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Overview of monitoring programs, gaps identification, and research needs at Black Sea region

Common borders. Common solutions.

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Acronyms

BS	Black Sea
BSBD	Black Sea Basin Directorate
BSC	Black Sea Commission
BSIMAP	Black Sea Integrated Monitoring and Assessment Program
BQE	Biological quality element
DeKoS	Project “Determination and Classification of Marine and Coastal Water Quality Status, (2011-2014)”
DİSSP	Project “Standardization in Marine Monitoring Project (2015-2016)”
EEA	European Environmental Agency
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EQRs	Ecological Quality Ratio
EU	European Union
GES	Good Environmental Status
GD	General Directorate
MSFD	Marine Strategy Framework Directive
MarinTurk	Project “Capacity Building on Marine Strategy Framework Directive in Turkey (2015-2018)”
MI-UAL	Materials Institute- Underwater Acoustic Laboratory of TÜBİTAK-MRC
MoAF	Ministry of Agriculture and Forestry replacing MoFWA (2018-)
MoENR	Ministry of Ecology and Natural Resources of Ukraine
MoEU	Ministry of Environment and Urbanization (2011-)
MoFWA	Ministry of Forestry and Water Affairs (2011-2018)
MoEF	Ministry of Environment and Forestry (Before 2011)
MoH	Ministry of Health
MoTI	Ministry of Transport and Infrastructure
MRC	Marmara Research Center of TÜBİTAK
NIMP	Project “National Integrated Monitoring Programme (DEN-İZ)”
MRU	Marine Reporting Unit
NIS	Non-indigenous species
RBMP	River Basin Management Plan
RSCs	Regional Sea Convention (s)
SMMP	State marine monitoring program of the Black and Azov seas
SEA	Strategic Environmental Assessment
UNEP/MAP	United Nations Environment Programme / Mediterranean Action Plan
VMS	Vessel Monitoring System
WFD	Water Framework Directive

Executive summary

This Report has been prepared as part of the ANEMONE Project “Assessing the vulnerability of the Black Sea marine ecosystem to human pressures” funded through the Joint Operational Programme Black Sea Basin 2014-2020. The report includes a review of the national marine monitoring programmes of Bulgaria, Romania, Turkey, and Ukraine. Information is presented on the policy/legal frameworks of monitoring and the national management specifics, types of implemented monitoring, measured parameters, monitoring networks, spatial and temporal coverage of available data, which are examined against the requirements of the European Directives - Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD,) as well as the regional Black Sea Integrated Monitoring and Assessment Program (BSIMAP.)

A chapter is dedicated to the updated MSFD requirements through the revised MSFD Annex III on the indicative ecosystem elements, anthropogenic pressures and human activities relevant to the marine waters and the new Commission Decision on Good Environmental Status (COMMISSION DECISION (EU) 2017/848 of 17 May 2017), which sets up the revised criteria, methodological standards, specifications and standardized methods for the monitoring and assessment of the marine environment.

National reviews reveal gaps at all levels - legal frameworks and implementation, institutional capacity and cooperation, scientific and technological methodologies for monitoring and assessments, spatial and temporal coverage of available data, integrated assessment approaches. Based on the gap analysis, the research needs are outlined, and recommendations are produced, which take into consideration the requirements of the MSFD to provide for knowledge-based decision-making.

The report contains 27 tables and 14 figures aiming to present the information collected.

In addition to the main text, Annexes 1 & 2 provide the detailed Monitoring Fact Sheets on selected qualitative descriptors of the marine environment as an example of marine monitoring programmes developed in Bulgaria and Romania to strictly meet MSFD requirements.

1.Review of the existing national marine monitoring programmes

1.1. Review of the existing monitoring programmes in Bulgaria

1.1.1. National legal framework

The provisions of the Bulgarian national water policy are outlined in a range of legal documents including laws, regulations, river basin management plans and marine strategy. The assemblage of these instruments' transposes altogether 19 EU Directives that provide the Community legal framework for water resources management and protection. Below, the main legal requirements of the core documents, which treat water management, the marine waters in particular, are outlined:

Water act (28.01.2000)

The Water Act is the primary legal instrument that regulates the ownership and the management of all waters in the Republic of Bulgaria as a common national natural resource with the purpose to safeguard the surface and ground waters and the marine waters of the Black Sea and thus to prevent or decrease the adverse impact on human life and health, and on the environment.

The Water Act stipulates that the inner marine waters and the territorial sea, including the seafloor within the territorial sea are exclusive state property.

The waters are managed at the territorial scope of river basins by the Minister of Environment and Waters and by the subordinate River Basin Directorates who operate at the level of the river basins. The Black Sea Basin encompasses the catchment areas of the rivers flowing into the Black Sea, the inner marine waters, and the territorial sea.

