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Environmental Security and Marine Ecosystem Protection: Addressing Regulatory Ambiguities in Bulgaria

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This report focuses on mechanisms to ensure environmental security and in particular protection of the marine environment from pollution, including the impact from incidents, disasters, accidents and other emergency situations. The presented analysis at the complex of measures and activities implemented in Bulgaria for prevention and response to pollution of the marine environment which reveals a number of gaps both in regulatory and organizational aspects. It has been demonstrated that an objective necessity to expanded the scope of mechanisms for ensuring environmental security in coastal waters, territorial sea and exclusive economic zone of the Republic of Bulgaria. Suggestions for the development of the environmental security system are proposed which would ensure regulatory compliance as well as real improvement in the effectiveness for the protection of the Black Sea against pollution.

Keywords— Black Sea, environmental security, marine environment, risk management.

I. Introduction

Environmental security has become a defining concept in contemporary governance responding to recognition of environmental degradation as a threat to human wealth, economic stability and geopolitical order. It takes into account the change in the traditional concept of security to a multispectral frame of environmental risks – pollution, climate change, biodiversity loss [1], [2], [3].

The specific and unique characteristics of the Black Sea - limited water exchange, fresh water balance, stratified layers and dependence from river flow presents high ecological sensitivity as well as significantly reduce capacity to recover after environmental disturbances. Consequently, even a moderate anthropogenic pressure – incident can result in a long term and irreversible environmental impact [4].

The Black sea is a critical marine transport corridor linking Europe, Asia and middle East, also a semi-closed basin with limited water exchange, unique structure of anoxic layers, vulnerable to pollution, environmental disturbances and anthropogenic pressure - industrial discharge, agricultural runoff, marine transport.

In the Bulgarian context environmental security is complicated by regulatory fragmentation and institutional overlap. As a coastal state and European Union member it operates within a comprehensive legal framework of European directives and international agreements but the effectiveness of these mechanisms remains constrained by coordination deficits and implementation gaps.

The increasing complexity of environmental risks in the Black Sea region – particularly associated with military activities requires more adaptive and integrated governance approach.

II. Materials and Methods

The regulatory requirements for practices and control are reviewed taking into account international activities, national legislation and normative documents concerning the protection of marine environment in its entirety. The analysis is focused on identifying gaps and ambiguities or inconsistency in the regulation of minimum requirements in order to achieve and maintain Good Environmental Status of the Black Sea ecosystem and in this aspect of Bulgarian environmental security.

A comparison between the regulatory requirements and the practice in the field of marine environmental protection was made as an element of ecological security. A review of public available data and risk for ecological security has been conducted in particular for the Bulgarian part of Black Sea based on the conceptual method DPSIR (Driver-Pressure-State-Impact-Response).

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III. RESULTS AND DISCUSSION

Environmental security is a fundamentally multidisciplinary concept that integrates ecological sustainability with political and socioeconomic stability. It is defined as the protection of the ecosystems and human society from environmental risks arising from natural and anthropogenic activities. Modern interpretations connect the interdependence between environmental degradation and security threats, highlighting how the ecological stress could trigger economic decline, migration and conflict [5], [6]. The key elements of environmental security are presented in Table 1.

TABLE 1 KEY ELEMENTS TO ENVIRONMENTAL SECURTIY

Element	**Key element characteristics**	
	Description	***Condition***
Environmental quality	The state of air, water, soil and overall environmental components	Clean, safe, stable and productive according to the requirements and standards
Environmental functions	The ability to provide ecosystem services	Support life and human activities
Environmental risk	Threats as pollution, climate change, resourse depletion, extreme weather condition and natural disasters	Risks are defined or predicted, minimized and manageable

The Black Sea region presents a particular and a complex case of environmental security. It is a semi-closed basin connected to Mediterranean Sea through Bosphorus Strait and the Sea of Azov through the Kerch Strait. The system of currents is under the influence of the largest European rivers flowing into the northern west part of the basin – Danube, Dnieper and Dniester [7]. The fresh water from rivers, atmospheric precipitation and the inflow of saline mediterranean waters create a specific thermohaline profile of the Black Sea. Strong and stable vertical stratification and anoxic layer with high hydrogen sulfide concentration at depths below 150 m distinguish the basin from the World Ocean [4]. The physical characteristics and geographical position of the basin amplify environmental risk and require the implementation of complex measures for prevention and response to pollution of the marine environment in the event of incidents, disasters, accidents and other emergencies [4], [6], [7], [8]. The main type of threats to the Black Sea ecosystem are presented in Table 2.

