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**SUSTAINABLE ENVIRONMENTAL MANAGEMENT  
OF THE BLACK SEA**

Boian Koulov, Ph.D.  
Senior Research Fellow  
Institute of Geography  
Bulgarian Academy of Sciences

**Abstract**

The main goal of the study is to possibly identify a geographic principle, on which environmental management of marine regions should rest. For this purpose, the paper focuses on the compatibility between the Black Sea water body and the geographic scale of its environmental management.

With the accession of Bulgaria and Romania in 2007, the Black Sea became an EU border. Its environmental status, however, has been long seen as unsatisfactory. The investigation analyzes critically the state-based approach of the 2008 EU Marine Strategy Framework Directive and reviews some of the problems that arise from its implementation to the geographic system of the Black Sea. The study applies cybernetic and geographic approaches to suggest that the environmental sustainability of a marine water body strongly depends on the geographic congruence between its watershed and the particular environmental management system. In this view, a watershed-based approach would be more suitable for the EU marine strategy, not just because it is less restricted by state boundaries. It is also able to more efficiently integrate the efforts of the real stakeholders.

Integrated watershed-based management of Black Sea environmental sustainability involves a re-definition of the geographic borders of this interstate cooperative process, as well as raising the degree of cooperation that needs to be achieved. The new borders determine a much wider set of countries which should necessarily participate in the Black Sea environmental management system, in addition to the littoral states. Further, it allows cooperation among the interested parties to reach the level of integration of their efforts within a joint Black Sea environmental management system.

An active interstate cooperation to protect the Black Sea environment has united the six littoral states (Bulgaria, Georgia, Romania, Russia, Turkey, and Ukraine) at least since 1992, when they signed the Bucharest Convention (Convention 1992). In 2007, the eastward expansion of the European Union (EU) reached the Black Sea and raised the issue of its protection and sustainable use officially to an all-Europe level. The same year, the EU further developed its European Neighborhood Policy with the “Black Sea Synergy” initiative, which stressed the environment, fisheries, and maritime policy as some of the main areas of trans-boundary regional cooperation (Black Sea Synergy 2007). The next year, the EU Marine Strategy Framework Directive accepted the Black Sea, which is facing an “unprecedented ecological disaster” (Fight... 2008), as the fourth EU marine region, in addition to the Mediterranean, the Baltic Sea and the North East Atlantic (Directive 2008/56/EC). The EU will need to adapt the existing institutional cooperation structure to achieve the necessary environmental criteria and enhance regional security at its borders. Bulgaria and Romania - the only EU members, which are also Black Sea littoral states - will have to set the example and lead in setting up a sustainable environmental management system of this marine region.

A major political geography aspect of the interstate cooperation in the Black Sea environmental management involves identification of the external, as well as internal, geographic borders of the process. Definition of boundaries, within which the managing sub-system fully corresponds to the managed sub-system, is a necessary condition for its efficient functioning. Such borders will determine the countries which should necessarily participate in the Black Sea environmental management system, the type and possibly the level of their participation, as well as the degree of cooperation that they need to achieve.

Thus, the main goal of this investigation is to study from a geographic point of view the compatibility between the Black Sea water body and its environmental management

system. On that basis, it aims to identify principles on which management of the environmental protection of marine regions should rest.

To achieve the goal above, the paper will first reveal and critically analyze the object and the approach of the 2008 EU Marine Strategy Framework Directive – the waters of the individual member-states. Next, the paper will review specific characteristics, including unique features, of the Black Sea and reveal some problems for its sustainable environmental management, which stem from the current state-based management approach. Finally, this paper will propose the integrated watershed-based approach to environmental management, as a way to improve its efficiency.

### **The 2008 Marine Strategy Framework Directive: A State-based Approach to Environmental Management**

The 2008 EU Marine Strategy Framework Directive aims at achieving good environmental status of the marine environment by the year 2020, per EU-approved criteria, through the development and implementation of respective environmental protection strategies. The Directive instructs the strategies to apply an ecosystem-based approach to the management of human activities, i.e., to manage the anthropogenic pressures and impacts that center on the specific marine ecosystem (Directive 2008/56/EC, Paragraphs 8 and 44). The Directive itself, however, is methodologically rather contradictive (E.g., see Article 15 from the Preamble and Chapter 1, Article). Rather than ecosystem-based, its approach is decisively state-based.

