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REVIEW

of a dissertation for the award of the educational and scientific degree "Doctor of Philosophy" (Ph.D.) in the professional field 4.3. "Biological Sciences", scientific specialty "Hydrobiology"

Author of the thesis: Borislava Petrova Gyosheva, full-time PhD student in the Department of Aquatic Ecosystems at the Institute of Biodiversity and Ecosystem Research (IBER) at the Bulgarian Academy of Sciences (BAS), with academic supervisor Assoc. Prof. Dr. Vladimir Vasilev Valchev and scientific consu ltant Prof. Dr. Rosen Todorov Tsonev.

Topic of the thesis: "Composition and phytosociological structure of macrophyte communities in different types of water basins in the watershed of the Bulgarian section of the Danube River"

Reviewer: Prof. Dr. Petar Zhelev Stoyanov, University of Forestry, member of the Scientific Jury appointed by Order No. 15/14.02.2025 of the Director of IBER-BAS.

1. General characteristics of the dissertation (volume and structure), relevance of the topic, and brief presentation of the PhD candidate

1.1 General Characteristics of the Dissertation

Ph.D. thesis of Borislava Giosheva's consists of 243 pages, with an additional 22 pages of appendices. The title pages, table of contents, and list of abbreviations span three pages. Of the main content, the introduction takes up two pages; the objectives, tasks, and working hypothesis occupy one page; the literature survey – 12 pages; study area – 15 pages; methods of study – 24 pages; results and discussion – 160 pages; and the conclusion and contributions – 4 pages. The reference list, which is 21 pages long, includes 72 sources in Cyrillic and 240 in Latin script. The 21-page appendix includes three tables and two lists of group definitions for classifying plant associations. The main text contains 20 tables and 56 figures.

When excluding the introduction, table of contents, and reference list, the literature review accounts for approximately 6% of the thesis, the study area 7%, the methods 11%, and the results and discussion 76%, which indicates very good balance among the sections. Notably,

the research objects and methods constitute around 18% of the content due to the variety of interdisciplinary approaches used.

1.2 Relevance of the topic

Wetland and riparian ecosystems are among the most vulnerable yet vital for maintaining ecological balance. They are distinguished by their very specific biodiversity and functions. The Danube River and associated natural complexes and ecosystems have significant environmental and economic importance for Bulgaria. They are of strategical importance for concerving biodiversity not only in Bulgaria but in the entire basin. Despite this, many issues related to their status, conservation, and threats remain unclear. This underlines the relevance of the topic of the reviewed Ph.D. dissertation.

1.3 Brief Profile of the PhD Candidate

Borislava Giosheva graduated from the Faculty of Biology at Sofia University "St. Kliment Ohridski" with a Bachelor's degree in Biology in 2009 and a Master's degree in Algology in 2011. After that, her entire professional career is connected with IBER-BAS and the former Institute of Botany. Since 2009, she has been a biology specialist, later becoming an assistant in the Department of Aquatic Ecosystems. She was a full-time PhD student from 2014 to 2016 and has teaching experience at the Faculty of Biology of Sofia University and the Medical University in Sofia.

According to BAS's credit system, she has accumulated 386 credits, significantly exceeding the minimum requirement of 250, as follows: part one – 130 vs minimum required 130; part two – 96 vs minimum required 40 and part three – 160 vs minimum required 80. Briefly, the required minimum was significantly exceded. She has participated in 18 scientific and applied projects relevant to her dissertation topic.

2. Literature Awareness and Theoretical Preparation

The reference list includes 72 sources in Cyrillic and 240 in Latin, approximately two-thirds of which are from the 21st century, indicating that the candidate is well-acquainted with current trends. Naturally enough, scientific domains like botany and hydrobiology cannot avoid older studies because they provide historical context and reveal the trends of development of both studied objects and the research activities. Although the literature review occupies only 6% of the content, literature is integrated throughout the discussion, showing the candidate’s

strong theoretical grounding. The literature survey helped revealing many issues that were not enough clear or not studied in detail.

3. Methodological Approach

The interdisciplinary nature of the work required diverse methods, divided into two groups: methods for studying species and their status, and methods for studying plant communities. Each of these two groups includes many and specific methods for solving of particular tasks: transect methods for studying of macrophytes, identification of indicator species, ecological quality ratio (EQR) assessments, and vegetation classification. Modern software and statistical tools were successfully applied. Fieldwork was extensive and demanding, but the candidate effectively selected and applied the appropriate methods, yielding reliable results.

4. Significance and Credibility of Results and Conclusions

The Ph.D. thesis presents a comprehensive study of macrophyte flora, communities, and habitat conditions in the Bulgarian Danube. Fieldwork was conducted across many water bodies, providing valuable data. Based on the wide set of research methods the PhD candidate presents very convincing results on a variety of topics. The results are interpreted in the context of national and international research, demonstrating the candidate's expertise. Conclusions are well-founded on the collected data.

5. Critical Remarks

I have no significant critical remarks. The candidate has addressed the comments made during the different stages of the internal review.

6. Nature of Scientific Contributions

Due to the variety of topics, the scientific contributions are also diverse and multidirectional. In general, I would classify them into three groups: 1) related to the study of macrophyte diversity; 2) related to the study and classification of vegetation and 3) related to the study and assessment of the state of species, communities and their habitats.