TABLE 2 THREATS TO ECOSYSTEM

Type	**Main threats to the ecosystem**		
	Source	***Pressure***	***Impact***
Euthro phication	Agriculture, urban discharge	High	Oxygen depletion, biodiversity loss
Chemical pollution	Industry, marine transport	High	Toxicity and contamination
Military activities	Conflict zones	High	Longterm ecosystem damage
Oil pollution	Marine transport, offshore drilling	High	Habitat pollution, biodiversity loss
Marine litter	Terrastrial sources, coastal activities, fishery and aquaculrure, shiping	High	Ecosystem disruption, biodiversity loss
Invasive spieces	Balast water	Medium	Food chain imbalance
Sound pollution	Marine transport, offshore drilling, mylitary operations	Medium	Habitat disruption, change in the migration routes

The Black Sea ecosystem has experienced significant degradation over the recent decades due to cumulative anthropogenic pressures [4]. The presence of anoxic deep waters limits biological activity to the surface layers, rivers transport nutrients, pollutants and litter from vast inland areas. Land based pollution remains one of the most significant threats. Agricultural runoff, industrial discharge and wastewaters from urban areas contribute to eutrophication and chemical contamination.

The environmental protection system for marine environment in Bulgaria is formed in accordance to international legal framework, EU directives and regional documents presented in Table 3, 4 and 5. That includes Convention of prevention of Marine Pollution by Dumping Wastes and other matter (London Convention), International Convention for Prevention of Pollution from Ships (MARPOL 73/78), United Nation Convention on the Law of Sea (UNCLOSE), International Convention on Oil Pollution Preparedness Response and Cooperation (OPRC), International Convention for the Control and management of Ships' Ballast water and Sediments (Ballast water convention).

TABLE 3 INTERNATIONAL DOCUMENTS FOR PROTECTION OF MARINE ENVIRONMENT

Document	**Black Sea International documents**	
	Description	***Year***
London Convention	Control of marine dumping	1972
MARPOL Convention	Ship pollution control	1973/78
UNCLOS	Law of the sea framework	1982
OPRC	Oil pollution emergenciy preparedness and response	1990
Ballast convention	Prevention of invasive spices transfer via balast waters	2004

OPRC, 1990 complements the preventive nature of MARPOL73/78 and focuses on incident response. While

MARPOL aims to reduce the probability of pollution and limit routine and emergency discharges, OPRC establishes framework for preparedness and international cooperation in case of major oil spills. OPRC requires states to develop a national action plan as well as regional plans for Varna and Burgas, to provide equipment and personnel, common assistance at transboundary incidents.

A system with different levels is applied in Bulgaria with responsibilities divided between environmental, maritime, emergency, fishery and aquaculture control authorities characterized by a fragmented institutional structure. Responsibly is divided among Ministry of Environment and Water (MOEW) and Executive Agency maritime Administration (EAMA), Black Sea Basin Directorate (BSBD) and General Directorate Fire Safety and Civil Protection. MOEW is responsible for marine environmental policy regarding international, EU and regional documents - implementation of UNCLOSE obligation on environmental protection, Marine Strategy Framework Directive (MSFD, 2008/56/EC), Water framework Directive (WFD, 2000/60/EC), London convention [9], [10], [11]. Through national legislation as Water Act, Environmental Protection Act, Biodiversity Protection Act and regional representatives as BSBD, EEA the ministry regulates activities in the sea, carries monitoring, data reporting at EC, pollution control and permitting regimes. EAMA at the Ministry of Transport is the main authority for MARPOL and the Ballast Convention. It is responsible for port state inspections and pollution standards, ballast water systems, certification of vessels. Executive Agency for Fisheries and Aquaculture (EAFA) as a administrative unit at ministry of Agriculture caries control of fishing activities and aquaculture ensuring sustainable development.

All this division reflects the management of marine environment combines environmental protection, maritime transport regulation and emergency response and also creates significant coordination challenges. One of the main difficulties is overlap of competencies – protection of the marine environment and quality of marine waters under MOEW and its regional representative BSBD, while pollution from the ships is regulated by EAMA and fishery by EAFA.

TABLE 4 EU DOCUMENTS FOR PROTECTION OF MARINE ENVIRONMENT

Document	**EU Directives**	
	Description	***Year***
Bird Directive, 2009/147/EC	Coastal ecosystems	1979
Habitats Directive 92/43/EEC	Marine NATURA 2000 areas	1992
Water Framework Directive, 2000/60/EC	Water quality in coastal waters, GES	2000
Marine Strategy Framework Directive, 2008/56/EC	Marine environment GES	2008
Maritime Spatial Planing Directive, 2014/89/EU	Spatial governance in marine environment	2014

In practice many of the marine pollution issues - oil spills, ballast water discharge requires joint action. The absence of clearly dominating and coordinating authority leads to delays and unclear accountability, institutional fragmentation weakens timely monitoring and control mechanisms. Although EEA collects monitoring data on marine environment ordered by BSBD and EAMA conducts ship inspections there is not a mechanism for an exchange of information which creates a gap in detection of pollution especially in cases of illegal discharges or non-compliance by vessels.