The Directive classifies its assumed object - EU marine ecosystems - in three different types: waters under the sovereignty and jurisdiction of member states, waters under sovereignty and jurisdiction of other states, and waters outside state sovereignty and jurisdiction (Directive 2008/56/EC). Next, instead of requiring respective strategies designed from the point of view of each specific marine ecosystem and prepared with the help of the

respective group of stakeholders, the Directive instructs each EU member to develop its own marine strategy and determine a set of “good environmental status” characteristics for its own waters (Directive 2008/56/EC, Article 11).

Marine ecosystems, however, generally belong to more than one state, so marine strategies have to be necessarily trans-state. Separate state-base strategies will hardly be efficient. Furthermore, marine ecosystems are divided ad hoc in zones and only the Contiguous Zone and the Exclusive Economic Zone are targets of the Marine Strategy Framework. The rest of the ecosystems are subject to regulation by two other sets of legal documents: the Community Water Policy – for the territorial sea waters, and the United Nations Law of the Sea – for the, so called, “high seas” (Directive 2008/56/EC; Directive 2000/60/EC). Designed from the point of view of state governance, these regulations serve a number of diverse interests, which may or may not coincide with protection, preservation, and restoration of marine environments. Such an approach certainly contradicts the principles of integrated ecosystem management.

Additionally, the Directive extends excessively large leeway to the individual member states to decide whether there is “significant risk to the marine environment”, or whether “the costs would be disproportionate...” (Directive 2008/56/EC, Chapter 1, Article 2.2). Due to the quite different economic, social, and cultural levels of EU member states, their governments are likely to have significant difficulties justifying these kinds of decision on the basis of environmental problems in an area, which could be quite removed from their particular jurisdiction, cultural sensitivities, or political agenda. Finally, the Directive fails to recognize that environmental security is an increasingly important aspect of state and regional security and, in fact, excludes national security activities from its scope of application.

The 2008 EU Directive does call for the individual state strategies to reflect the “overall perspective of the marine region or sub-region concerned” (Directive 2008/56/EC,

Article 11), which is a step in the right direction. It also acknowledges the transboundary nature of the marine environment and encourages coordination among member states and third countries, as well as using the already established institutional structures and in particular Regional Sea Conventions. (see Directive 2008/56/EC, Article 13). While these Conventions are certainly good examples of interstate environmental coordination and a promising basis for future work, the Directive state-based approach stakes the success of the respective strategies on coordination among a large number of very different actors - member states, non-EU members, inter-governmental, and non-government stakeholders. Moreover, they will have to abide by EU-devised environmental criteria, methodological standards, and requirements for their joint implementation. Even with EU assistance, implementation of such a convention seems rather problematic.

The state-based approach is certainly a necessary and useful tool for energizing and mobilizing the full potential of the individual countries at the initial stage of planning a marine environmental strategy. However, the challenges of coordination such an endeavor among a multitude of actors with diverse capacities, often with conflicting interests, can hardly be overlooked. Moreover, the sheer magnitude of the geographic scale of marine bodies plus the land areas that affect them, as well as of the enormity of the possible effects of their deterioration, suggest that sustainable environmental management of marine environments can only be achieved at supra-state level. The Marine Strategy Framework only suggests the possibility of EU action at Community level (Directive 2008/56/EC, preamble paragraph 43), but does not seem to have accepted it philosophically and methodologically. Instead of focusing on the health of the whole marine ecosystems, as stated, its basis is the environmental management of separate parts of them: jurisdictional marine areas of individual states.

## **The Challenges of Application of the State-based Approach to the Black Sea**

The state-based approach already has a significant history in the Black Sea environmental management process, dating as far back as at least the Bucharest Convention on the Protection of the Black Sea against Pollution (Convention 1992). The 2008 European Marine Strategy Framework Directive calls for the six littoral states to raise the level of their environmental cooperation and produce a Black Sea Strategy, which will include a Community-wide set of comparable environmental criteria, methodological standards, and requirements for their joint implementation (Directive 2008/56/EC, Article 25). The study of the specific characteristics of the Black Sea, however, demonstrates that the use of a approach, focused on state's Contiguous and the Exclusive Economic zones, will face significant challenges.

First, the Black Sea ecosystem is largely defined by the upper, 150 to 200 meters deep, aerobic layer of the water body. A unique quality of the Black Sea is that it contains the largest anoxic water body in the world. About 90 percent of its total water mass of 538 124 cubic meters (Практическая 1990) is virtually “dead.” The complete lack of oxygen is combined with the presence of the poisonous gas “hydrogen sulfide,” formed by bacterial reduction of sulfates. The anoxic part of the water body is situated at the sea floor and ends about 150 to 200 meters below the surface.

