

REVIEW

by

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regarding a dissertation thesis for the acquisition of the educational and scientific degree "Doctor" (PhD)

Topic: Optimization of Marine Coastal Macrolitter Management along the Bulgarian Black Sea Coast

Author: Miroslava Damyanova Robinson

Scientific Supervisor: Assoc. Prof. Daniela Simeonova Toneva, PhD

Scientific Field: 5. Technical Sciences

Professional field: 5.5. Transport, navigation and aviation

Doctoral program: Environment preservation systems and devices

1. Relevance of the Problem

With its complex negative impact on ecosystems, the economy (tourism, fishing), and human health, the pollution of the global ocean with solid waste, specifically plastics, has become one of the most serious environmental problems of the 21st century, on both a global and regional scale. Scientifically, the problem is extremely complex, as it encompasses the study of intricate hydrodynamic, meteorological, and other processes that influence the transport and accumulation of waste, as well as the formation of pollution "hotspots". The relevance is further emphasized by Bulgaria's commitments under the Marine Strategy Framework Directive (Directive 2008/56/EC, MSFD) and the necessity of achieving "good environmental status" of the marine environment.

The author highlights a specific gap expressed in the inability of the current national monitoring to cover all significant zones and to offer innovative solutions, such as the use of Unmanned Aerial Vehicles (UAVs).

The degree of relevance of the dissertation thesis is indisputable. It is defined by the intersection between urgent environmental needs and the capabilities of modern remote sensing methods, which makes the research significant both for fundamental science and for direct management practice.

2. Degree of Knowledge of the State of the Problem and Literature Analysis

The author demonstrates an in-depth understanding of the subject matter by analysing the topic within a broad interdisciplinary context. The bibliographic reference includes 213 sources, the vast majority of which are in English (181). The doctoral candidate demonstrates an excellent knowledge of the European regulatory framework, particularly the Marine Strategy Framework Directive, which is critical for the practical applicability of the work. A detailed review of international treaties, agreements, and regional conventions (such as the Bucharest Convention) has been conducted.

The use of the most current reports from international organizations such as UNEP, IMO and the Black Sea Commission, as well as the latest, up-to-date scientific publications in the

field of marine litter and the use of drones for environmental purposes, is impressive, proof that the candidate is familiar with the latest global trends and innovations.

The literature review (Chapter 1) is not merely a mechanical listing of sources but a systematized study of the evolution of concepts regarding marine litter. The derived conclusions allow for the correct formulation of the research's aim and objectives.

The candidate's creative approach is evident in the critical analysis of existing monitoring methodologies. Instead of accepting the existing JRC (Joint Research Centre) protocols as universally applicable, she explores their limitations under the specific conditions of the Bulgarian Black Sea coast. Particularly valuable is the analysis of the "pathway" of waste from the source through the marine environment to the coastline, where the author creatively interprets the influence of factors such as wind fields and sea currents on accumulation processes.

The author succeeds in identifying existing "blank spots" in previous studies of the Black Sea, namely, the lack of sufficient data for hard-to-reach coastal strips and the need for rapid assessment methods. This critical evaluation serves as a solid scientific foundation for formulating the goals and tasks of the dissertation.

In conclusion, it can be categorically confirmed that the doctoral candidate not only knows the state of the problem in detail but also possesses the capacity for analytical and creative thinking, allowing her to build upon existing theoretical models with new, practically applicable solutions.

3. Research Methodology

The selected methodology is complex, well-structured, and fully adequate for the set goal. Conventional (classical) monitoring, carried out through a one-year study (4 seasons) in accordance with European standards (JRC Guidance), is skilfully combined with innovative monitoring via remote methods (drone imaging and waste identification through software solutions). This combination allows for data verification and an assessment of the applicability of new technologies for the purposes of national monitoring.

The applied methodological approach is scientific and sound. The integration of UAV technology into the monitoring process is not only a technical innovation but also a methodological contribution that allows for the optimization of survey time and the coverage of larger areas. The chosen methodology leads directly to the fulfilment of the tasks and enables the formulation of proven scientific conclusions.