EU addresses marine environment most notably through MSFD [9] and WFD [10] MSFD establishes a comprehensive approach to protection of marine waters reqireing from Member States to acieve „Good environmental Status“ (GES) via ecosystem based management, monitoring programmes and policy measures, transborder coordination in the same regions such as Black Sea. Water Framework Directive (WFD, 2000/60/EC) provides water management on river basin principle , assesment of the quality, recognising that inland and coastal waters are connected. WFD also establishes prevention of water deterioration, water biodiversity and pollution control at the source.

Black Sea region is also addressed by EU strategic approach which is based on three pillars – security and stability, economic development, environmental protection and resilience. The environmental pillar emphasizes on the importance of climate adaptation, pollution control and ecosystem restoration with focus on environmental sustainability. The effectiveness of this current strategy is limited by funding, technological capacity and coordination at regional level.

TABLE 5 REGIONAL DOCUMENTS FOR PROTECTION OF MARINE ENVIRONMENT

Document	**Black Sea regional documents**	
	Description	***Year***
Buchares Convention	Regional framework at basin level	1992
Black Sea Biodiversity Protocol	Bidiversity conservation	2002
Black Sea Strategic Plan	Pollution reduction	2007
Black Sea Monitoring and Assessment Plan	Initial monitoring for the basin	2009

Bucharest Convention at the Black Sea level sets the main guidelines for prevention, reduction and control of marine pollution, conservation of biodiversity, restoration of ecosystem services [12]. Convention and associated protocols provide cooperation among Black Sea countries and advisory groups have been established to provide coordinated regional action. Advisory groups participation and reporting in Bulgaria is divided between several organizations – BSBD (MOEW), EAMA (MT), Institute of Oceanology – Bulgarian Academy of Science, Ministry of Regional Development and Public works.

Environmental security does not have a definition in the Bulgarian legal framework. National regulation includes EU directives transposed into Bulgarian presented in Table 6.

TABLE 6 NATIONAL REGULATIONS FOR PROTECTION OF MARINE ENVIRONMENT

Document	**National regulations**	
	Description	***Year***
Environmental Protection Act	Environmental protection	2002
Water Act	Protection of water resources on basin principle	1999
Maritime Spaces, Inland Waterways and ports of Republic of Bulgaria Act	Regulates Bulgarian maritime zones, inland waters, navigation and ports.	2000
Biodivercity Act	Protection of biodivercity	2002
Black Sea Spatial Planning Act	Framework for maritime spatial planning	2021
Environmental Liability Act	Ecological responsibility, „the pollutant pay“ priciple	2008

Despite all legal framework significant challenges remain in Bulgaria regarding environmental security. The main critical is fragmentation of governance – responsibilities for environmental protection, maritime policy and emergency response are distributed across different institutions. Duplicating the functions delays decision making and leads to inefficiency in case of incidents, disasters, accidents and other emergency situations. Also the lack of use of modern technologies proven for remote monitoring – drones or access to satellite images not used. The advantages of drone technology – high mobility, ability to reach dangerous and restricted locations, reduction of risk in emergency situation, time and cost effective as well as improved coordination between different institution involved make them a key element of environmental security [13], [14].

The environmental protection of Black Sea region is a complicated and challenging process with regulatory fragmentation especially in the current geopolitical situation. Military activities on the territory of Ukraine introduced new risks including oil spills from damaged infrastructure and vessels, chemical contamination, noise pollution and marine litter. These threats need to be adequately addressed by current legal frame [15]. Environmental security in the Black Sea requires an integrated governance approach combining legal harmonisation, institutional coordination and regional cooperation [16], [17].

First key element needed for development of environmental security in Bulgaria is legal harmonization to ensure consistency of national law international agreements. Second key is strengthening national coordination, improved communication and collaboration of competent authorities. Third key is monitoring and modern technology – drones, satellites to support decision making at incidents, disasters, accidents and other emergency situations.

IV. CONCLUSIONS

Environmental security and marine ecosystem protection in Bulgaria represents a complex and evolving challenge formed by vulnerability, geopolitical instability, regulatory fragmentation and overlapping responsibility. Although an international and EU comprehensive legal framework is established, significant gaps remain in the implementation and coordination at national level. A need has been revealed for the key requirements to go beyond the existing regulation to achieve real environmental security. Addressing these challenges requires an integrated governance approach that combines legal harmonization, institutional coordination and technology implementation. A comprehensive system on environmental security in Bulgaria needs to focus on several key elements -harmonization of law, institutional coordination, accountability and investment in modern technology for distance monitoring and observation. Strengthening the environmental security system of Bulgaria will contribute to stability and sustainability of the Black Sea region.

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