin diagnoses, herbarium works, writig, correspondence with the Editors and Reviewers)

Gereau, R.E., S. Kativu, P. Meerts, L. Merrett, J. Osborne & K. Vollesen. 2023. Chlorophytum vespertinum (Asparagaceae, Anthericeae), a new species from Zambia and Tanzania. Novon 31: 181-190.

Paper 6 - (field works, conceptualisation, writing, reviewing, correspondence with Reviewers)

Cheek, M., R.E. **Gereau & J.** Kalema. 2024. Afrothismia ugandensis nom. nov. (Afrothismiaceae), Critically Endangered and endemic to Budongo Central Forest Reserve, Uganda. Kew Bull. DOI: 10.1007/s12225-024-10212-5 pp. 1-11.

The contribution of the Candidate in above mentioned papers is significant, the total IF coefficient of publications included in the doctoral thesis is **21.5**. The total score according to the Minister of Science and Higher Education of Poland is **460**.

This thesis is a biological and conservation study from the borderline of biological science (including taxonomy, molecular biology and conservation biology) and environmental management (protected areas management).

Critical evaluation of the Thesis:

1. Introduction

The PhD Thesis of Mr. Roy E. Gereau is a set of complementary research papers with the main objective to better understand the plant diversity, evaluate their conservation status and asses the effectiveness of their management in Tanzania's current protected area system. One of the key methods in the biological sciences (as in many others) is observation. The ability to identify a difference in shape, colour, smell, composition, structure or function is a fundamental skill for any field researcher. Research in the so-called hotspots of the world's biodiversity, which has developed intensively in recent decades, is based on these skills. Only

with these approach can the rarity and dynamics of genotypes, populations and entire ecosystems be effectively classified, compared, evaluated and maintained. In turn, by comparing the area occupied, the quality and size of the populations, the patterns of distribution, frequency of occurrence or abundance, it is possible to assess the conservation status of a given species or habitat, which is the basis for rational nature conservation, including biodiversity protection. Especially if the research has been conducted over many decades by an experienced, focused and engaged researcher. This is why work in the field of applied biology, i.e. conservation biology, is highly appreciated. And when it concerns a species- and ecosystem-rich, endemic region, it is all the more needed.

It is also noteworthy that any work involving field observations, even short-term ones, is the only way that, years later, a summary can be produced, a so-called "milestone work" (e.g. the Flora of a country), the life span of which is extremely long and without which it is difficult to imagine biological science functioning.

In my opinion, the text of the Introduction is very informative, fitting the topic and content of the work. However, it could have been a little shorter. It gives a very broad background on the history of flora surveys and inventories, species richness, threat assessment and conservation status of plants, how protected areas are managed and what was prioritization of the conservation targets established. This is certainly very interesting information, but it could have been more concise, and in this place it could have introduced issues related to specific works that are part of the doctoral thesis - e.g. related to the phylogeny of newly described plants, the phylo- and phytogeography of the region or the differentiation of ecosystem types, habitat zonation and biome characterization.

2. Research objectives

In my opinion, the main aim of the thesis was to complete the knowledge on plant diversity, evaluate the conservation status of selected model species, compare the region's flora to other hotspots of world floristic diversity and asses the effectiveness of their management in Tanzania's current protected area system.

They are explicitly expressed and formulated in the two research hypotheses:

- to test whether protected areas (PAs) constitute the primary component and organizing principle of practical and sustainable nature conservation in eastern Africa,
- to investigate the use of existing PAs in the furtherance of *in-situ* and *ex-situ* biodiversity conservation in Tanzania.

In my opinion all research objectives are clear, concise and logic. They match well with the given structure of the Thesis and because they are presented separately for each particular paper are easy to follow. Although, in order to embed them more in the biological and conservation sciences, I would suggest referring more deeply to the biogeographical theory of islands or the principles expressed as Single Large or Several Small dilemmas (see e.g. Szangolis et al. 2022, Single large AND several small habitat patches: A community perspective on their importance for biodiversity, Basic and Applied Ecology).

3. Thesis plan and outline

Each objective has been assessed in separate publication, so they have been analyzed and evaluated properly as a single research topic but without losing the general overview and the main focus. Therefore, the Thesis plan is accurate and follows a logic order of that sort of studies.

4. Originality of the research and the results obtained

The PhD Candidate presents apparently original research data and novel results. With an accurate analysis of the research outcomes and proper discussion presented in each section, the conclusions of the particular paper are well justified, concise and match well the initial objectives of the Thesis. With no doubt this contribution substantially enriches the scientific knowledge regarding the flora of the East Africa (new taxa, genotyping of critically endangered plants), but also significantly contribute to conservation management of the diversity hotspots. Each of the papers have been assessed individually by the experts in the field in the reviewing processes, but also the overall view of the completed research program gives the perception of the well prepared original scientific project with sound and unmitigated results. In the light of the recent literature and known research projects, undoubtedly the thesis is an original scientific contribution which is aimed at increasing the theoretical knowledge and broaden the application potential within the topic of taxonomy, applied botany or conservation botany.

5. Thesis assessment with summary of the strengths and weaknesses of the work

In my opinion the most valuable feature of the Thesis is the demonstration how basic research, including painstaking taxonomic surveys, by analyzing known populations and discovery of the new ones, after assessing the functionality of a specific ecosystem's

conservation regime and assessing the whole PAs system, can contribute to evaluating the conservation effectiveness of a biodiversity-important area of the world.