4. Characteristics and Reliability of the Material

The material upon which the dissertation is built is authentic, scientifically collected, and correctly documented. The lack of contradictions between the theoretical framework and the empirical results provides full justification to accept that the presented data are entirely reliable and constitute a solid foundation for the formulated scientific contributions.

The research is based on real data collected *in-situ* during the period from May 2024 to January 2025. Various categories of waste were analysed on an adequately selected experimental polygon, thereby eliminating "noise" from regular cleaning activities. Reliability is guaranteed by the application of established statistical methods and the comparison between visual observation and the results from drone imaging.

5. Scientific and Scientific-Applied Contributions

The aim of the dissertation is correctly and precisely formulated, and seven specific tasks have been set for its achievement. These tasks were successfully fulfilled during the research and development process, while the interpretation of the obtained results and the formulated conclusions fully correspond to them.

The dissertation presents claims for seven distinct contributions, which are categorised as both scientific and scientific-applied in nature.

The primary scientific-applied contribution consists of proving the applicability of Unmanned Aerial Vehicles as a reliable and high-tech tool for the monitoring of marine coastal macrolitter. Through the implementation of modern photogrammetric methods, an accuracy of approximately 75% in automated object identification was established, representing significant new evidence of the effectiveness of remote sensing methods compared to conventional monitoring.

Furthermore, the dissertation provides new factual data regarding the composition and seasonal dynamics of waste in the understudied area of the "Orlovo Blato" polygon, effectively filling existing information gaps for the Northern Black Sea coast. The work also presents confirmatory facts regarding the decisive role of specific wind fields and sea currents on the processes of transport and uneven accumulation of anthropogenic pollutants along the shoreline.

An innovative methodology for the "rapid detection of hotspots" was developed, which allows for the quick localisation of critically polluted sections through aerial imaging. Additionally, a new complex of complementary measures is proposed to optimize the national monitoring methodology, including the requirement for reporting waste density.

The scientific significance of the work is expressed in the enrichment of the field with up-to-date data for closed sea basins and the integration of drone technologies into environmental research. The practical significance lies in the creation of functional algorithms for processing orthophotomaps, which can be directly implemented into the operational activities of the Basin Directorate and the Executive Agency "Maritime Administration".

The character of the implementation-related contributions includes specific technological schemes and methodological guidelines designed to optimize logistics and budget expenditures in coastal monitoring. I accept the contributions defined by the author as well-founded, correctly formulated, and confirmed throughout the research, as they present new methodologies to the field and enrich existing knowledge. Finally, I consider the contributions of the dissertation to be the personal work of the doctoral candidate, as evidenced by the provided scientific publications.

6. Personal Contribution of the Candidate

The dissertation bears the hallmarks of independent scientific research. The doctoral candidate personally planned and conducted the field studies, processed the drone imaging data, and formulated the conclusions and recommendations.

Performing the one-year *in-situ* monitoring in the "Orlovo Blato" polygon required not only physical presence but also strict adherence to the protocols for waste identification and classification. The described details of the field work and the seasonal specificities of the region demonstrate the direct experience and personal commitment of the candidate in collecting the primary data.

The work is characterised by a unified style of presentation and a logical connection between the theoretical framework, the experimental part, and the formulated contributions. The author has clearly defined her thesis and consistently defended it through the presented evidence.

The results of the dissertation have been approved through scientific publications in which the candidate is the lead author or a key co-author, which serves as proof of her contribution to the dissemination of the newly acquired knowledge.

I have no doubt that the dissertation is the result of the candidate's independent research efforts. All main ideas, methodological solutions, and contributions are her personal work, and

the role of the scientific supervisor was correctly focused on guiding and supporting this individual scientific process.

7. Publications on the Topic

The scientific output accompanying the dissertation is fully sufficient and adequately presents the author's main theoretical and experimental achievements. The publications reflect the consistent development of the research and its approbation within the scientific community.

The primary research results have been reported and published at 4 scientific forums (1 abroad and 3 international forums in Bulgaria). Four scientific publications are presented, covering the key aspects of the dissertation. An exceptionally high indicator of the work's quality is the publication "Marine Litter Accumulation and Distribution on Durankulak Beach" (2025) in an international conference proceeding indexed in the global database Scopus, which ensures the visibility and traceability of the results at an international level. The publications in proceedings of established forums for sharing engineering and technical achievements demonstrate the author's active presence in the Bulgarian scientific environment.