At the same time, Black Sea is the largest water body in the world with permanent stratification of its water layers (Михова 2002). While thermo-haline circulation brings oxygen even to the greatest depths in the other seas and oceans, in the Black Sea, even during large storms and despite the winter cooling, the maximum direct vertical mixing is limited to about 150 meters (Блатов и др., 1984). A decreasing mixing is noticeable down to 150-200 meters and oxygen and aerobic organisms are found only to that level. The higher salinity and greater density of the bottom layers limit water circulation below the 200 m horizon. Only the very limited inflow of water from the Sea of Marmara plays a role in the vertical water

exchange below the 200-meter upper layer of the Black Sea. Rozhdestvenskii's research shows that the full water exchange of the deeper waters takes about 480 years (Вълканов и др. 75-78).

A third specific feature highlights Black Sea hydro-morphology, which is very close to that of a lake: the narrow (about 0.7 km minimal width) and shallow (a minimal depth of 27.5 m) Bosphorus Strait determines a very low flushing rate. The upper, oxygenated sea layer provides the outflowing water and, on balance, the Black Sea is losing twice more oxygen-rich water to the Mediterranean than it is gaining (Вълканов и др. 69).

Thus, for most useful purposes, the Sea is, in fact, rather "shallow," which increases the exposure of the ecosystem to both natural hazards and anthropogenic pressures, lowers its resistance and elasticity to stress, and makes it much more vulnerable than an "average" marine ecosystem. A number of authors (e.g., Ozsoy et al. 1997, xix) point out that, compared to the other EU marine regions, like the Baltic and the North Seas, the Black Sea can offer little resistance to degradation.

Finally, this relatively shallow marine ecosystem has an extremely large watershed. The very high watershed to water surface ratio - over 5:1 - allows the Sea to collect "ten times more water per square meter of surface area than other seas" (Carter 1997, 61). Almost a third of continental Europe, including the second-to-fifth-largest rivers (the Danube, Dneper/Dnipro, Don, and Dniestr/Dnister), drains into the Black Sea. The Danube watershed alone (817 000 square km) is almost twice larger than the surface area of the Black Sea (431 000 square km), while its water input (on average around 202 cubic km per year) is about two thirds of the total river inflow (Atlas 2003). Fresh and oxygenated river waters, as well as load, are by far the largest input in the Black Sea ecosystem. The sedimentation layer on the Sea floor is ten times thicker than in the Atlantic (Мишев и др. 41). The large

discharges of the above rivers determine their high capacity to carry transported material, including different polluting substances.

According to Aubrey (1995) and Mee (1998), eutrophication is the main factor for anthropogenic damage in the Black Sea. It results mostly from the decreasing water discharge and increasing nutrient delivery by the rivers and, to a much lesser extent, atmospheric transfer (Black Sea TDA, 1997, iv). The large increases in water use in the watershed - for irrigation, urbanization, industrialization, and tourism development – has led to sharp reduction of fresh water input (Mandysh et al 1991; Bronfman and Khlebnikov 1985). Hanley (1990) estimates that dams and irrigation projects reduce the freshwater influx by about six percent (50 cubic kilometers) of the total water inflow annually. The resulting increase in anaerobic conditions includes the much thinner aerobic zone and classifies the Black Sea as an exceptionally ecologically-sensitive water body (Михова 256).

In summary, the unique combination of the features which characterizes the Black Sea describes a marine ecosystem, which is, effectively, much smaller in size, than the actual water body, relatively shallow, and hosted in a surface layer of water with salinity (around 17 per mil) twice lower than the global ocean. This ecosystem is exceptionally dependent on the much larger watershed, which provides the majority of the inflow of fresh, oxygenated water, but also its pollution. Some of the most polluted European rivers flow into the Black Sea. The Danube alone carries at least 75 percent of the waste water discharges (measured by BOD), 66 percent of the total phosphorus, and 53 percent of the total nitrogen discharge entering the Black Sea (Keondzhayan, Kudina, and Terehena 1990, cited in Broadus et al. 1994, 40; Black Sea Transboundary... 1997, iv).