For each water management basin River Basin Management Plans are developed and include the following main components: the location, boundaries and types of surface water bodies, the reference conditions for the surface water types, overview of the significant pressures and impacts from human activities on the surface water status, the monitoring results for the chemical and ecological status (sensu WFD) of the surface waters, the aims of the water bodies environmental protection and the programme of measures for achieving the aims and for water pollution prevention.

The monitoring of the water's status shall be carried out according to monitoring programmes developed by the River Basin Directorates and approved by the Minister of Environment and Waters and shall provide coordinated and comprehensive evaluation of waters status in each river basin management region. The monitoring programmes shall encompass generally observation on the hydrological and morphological characteristics, and assessment of the ecological and chemical status of the waters.

The monitoring of the ecological and chemical status of the marine waters is carried out by the Institute of Oceanology of the Bulgarian Academy of Sciences.

In addition to the above provisions that transpose the requirements of the WFD, the Water Act requires that the Black Sea Basin Director shall plan, develop, update and report the implementation of a Marine Strategy and a Programme of Measures for achieving good status of the marine environment sensu MSFD.

Law on maritime spaces, inland waterways and ports

The protection of the coastal waters, inner and territorial sea from pollution from other sources except those based-on land is regulated by the Law on Maritime Spaces, Inland Waterways and Ports.

Further details on the implementation of the WFD and MSFD are provided by corresponding national ordinances, which are relevant to the monitoring of the coastal and marine waters.

Ordinance no. 1 of 11 april 2011 for water monitoring

The Ordinance stipulates that monitoring of surface waters and groundwater shall be carried out according to programmes approved by the Minister of Environment and Waters, which are part of the River Basin Management Plan (RBMP) and are developed by the respective Basin Directorate jointly with the Institute of Oceanology in the part of the marine waters monitoring.

The Institute of Oceanology is legally bound to:

1. Carry out the monitoring of the ecological and chemical status of the marine waters, including field measurements and laboratory analyses of the biological quality elements, physico-chemical and hydromorphological parameters and chemical quality elements.
2. Assist BSBD (Black Sea Basin Directorate) in the reporting to the European Environmental Agency (EEA) and in the preparation of the national reports on the EU Water Directive.

Ordinance no. N-4 of 14.09.2012 for characterisation of the surface waters

The Ordinance transposes in particular the requirements of the WFD and provides the methodology, procedures and requirements for identification and characterization of the water types, definition of type-specific reference conditions of the biological quality elements and the physico-chemical and hydromorphological conditions, identification and assessment of the significant human pressures and water status classification in each river basin.

The status of the coastal waters is assessed based on the following quality elements:

1. Biological quality elements:
 - Composition, abundance, and biomass of phytoplankton
 - Composition and abundance of other water flora (benthic macroalgae and seagrass)
 - Composition and abundance of benthic invertebrate fauna
2. Hydromorphological elements supporting the biological quality elements:
 - Changes in depth
 - Seabed substrate
 - Dominant currents
 - Wave action
3. Chemical and physico-chemical elements supporting the biological elements:
 - Water transparency
 - Temperature condition
 - Redox conditions
 - Salinity
 - Nutrients conditions
 - Specific pollutants
 - Other substances with significant inflow to the water body.

The ordinance provides compliant to the WFD qualitative definitions, quantitative thresholds and EQRs for high, good, and moderate status of the biological quality elements, the general physico-chemical conditions and quality standards for the pollutants.

The above listed elements and parameters are obligatory for monitoring in the coastal marine waters.

Ordinance for protection of the environment in the marine waters (23.11.2010)

The Ordinance transposes specifically the requirements of the MSFD. It provides directions and approaches on how to achieve and maintain Good Environmental Status (GES) in the marine ecosystem including the waters, the seabed, the habitats, and the species groups. The Ordinance coordinates all different policies and instruments which target the marine environment and its discrete components. This coordination is achieved through the development and implementation of a national Marine Strategy.

The Ordinance is applicable to the marine waters of Bulgaria including the coastal waters, territorial sea and EEZ.

The competent authorities on the implementation of the Ordinance (MSFD) are the ministers of different sectors (transport, information technologies and communication, agriculture, foreign affairs, regional development, energy, tourism, health) under the leadership of the Minister of the

Environment and Waters. The Black Sea Basin Directorate has specific obligations among which are the planning, development, and approval of the marine monitoring programmes.

The Bulgarian Academy of Sciences is also listed among the competent authorities. In particular, the Institute of Oceanology executes the marine environmental monitoring that is set up in the programmes approved by the Minister of environment and waters.