Although the publications are relatively recent and it is too early to fully assess their potential for citations and impact within the scientific community, the presence of 2 citations in the global database Scopus should be noted.

The publications fully comply with the minimum national requirements for the award of the educational and scientific degree "Doctor." They are published in authoritative editions, possess the necessary international identifiers (ISSN, doi), and present the doctoral candidate as a mature researcher capable of presenting her results to both national and global audiences.

8. Practical Use of the Results

The results of the work have a clear applied character. The proposed technological solutions offer the potential for implementation and promise the optimization of public expenditures for environmental monitoring. The findings have direct applications for improving national monitoring programs under Descriptor 10 of the EU Marine Strategy Framework Directive. Furthermore, the proposed methods for the "rapid detection of hotspots" can optimize cleaning costs.

The results of the dissertation are already finding their place in scientific practice through published articles in authoritative editions, such as the international conference proceedings indexed in Scopus. The data on the seasonal dynamics of accumulation in the "Orlovo Blato" area can be used as reference data for comparative environmental studies within the Black Sea basin. The UAV imaging methodology represents a contribution to the development of remote sensing research in Bulgaria and serves as a foundation for future academic developments in the field of environmental monitoring.

Although the dissertation has a strong environmental focus, it can yield both indirect and direct economic effects: the use of UAVs for monitoring can reduce logistics costs, man-hours, and fuel consumption compared to traditional surveys of long and hard-to-reach coastal strips.

9. Recommendations for Future Use

The complex of measures for monitoring optimization proposed in the dissertation has the potential to be integrated into the activities of state institutions (e.g., the Black Sea Region Basin Directorate and the Environment Executive Agency). The introduction of the methodology for "rapid detection of hotspots" allows municipalities and the NGO sector to organize more effective volunteer cleaning campaigns focused on the most affected areas.

It is recommended to integrate UAV observations as a complementary method to conventional monitoring, especially for hard-to-reach or protected zones.

10. Abstract

The abstract consists of 57 pages, which is fully sufficient for a detailed presentation of the dissertation's content. It includes all mandatory elements and presents the logical structure of the dissertation in a correct and systematized manner. Special attention is given to Chapter 3 and Chapter 4, where the monitoring methodology, the results of the experimental studies, and their discussion are described. The text accurately conveys the main conclusions regarding the seasonal dynamics of waste and the precision of remote methods.

Based on the provided work, it can be confirmed that the abstract has been prepared in full compliance with the regulatory requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria and the relevant regulations for its implementation.

In the concluding part of the abstract, seven main contributions are synthesized. They are formulated clearly and precisely, correctly reflecting both the new factual data and the methodological and applied achievements of the author. The abstract objectively reflects the scientific and practical significance of the research and can serve as a reliable basis for acquainting the scientific community with the doctoral candidate's work.

11. Critical Remarks and Recommendations

I have no significant critical remarks regarding the dissertation. It is prepared with a high level of scientific presentation and demonstrates a thorough understanding of the subject matter. Occasional technical and punctuation errors do not diminish the value of the presented work.

I consider the doctoral candidate to be a mature specialist with the ability to solve scientific problems independently, and I recommend that she increases her publication activity in journals indexed in global databases.

Conclusion

The presented dissertation is a complete study dedicated to a highly relevant problem, characterised by clear scientific-applied value and a realistic potential for implementing its results into practice. The author has fulfilled the set aim and tasks of the dissertation, based on which scientific-applied and applied contributions have been achieved and adequately reflected in scientific publications.

The dissertation fully complies with the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation, and the Regulations for the admission and training of doctoral students and the acquisition of the educational and scientific degree "Doctor" (PhD) and the scientific degree "Doctor of Sciences" at the Technical University of Varna.

The above-stated gives me reason to provide a positive assessment of the presented dissertation and to propose to the honourable members of the Scientific Jury that Miroslava Damyanova Robinson be awarded the educational and scientific degree "Doctor" (PhD) in the Professional Direction: 5.5. Transport, Shipping, and Aviation, Doctoral Program: Systems and Devices for Environmental Protection.

26 March 2026

Reviewer:

Varna

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