The first group of original contributions should be highlighted by the characterization of the macrophyte flora in the 31 studied sites (designated in the dissertation as "points"). 115 taxa have been identified, of which 16 are of limited distribution and/or conservation importance. The structure of the communities has been established and the taxa have been

classified into six types of growth forms. New chorological information has been presented for several species – these are either species that are reported for the first time for a given floristic region, or rare species for which new localities are indicated. 6 species of invasive plants were also identified, and their degree of threat to natural ecosystems was also commented on.

Species diversity was determined using the Shannon index, which was originally developed for information theory and "borrowed" in ecology. The application of the index made it possible to objectively assess diversity and compare the values obtained during different periods of research. The highest diversity was found in Lake Srebarna, which emphasizes the nature conservation importance of this unique site.

The main merit of the dissertation is the very detailed description and analysis of the plant communities in the various reservoirs along the floodplain terrace of the Danube River. Plant syntaxons belonging to 4 classes, 7 orders, 11 unions, 33 associations and 17 communities were identified. Analogously to the species richness, the importance of Srebarna as a “hot spot” of diversity is highlighted here. For the first time in Bulgaria, five plant associations have been established, previously unknown for the country. The applied algorithms of Landucci et al. (2015) for identification and differentiation of syntaxa of hydrophytic and helophytic plant communities, the updated and supplemented syntaxonomic scheme of vegetation are also original contributions.

In the third group of contributions, the first, large-scale study of the state of the environment in the studied water bodies is highlighted. The values of 13 measured parameters characterizing this state have been established. An original scientific contribution is the application of the EQR index for assessing the ecological state and potential of the studied water bodies, as well as the established correlations between EQR and the measured physico-chemical parameters of the environment.

Multivariate statistical analysis in different variants has allowed the identification of the ecological factors that have the strongest impact on the identified species, as well as on the differences between the plant communities of the individual water bodies and their change over time. Of interest are the significant differences established between the different categories of water bodies in their species composition (with minor exceptions), which emphasizes the differentiating capabilities of the applied methods. As the most significant factors determining the specificity of the water bodies, in most cases the hydromorphology and the connection with the main water body – the Danube River have been highlighted.

Similar results have been obtained from the analysis of the environmental parameters and their influence on the distribution and characteristics of plant associations. The most

important factors influencing phytocenoses have been highlighted. Here too, hydromorphology is indicated as the most important factor, and after it several other factors are identified with almost equal importance.

Personally, I would give different titles to points 6.1.5. and 6.2.5. In the version, as they are titled in the thesis, the focus is mainly on the applied multivariate statistical methods, and in fact the methods are only a tool for establishing the influence of various ecological factors on the distribution of species and plant communities, as well as many other relationships.

I accept the reference for the contributions, but I believe that the contributions related to establishing the ecological state and potential of the studied water bodies, as well as the contributions resulting from the analysis of the environmental parameters in the studied plant communities (hydrophytic and helophytic associations) are not only confirmatory, but also have a largely original character.

7. **Evaluation of Scientific Publications**

Three publications related to the dissertation have been presented. All are co-authored, with the Ph.D. candidate as lead author. One article is published in Ecohydrology & Hydrobiology (Q2, indexed in WoS and Scopus), one is in Phytologia Balcanica (WoS-indexed) and one is in a proceedings volume of the Seminar of Ecology. These publications meet the BAS minimum requirements and as mentioned above, the Ph.D. candidate has gained 160 credit points vs 80 required. Additionally, she has presented two papers and two posters at national and international forums, further disseminating her work. The paper in Ecohydrology and Hydrobiology has received 17 citations. All these facts demonstrate that the scientific community is well aware of the research and achievements in the Ph.D. thesis.

8. Personal Contribution of the Candidate

Since I am familiar, albeit partially, with the work on the dissertation, I can confidently state that the research on the dissertation is the personal work of the doctoral student. This is especially emphasized in the large-scale and difficult field work, during which, however, specific methods were applied and a significant volume of experimental results were collected. Borislava's personal contribution is also clearly expressed in the mastering and application of mathematical and statistical methods for processing the results, and then - in the discussion of the results and writing the text of the dissertation. In all these stages, her personal contribution which convincingly proves that the dissertation is primarily her personal work.

The abstract is written compactly on 43 pages. It sufficiently reflects the most significant results and achievements of the dissertation work.

9. Final Motivated Conclusion

The Ph.D. thesis of Borislava Gyosheva represents a significant contribution to the knowledge of the macrophyte flora and vegetation in the Bulgarian sector of the Danube River. A very characteristic feature of the thesis and the research conducted in connection with it is the clearly expressed interdisciplinarity. The Ph.D. candidate demonstrates very good theoretical preparation in several, albeit close, scientific fields. She has managed to master and apply various research methods and with the obtained results to achieve original scientific contributions. Her research significantly enriches the scientific information about the macrophyte flora and vegetation in the study area, as well as about the factors modeling the flora and plant communities. The achieved contributions meet all the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation and the specific requirements of the Regulations on the conditions and procedure for acquiring scientific degrees and for occupying academic positions at the IBER-BAS.

Therefore, I could highly appreciate the dissertation work and to propose to the members of the esteemed scientific jury to vote for awarding the educational and scientific degree "Doctor of Philosophy" to Borislava Petrova Gyosheva in the field of higher education: 4. Natural Sciences, Mathematics and Informatics, professional field 4.3. Biological Sciences, scientific specialty "Hydrobiology".

31.03.2025 Reviewer:

Sofia /Professor Petar Zhelev, Ph.D./