In my opinion the most distinguished strengths of the work are as follows:
- finding out reliable estimates of total biodiversity values for three tropical areas of the world (Afrotropical, Latin America, and Southeast Asia) by combining the numbers of indigenous vascular plant species with species numbers for insects, birds, amphibians, reptiles, and mammals,
- discovery, description and genetic study of several taxa endemic to the region: *Afrothismia winkleri* var. *budongensis, Chlorophytum vespertinum, Impatiens butu, Impatiens ndovu, Karomia gigas,*
- showing how starting from the level of the species and even its intra-population genetic diversity, passing through the ecosystem level up to the management of a system of protected areas, can contribute to increasing the effectiveness of the protection of the floristic diversity of a macro-region (East Africa).
- highlighting the important threat category - species that do not meet the criteria of a threatened taxon (LC) but are dependent on conservation actions. These taxa (formerly known as conservation dependent) often found in protected areas will only have stable populations if a PA exists and is properly managed.

As a Reviewer my main role is to find some shortcomings or not well explained issues in the Thesis. Thus I want to highlight some disputable weaknesses of the work that probably can help with improvement of the future projects of the Candidate or preparation of the more clear manuscripts:
- the introduction to the Thesis lacks an explanation of the most intriguing question - why there are fewer species in East Africa than in SE Asia or S America. A better description of the 'odd man out' hypothesis is missing. Is it the result of faster separation, greater stress (e.g. aridisation, seismic and volcanic activity) or natural history of the region? In recent years, papers have been published on this topic suggests the multifaceted nature of this issue. It is probably the result of numerous intricate causes impacting speciation, extinction and/or migrations such as present and past adverse climate, geology, time and area and even human impacts. Recent diversification analyses of pan-tropical plant families support the ''high speciation hypothesis'' over the ''high extinction hypothesis. So, discussing these issues in

the thesis would be interesting, embedding the work more deeply in strictly biological issues and interesting for the reader.

- in my view, when analyzing the effectiveness of the conservation of Tanzania's flora, it can also been analyzed:
  - ✓ changes in threat categories over the years for individual species, and the proportion of threat categories (EX/RE, CR, EN, VU, NT, LC; if there is a historical perspective for that),
  - ✓ the increase/decrease in the area of strictly protected conservation areas,
  - ✓ change in number of species in permanent *ex situ* collections,
  - ✓ change in number of species conserved in Gene Banks (including cryopreservation),
  - ✓ assessment of increase/decrease in funding for conservation of endangered plant species,
  - ✓ change in number of court cases, confiscation of plant material etc. over the years,
  - ✓ perhaps it would also make sense to indirectly assess the effectiveness of plant protection by comparing the proportion of species threat categories (EX/RE, CR, EN, VU, NT, LC) in Tanzania and other African countries,
  - ✓ funds implemented in flora conservation over the years.
- protected areas (PAs) is a very general term. The author lists a number of internationally based protection areas that exist in Tanzania (Global Biodiversity Hotspots, Key Biodiversity Areas, Important Bird Areas, and Tropical Important Plant Areas), but does not describe them in the context of national law. I am curious to know what the conservation regime and types of protection areas are in accordance to the Tanzania Nature Conservation Act. Are these uniform types of areas or are they very diverse (for example in Poland we have about 8 different forms of land protection with very different conservation regime according to Nature Conservation Act),
- if the effectiveness of flora conservation is higher in protected areas, it would be useful to have some evidence that it is lower outside them - e.g. a comparison of the frequency of endemic sites, natural habitat types, population density, etc.,
- conclusion number 5 (Decisions on *in-situ* and *ex-situ* conservation priorities are crucial for conservation planning) is quite general and does not add much to the work.

6. Methodology applied

The Candidate applied standard methods used in taxonomy, conservation biology, environmental management and statistics.

All these methods are sound and relevant and despite they don’t applied much of the novelties, they are sufficient and well adjusted.

7. Overall Thesis evaluation

In conclusion I must admit, that the Thesis of Mr. Roy E. Gereau has high scientific value and is important contribution to the knowledge of East African flora and ecosystem conservation. In my opinion the PhD Candidate fulfills all requirements of the Doctor of Philosophy degree and is ready to defend the Thesis through the final exam.

In this dissertation thesis, the student has demonstrated his creativity, diligence, and an understanding of the phenomena concerning the identification of botanical values and the possibility of protecting them in a country with a completely different culture and legal environment.

I am recommending the dissertation thesis for defense.

Out of the reviewer's duty, I drew attention to a number of shortcomings and doubts, which do not have a significant impact on my high assessment of the thesis, but should be considered and possibly taken into account by the Author.

The reviewed thesis was very well prepared in terms of content and form, meeting all the conditions and requirements for doctoral theses, in accordance with the Act of 14 March 2003 on scientific degrees and academic title (consolidated text, Dz. U. 2014, item 1852).

My final assessment of the doctoral dissertation of Roy E. Gereau is high, therefore I submit to the Council of the Faculty of Biology of the Adam Mickiewicz University in Poznań to admit the Doctoral Student to further stages of the doctoral procedure.

with best regards

prof. dr hab. Arkadiusz Nowak

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Signature Not Verified

Dokument podpisany przez
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