The Black Sea ecosystem is dependent to an extraordinary degree on the environmental health of its watershed. At the same time, most of the watershed and the most significant sources of man-induced environmental problems lie outside the territories of the

six coastal states. Signatories to the 1992 Convention and members of the World Bank- and UN-sponsored Black Sea Environmental Program (Strategic... 1996), Bulgaria, Georgia, Romania, Russia, Turkey, and Ukraine have significant experience with state-based approaches to environmental management and cooperation. While these states stand to suffer the most from the degradation of the Black Sea ecosystem, eighteen countries (Albania, Austria, Belarus, Bosnia and Herzegovina, Croatia, the Czech Republic, France, Germany, Hungary, Italy, Luxembourg, Moldova, Poland, Slovakia, Slovenia, Switzerland, Serbia and Montenegro) own parts of the watershed and use or affect Black Sea ecosystem resources, but are not yet identified as parties responsible for their sustainable management. Implementation of the precautionary principle, the principles that preventive action should be taken, that environmental damage should, as a priority, be rectified at source and that the polluter should pay, needs to meet geographic realities.

### **Border and Order: Political Geography Aspects of Environmental Management Systems**

The 2008 European Marine Strategy Framework imposes a state-based concept of environmental management of marine ecosystems, which limits international cooperation solely to the coastal states. Public and private users of ecosystem resources and services are sometimes situated far from the sea, where pressures they cause actually cumulate and multiply. Therefore, they often do not feel responsible to the degree necessary to participate in the environmental protection and rehabilitation activities.

Currently, most environmental management systems are created, financed, and operated predominantly at the state level. As a result, they are relatively inflexible, hierarchical, and exclusive. Quite often, environmental management systems use the state's regular administrative-territorial divisions to administer natural ecosystems' protection,

rehabilitation, and sustainable use, ignoring their natural boundaries. This geographic discrepancy between the damaged or endangered nature areas and the systems which manage them produces disputable results and invariably decreases the effectiveness and efficiency of environmental management.

Cybernetics advises that, within any management system, the scale of the managing sub-system should correspond with that of the managed sub-system. Therefore, the application of an ecosystem-based approach to environmental management necessitates, first, bringing the external boundaries of the managing subsystem in congruence with those of the managed subsystem. Scientific discussions may take place over where the borders of a marine ecosystem lie and they will certainly be affected by the purpose for defining the managed region; however, the ecosystem borders have to include all areas of a water body, rather than only those, over which states have some jurisdiction or power.

In terms of the environmental management, marine ecosystems are significantly different from terrestrial ones. Their higher dynamism makes their environmental status much more dependent on the surrounding territory where most pressures and impacts originate. Furthermore, surface and, to a lesser degree, ground waters that connect to the marine ecosystems play the role of transport infrastructure for the majority of the pollution that affects seas and oceans. For this reason, the environmental management of marine ecosystems should resemble much more that of river ecosystems, i.e., it should be watershed-based, rather than rely on the immediate coastal areas only. In the Black Sea case, the application of such principle is even more relevant, given the, above mentioned, extraordinarily large dependence of that particular marine ecosystem on its watershed.

Thus, effective management of the Black Sea ecosystem requires the inclusion of the whole sea watershed, as well as the participation of all and any stakeholders to the degree to which they own, use or affect the territory within these limits. A hierarchically flatter, open,

functionally dynamic, and spatially flexible management structure will be able to make better use of the wealth of specific knowledge and long practical experience they possess, as well as their direct interests in the protection and sustainable use of the local resources. More importantly, the inclusion of eighteen more states to the six, which already participate in Black Sea environmental management, would make a very significant difference, which could prove crucial to this ecosystem's environmental health.

Another political geography aspect of the application of the ecosystem-based approach to environmental management of the Black Sea presents itself in identifying internal boundaries within the respective marine region, to be of use specifically for management purposes. Aquatic regionalization is little researched in Black Sea geography and marine studies and certainly not for environmental management purposes. Due to economic and utilitarian reasons, very few investigations part with the state-based concept and study the Sea as a whole (but see Черно море 1978). Everyday marine activities also follow the respective political administrative marine zones. The 2008 Marine Strategy Framework, however, suggests the relevance of marine sub-regions and, in the Black Sea case, the proposition of a Northwestern marine sub-region seems rather useful from an environmental management point of view. The goal is to propose a sub-region, which will concentrate environmental activities in the Black Sea region and where environmental rehabilitation and protection will bring maximum benefit to the whole marine region at least cost. Furthermore, fewer countries, mostly EU members will have to cooperate in the sub-region, which will facilitate the environmental management process.

