REVIEW

on a dissertation work for obtaining the educational and scientific degree "**Doctor**" in: field of higher education 4. Natural sciences, mathematics and informatics; professional direction 4.4. Earth Sciences; the scientific specialty: "Ecology and ecosystem protection"

Author of the dissertation: Radoslava Georgieva Zaharieva. Full-time doctoral student at the Department of "Agroecology and Environmental Protection" at the Agricultural University, Plovdiv

Topic of the dissertation: "Parasites and parasite communities of fish from the Danube River - ecology and biodiversity.

Reviewer: Prof. Dr. Diyan Mihailov Georgiev, Trakia University, Faculty of Agriculture, Department of Ecology and Animal Hygiene, 4.3. Biological Sciences, "Ecology and Protection of Ecosystems", designated as a member of the Scientific Jury by Order No. RD-16-1118/31.10. 2022 by the AU Rector.

1. Brief introduction of the candidate.

Doctoral student Radoslava Zaharieva was born in 1991 in the city of Plovdiv. She graduated from secondary education at a private vocational high school in economics and trade, the city of Plovdiv in 2010. She completed her higher education at the Agricultural University, majoring in "Agrarian Economics" in the period 2010-2014. After graduation, she continued her studies at the Agricultural University, Master's programme "Ecology of settlement systems" and acquired the qualification "Ecologist". An important stage in the biography of Radoslava Georgieva is the investment she made in the educational and scientific degree "Doctor". Since 2019, she has been enrolled as a full-time doctoral student in the specialty "Ecology and Ecosystem Protection" at the Department of "Agroecology and Environmental Protection" at the Faculty of "Plant Protection" at the Agricultural University, Plovdiv. Radoslava Zaharieva completes and presents her dissertation in the regular term of the doctoral studies.

Doctoral student Radoslava Zaharieva declares a very high level of professional training related to the preparation of a dissertation and issues in which she works and develops. Her high language training, computer skills, professional qualification and

administrative abilities are confirmed in the developed and presented dissertation, diplomas and certificates, publications and other materials on the competition. Radoslava Georgieva's development as a motivated, young scientist is complemented by her participation in national and international conferences and projects.

2. Relevance of the problem.

In one of the publications cited in the dissertation, it is written that parasites are not fundamentally different from other organisms, but given the complexity of their life cycles, it is necessary to introduce clarifications regarding their population characteristics. In this line of thought, I would like to point out that Radoslava Zaharieva's work is extremely interesting and up-to-date related to the biological diversity of parasites and the ecological structure of their communities. For many of them, to this day, the life cycle remains a mystery or is not fully understood. Also, in support of the topicality of the problem, I want to share the fact that in aquatic communities, vegetation gives way with its dominant role, and animals and their groups come to the fore.

The study is carried out in the ecosystem of a river of European and national importance, passing through the territories of 10 and including in its catchment basin 19 countries. Focusing her attention on fish and their parasites, doctoral student Zaharieva declared her desire to study the biological diversity of the river and the state of fish resources.

3. Purpose, tasks, hypotheses and research methods.

The complexity of the study and the high scientific level of the implementation of the set tasks make an exceptional impression. The goal is clearly and precisely defined, 5 tasks and subtasks are set, which are sufficient for its realization.

The research methodology includes a complex of field sampling and laboratory analyses. A correct, ecological characterization of the studied biotopes from the Danube River and the Danube Basin has been made. The conservation significance of the area and the studied fish species are presented.

Basic indicators were used to characterize the invasion. Infracommunities of dominant parasite species are described by season, evenness, dominance and

diversity. As a result, a reliable, positive correlation was found between MI, MA and P% with endohelminths in the three seasons.

4. Transparency and presentation of the obtained results.

The presented dissertation meets the requirements of the ZRASRB. It is written in 250 pages. It contains scientific and scientific-applied results that represent an original contribution to science. Present are all sections in sufficient volume and ratio between them.

The information is illustrated by 75 figures and summarized in 108 tables. The dissertation shows that the candidate has in-depth theoretical knowledge and abilities for independent scientific research. After each researched element, group of factors or analysis, an adequate conclusion is made, which allows for grading the contributions of the dissertation work and formulating original theses. Therefore, I allow myself to express my opinion about the originality of the research and the credibility of the discussed material.

5. Discussion of results and used literature.

Extensive field and laboratory work was carried out. 31 species of fish were studied and 34 species of helminths were found.

High invasion values were found with an intensity of up to 7828 specimens in *Chondrostoma nasus* (N=349); 6024 in *Abramis brama* (N=351); 3120 in *Barbus barbus* (N=15). Some of the studied hosts have a high species richness - 11 species of helminths in bream, 16 in bream, 9 in uklei and babushka, etc.

Four helminth species (*N. skrjabini, Sph. bramae, P. laevis* and *Contracaecum sp.)* were found to be common to the three dominant fish species. Two parasite species (*N. skrjabini* and *P. laevis*) had the highest invasion rates in *Abr. brama* and one each (*Sph. bramae*) at *Alb. alburnus* and *(Contracaecum sp.*) at *Ch. nasus*.

