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OPINION

regarding dissertation labor for award on educational and scientific degree " doctor " of Jordan Raev Raev , PhD student in science section " Biology and Ecology" on the sea " , by area on higher education 4. " Natural sciences , mathematics and informatics " , professional direction 4.3. Biologically sciences " , doctoral program " Ecology and Conservation" on ecosystems " , scientifically direction " Sustainable operation and conservation on alive marine resources " , on topic : **" Technological solutions for reduction on discards in fisheries "**

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I. General presentation on the dissertation labor

1. Subject and relevance on scientific research

The subject of the study is the development and evaluation of technological solutions to limit unwanted catches and subsequent discards by increasing the selectivity of a conventional trawl used for catching demersal and demersal species in the Bulgarian Black Sea. The emphasis is on the selective characteristics of the fishing gear and the quantitative description of the retention and release of fish of different size classes.

The introduction justifies the relevance of the problem of selectivity of fishing gears and emphasizes its insufficient knowledge in the Bulgarian Black Sea waters. The study focuses on two economically important species – *Mullus barbatus* (Linnaeus, 1758) (red mullet) and *Merlangius merlangus* (Linnaeus, 1758) (whelk).

The literature review outlines a scientific and applied gap related to the lack of systematic experimental studies of the selectivity of trawl gears in the Bulgarian Black Sea waters. This justifies the need to evaluate conventional trawl designs and to formulate solutions to limit unwanted catches and discards.

The aim of the dissertation is to assess the operational selectivity of conventional trawl gears when catching M. barbatus and M. merlangus in the Bulgarian waters of the Black Sea and, based on experimental data and statistical analyses, to formulate scientifically based recommendations for its increase and for limiting unwanted catches.

To achieve the goal, eight tasks have been formulated, which include a study of the design characteristics of trawl gears, experimental trawling in real conditions, measurement and analysis

of the catch, quantitative assessment of selectivity and statistical modeling of the characteristics of different variants of the trawl codend.

2. Volume and content

The dissertation work is common volume of 156 pages , of which 111 pages main text , 22 pages list on the used literature and 23 pages appendices . Contains 30 figures and 25 tables . In the bibliography list are 218 sources included , from which 2 of Cyrillic , 201 of Latin and 15 internet the source .

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presenting programmatic codes , data from experimental trawling and sampling , as well as extended sets from data for assessment on the operational selectivity at *M. barbatus* and *M. merlangus* . They contribute to the transparency of analytical procedures and the traceability of the processing of primary data.

3. Structure of the dissertation labor

The scientific development there is clear structure and follows logic on the researched The content is organized sequentially – from justification on topicality on the problem and formulation on the goal and objectives , through presentation on the experimental approach and the methods used methods , to analysis and interpretation on received results .

Particular attention is paid to the quantitative assessment of selectivity and statistical modeling of the retained catch depending on the size characteristics of the fish and the construction of the trawl codend.

4. Experimental material and statistical methods

The research is founded on significant by volume experimental material . Analyzed are total 299 species specific samples , from which 185 for *M. barbatus* and 114 for *M. merlangus* . Measured are total 36,241 individuals , including 23,328 specimens from *M. barbatus* and 12,913 specimens from *M. merlangus* . The volume on the collected data creates good basis for comparative analysis on the dimensional structure on catch and for assessment on selective characteristics on the researched fishing appliances .

The analysis is structured by combinations "trawling × species × size class" , with the dependent variable being the number of individuals captured.

A generalized additive model (GAM) with a negative binomial distribution was applied to model the number of individuals detained. The approach allows for the description of nonlinear dependencies and accounting for overdispersion in the data.

The uncertainty of the estimates was analyzed using a bootstrap procedure at the trawling level, based on repeated sampling with return. This assessed the robustness of the results obtained.

The Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Likelihood Ratio Test (LRT) were used for model comparison and selection. Their application allows for a comparison of models while taking into account their complexity and the risk of overfitting.

5. Basic results and their interpretation

The results show more stable characteristics of operational selectivity in *M. barbatus* and greater variability of the selective process in *M. merlangus* .

The fit between the observed and modelled data was assessed by comparing the median length and the main quantiles of the size distribution of the retained catch. A good fit was found, indicating that the models reproduce the main features of the observed size distribution. The median length of the retained catch should be distinguished from L_{50} – the length at which the probability of retention is 50%.

The analysis shows a nonlinear relationship between the length of individuals and their retention characteristics. The interpretation of this relationship is related to the morphometric characteristics of the fish and the construction parameters of the trawl codend.

The analysis of the operational selectivity shows that the studied conventional trawl designs do not sufficiently limit the retention of immature individuals of *M. barbatus* and *M. merlangus* . In the considered configurations, the estimated values of L_{50} (length at 50% probability of retention) are below the values of L_{m50} (length at 50% sexual maturity) reported in the literature. According to the presented results, the proportion of retained individuals with a length below L_{m50} exceeds approximately 58–60% of the catch.

These results highlight that setting minimum catch sizes alone is not sufficient to limit fishing pressure on immature individuals. A comprehensive approach is needed, including increasing the selectivity of trawl gear so that a proportion of undersized fish can be released during trawling.

In summary, the results outline species differences in selectivity characteristics and justify the need for species-specific technological solutions. The experimental and statistical approach used provides a basis for evaluating design modifications to trawl gears and for formulating practical recommendations for limiting unwanted catches and discards.

II. Scientific and applied scientific contributions of the dissertation work

Based on the results presented in the opinion, the following scientific and applied scientific contributions can be highlighted:

- Information on the selectivity of conventional trawl gears has been systematized and insufficiently researched aspects of the problem in the Bulgarian waters of the Black Sea have been outlined.
- Considerable experimental material on the size structure of the retained catch of M. barbatus and M. merlangus has been collected and analyzed.
- Statistical methods were applied for quantitative analysis of the selective characteristics and for assessment of the uncertainty of the model results.
- Differences between the two species were identified and the limitations of the studied trawl designs in terms of retaining sexually immature individuals were outlined.
- The results obtained provide a basis for species-specific recommendations for improving selectivity. The opinion states that the results have been presented in four publications.

III. Summary evaluation of the dissertation and conclusion

The dissertation on the topic "Technological solutions for reducing discards in fisheries" is a thorough scientific and applied research with a clearly expressed practical focus. The development demonstrates knowledge of the research topic, skills in experimental work and application of modern statistical approaches. The presented materials provide grounds for a positive assessment of the scientific preparation of the doctoral student. According to the provided documentation, the work and the remaining materials comply with the applicable requirements for acquiring the educational and scientific degree " doctor" .
In conclusion, taking into account the relevance of the topic, the volume of experimental material, the analytical methods used and the scientific and applied value of the results, I confidently express a positive opinion for awarding the educational and scientific degree " Doctor" to Yordan Raev Raev in professional field 4.3. "Biological Sciences" , doctoral program "Ecology and Ecosystem Conservation " .

Recommendation: I recommend that the results and the resulting proposals for improving the selectivity of trawl gears be presented to the competent institutions involved in management . on fisheries .