The Northwestern Black Sea Sub-region is a large, self-contained area in the respective part of the Sea region. Its designation as sub-region is mainly due to the extremely strong influence of the rivers in the northwestern part of the watershed. According to Михова (251), the rivers flowing in this marine sub-region (Danube, Dnepr/Dnipro, Dniester/Dnister,

and other smaller rivers) discharge about 97 percent of the total annual river input (338 cubic km) in the Black Sea. River discharge, especially from the Danube, provides the most significant share (42 percent) of water inflow and, respectively, the pollution in the Black Sea, which would fully justify the application of this sub-region for a designated pilot project under direct EU supervision and funding (Directive 2008/56/EC).

The Northwestern Black Sea Sub-region is naturally shaped like a bay. It is enclosed by land on all sides, except for its southeastern marine boundary, which, according to this proposition, should connect Cape Sarich, the southernmost tip of the Crimean Peninsula in Ukraine, with Cape Kaliakra in Bulgaria. The 14-degree mean annual temperature of the surface water isotherm almost completely coincides with the thus outlined boundary. About 90 percent of the sub-region is within the shelf zone, which reaches its maximum width of 200-250 km here (Мишев и др. 36). This fact explains also to the higher biological productivity and biodiversity of the selected sub-regional ecosystem.

Among the physical geography characteristics which distinguish the Northwestern Black Sea Sub-region is the lowest salinity in the Sea (13 to 15 parts per thousand), due to the high river discharge. The hydro-dynamics of the Black Sea Northwest also facilitates the description of the area as a sub-region with its own gyre, formed by the surface currents to the North of the Western Black Sea Cyclonic Current (Вълканов и др. 74). The Azov Current, which travels to the west of the Kerch Strait, splits in two after passing to the south of the Crimean Peninsula: its northwestern arm goes towards the town of Odessa, Ukraine, joins the “river” current and continues south. A part of the powerful “river” current runs into the Crimean Current, which goes toward the town of Varna, Bulgaria and returns east to form the southern arm of the northwestern gyre.

The described specific combination of physical geography features possesses enough internal homogeneity and differs sufficiently from the neighboring aquatory to sanction the

designation of this section of the Black Sea marine region as a separate Northwestern Sub-region for environmental management purposes. This sub-region includes marine waters under the jurisdiction of Bulgaria, Romania, and Ukraine – the last one being the only non-EU member state – and qualifies uniquely to serve as a pilot sub-region in the meaning of Article 14 of the EU Marine Strategy Framework (Directive 2008/56/EC). Even if the catchment-based principle is applied, the majority of participating states are EU members, which should facilitate their cooperation.

A third political geography aspect of the ecosystem-based environmental management of the Black Sea concerns the structure of the managing system - the interconnectedness level - or the degree of cooperation among the participating elements. The existing system stresses cooperation in the name of the environmental status of the Black Sea among EU member states, as well as between EU and non-EU countries. However, the scale and level of complexity of the managed marine ecosystem are very high. The situation with the managing sub-system is quite similar. It already includes a large number of states with different interests, priorities, economic potential, environmental legislation, and culture. Its complexity is only bound to increase, if the watershed-based environmental management principle is applied. The number of stakeholders and the level of their inclusion in the management process are going to rise even more. Internal regionalization and the use of a marine sub-region as a pilot project supported by the EU can certainly postpone a management crisis, but only for some time. After a certain threshold, the complexity of the management system becomes a limiting factor to its efficient functioning.

What is needed is a higher level of integration – much closer interconnectedness among the elements of the managing sub-system - which can hardly be achieved on the state scale. In the case of the largest and most complex ecosystems, like the marine bodies, the EU

would have to support the involved stakeholders to create special supra-state bodies to protect, rehabilitate, and regulate the sustainable use of their resources.

## **Conclusion**

Environmental management principles, like the ecosystem-based approach and the watershed-based cooperation are present in the 2008 EU Marine Strategy Framework Directive, however, due to its fundamentally state-based ideology, they lack a logical, scientific connection and, at times, even contradict each other or other principles in this document. The specific characteristics of the Black Sea ecosystem and, particularly, its high dependence on the respective watershed, suggest difficulties in the application of state-based approaches to environmental protection and sustainable resource use. The use of an integrated watershed-based principle would increase management efficiency and raise the level of environmental cooperation among all interested parties to integration of their efforts, so that they can aptly respond to the natural complexity and the anthropogenic challenges that the Black Sea ecosystem faces.

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