The dominant role of helminths was determined: respectively, the largest number of specimens of the Trematoda class and the Cestoda class were found in *Abr. brama* (5840 copies and 114 copies); and from the Acanthocephala class – in *B. barbus* (3105 specimens); from the class Nematoda – in *Ch. nasus* (7786 specimens).

The mentioned species are dominant in the ichthyofauna of the river included in the study. In this connection, the attention is logically focused on determining the

seasonal changes of the helminth communities of the dominant fish species from the Danube River.

The obtained results are subjected to statistical processing, correlation dependences and degrees of credibility of the discussed problems are highlighted. In the dissertation, acquired new knowledge and proposed new approaches to solving the scientific problem stand out. A significant credible difference in MI was found between the spring, summer and autumn seasons. As a result, the dynamics in invasion parameters are revealed. Invasion peaks are described, which are pronounced in spring and autumn with declines in summer.

As a result of the established differences, a comparative examination of the endohelminth complexes of the dominant host species by season according to qualitative data was applied.

In order to evaluate the dynamics in the quantitative structure of the endohelminth complexes of the dominant hosts, a cluster analysis was made, as a result of which a hypothesis was proposed for the circulation paths of the helminth flow.

The list of literature contains 206 sources, of which 45 in Cyrillic and 161 in Latin (including websites of ministries, municipalities, etc.)

On the basis of the conducted study, 18 conclusions were formulated which logically and concisely presented the conducted studies and achieved results. 8 real recommendations for science and actionable activities for practice are made.

6. Contributions of the dissertation work.

The first complex ecological-taxonomic study of fish and their helminths from the upper part of the Danube River in Bulgaria was conducted. Therefore, the contributions that the dissertation work has are the two fields of science - ecology and biodiversity.

Scientific contributions

Contributions of exceptional scientific value refer to the taxonomic diversity of helminths and helminth communities and the species richness of the hosts (representatives of the ichthyofauna) in Bulgaria and the Danube River basin. In this connection, the helminth species described as new for Bulgaria are: *Sch. acheilognathi, L. confusus, Sph. bramae, N. heilancristrotus (larvae), C. lacustris, Ph. obturans, K.*

intestinalis) and new species for the river (*L. confusus, N. cheilancristrotus (larvae), Ph. obturans*).

For 25 species of helminths, new hosts have been established in Bulgaria. For 29 species of helminths, new hosts were established for the Danube River and the river basin in Bulgaria, and for 26 species of helminths, new hosts were established for the Danube River and the river basin.

Scientific and applied contributions

The scientific-applied nature of the contributions refers to the studied and described helminth communities of *Abr. brama, Alb. alburnus* and *Ch. nasus* from the Danube River.

The updated helminthological lists of 25 species of fish from the Danube River and the provided new data on the invasion indicators of the pathogenic species *Sch. acheilognathi, P. laevis, Contracaecum sp., E. excisus* and *R. acus*.

7. Critical Notes and Questions.

I have no critical remarks about the PhD student and the dissertation. I recommend continuing work on the taxonomy and ecology of helminths in the ichthyofauna of the Danube River and its catchment basin.

8. Published articles and citations.

Two articles have been published on the dissertation, which are in a global database (Web of Science, Q4) and through them the doctoral student covers the MNI for acquiring the ONS Doctor:

1. Zaharieva R., Kirin D., 2020. New data on parasites and parasite communities of Alburnus alburnus (Linnaeus, 1758) from the Danube River. Book of Proceedings, Scientific Papers. Series D. Animal Science. LXIII(2), 397-404. ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750 http://animalsciencejournal.usamv.ro/pdf/2020/issue_2/Art61.pdf.

2. Zaharieva R., Kirin D., 2020. Parasites and parasite communities of the Common nase (Chondrostoma nasus (Linnaeus, 1758) from the Danube River. Book of Proceedings, Scientific Papers. Series D. Animal Science. LXIII(2), 413-420. ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online

2393-2260; ISSN-L 2285-5750
http://animalsciencejournal.usamv.ro/pdf/2020/issue_2/Art63.pdf

9. Abstract

The presented abstract is structured according to the requirements of the ZRASRB, PPZRASRB and PRAS of the AU. It objectively reflects the structure and content of the dissertation. It is written on 32 pages and in an English version. This makes the scientific achievements of PhD student Radoslava Zaharieva noticeable in global databases and accessible to a large circle of scientists.

CONCLUSION:

Based on the different research methods learned and applied by the doctoral student, the correctly performed experiments, the generalizations and conclusions made, I believe that the presented dissertation meets the requirements of the ZRASRB and the Regulations of the Agrarian University for its application, which gives me the reason to rate it POSITIVELY.

I take the liberty of proposing to the honorable Scientific Jury to also vote positively and award Radoslava Georgieva Zaharieva the educational and scientific "Doctor" in the scientific specialty "Ecology and Ecosystem Protection"

Date: 21.11. 2022 REVIEW PREPARED BY: .....

Plovdiv (prof. Dr. Diyan Georgiev)