The Ordinance provides indicative lists of the ecosystem elements, anthropogenic pressures and human activities corresponding to those listed in MSFD ANNEX III that shall be analyzed for the assessment of the marine environmental status.

The assessment of the extent to which GES is achieved is based on the criteria and methodological standards set up by the Commission decision 2010/477/EC. The Ordinance has not been updated yet with the new Commission Decision (EU) 2017/848 on Good Environmental Status and Annex III of the Directive amended in 2017.

Marine strategy of Republic of Bulgaria 2016-2021

The Marine Strategy (MS) was adopted with a Decision of the Council of Ministers No. 1111/29.12.2016. The MS encompasses the following parts:

1. The initial assessment of the current environmental status of national marine waters and the environmental impact and socio-economic analysis of human activities in these waters.
2. The determination of GES for national marine waters.
3. The establishment of environmental targets and associated indicators to achieve GES by 2020.
4. The establishment of a monitoring programme for the ongoing assessment and the regular update of targets.
5. The development of a programme of measures designed to achieve or maintain GES by 2020.

The first three components - initial assessment, determination of GES and establishment of ecological targets were completed in 2012. The monitoring programmes and programme of measures were developed in 2014.

The Monitoring Programmes under MSFD were initially developed in 2014 and updated in 2016 based on improved information, data and knowledge acquired within the Project "Investigations on the State of the Marine Environment and Improving Monitoring Programs developed under MSFD - ISMEIMP" funded through the Financial Mechanism of EEA. The Programmes were aligned with the drafts of the Commission Decision (EU) 2017/848 on GES and Commission Directive (EU) 2017/845 (amended Annex III of MSFD) that were revised during the life of the project ISMEIMP.

Responsible authorities

The responsible authorities for the marine monitoring and assessment are well established by national administrative and scientific bodies as described below.

Effort towards better co-ordination between and within the responsible authorities and other stakeholders of the marine environment has been made through the establishment of Consultative and Coordinative Council to the Council of Ministers on the Marine Strategy and Programme of Measures implementation for achieving good marine environmental status. The Council is chaired by the Minister of Environment and Waters and involves representatives of all connected to the marine environment economic and public sectors:

- Deputy-Minister of Transport, information technologies and communications
- Deputy-Minister of Agriculture and forests
- Deputy-Minister of International affairs
- Deputy-Minister of Regional development
- Deputy-Minister of Economy and energetics
- Deputy-Minister of Health
- Director of the National Agency of Environment
- Director of the Institute of Oceanology
- Director of the Black Sea Basin Directorate
- Director of the Maritime Administration Agency.

1.1.2. National monitoring programmes description

There are two types of marine environmental monitoring programmes developed in Bulgaria: for the implementation of the WFD and the MSFD, respectively. Both are implemented by IO-BAS and coordinated by the Ministry of Environment and Waters through its regional subordinate - the Black Sea Basin Directorate.

In addition to the environmental monitoring:

- bathing water monitoring is under the Ministry of Health, conducted by its regional inspections in Varna and Burgas
- fish stocks monitoring is under the Ministry of Agriculture and Forests, through the National Agency for Fishery and Aquaculture, funded on project basis.

1.1.2.1. Monitoring programme under the WFD

The monitoring programme for the implementation of the WFD requirements is an integral part of the Black Sea Basin Management Plan (2016-2021) and comprising information about monitoring and assessment of the state of surface waters, ground waters and water protection zones.

The objective of the monitoring programme is to ensure complete and objective information on the water state, the level of impact from anthropogenic activities, the risk to not achieve good ecological status, the planning of measures to achieve the ecological targets and an assessment of these measures' effectiveness.

Parameters, indicators and monitoring frequency

The water quality elements that are included in the monitoring program for the marine coastal waters comprise biological quality elements, physico-chemical parameters, priority substances and specific pollutants as required by the WFD. The indicators and parameters, and the monitoring frequencies of the BQEs (biological quality elements) are listed in Table 1.1. The physico-chemical parameters are listed in Table 1.2. Their monitoring frequency is four times per year seasonally.

Table 1.1 - List of indicators and minimum monitoring frequencies of the biological quality elements

Biological Quality Elements in Coastal waters				
BQE	Features	Indicators	Frequency minimum	Seasonality and optimum frequency
Phytoplankton	Trophic Status	TRIX	6 months	Spring, Summer, Autumn (4 times, annually)
	Abundance, species composition	Abundance, species composition		
	Biomass	Chlorophyll a		
		Taxonomic ratio of biomass		
	Abundance	Bloom frequency		
		Concentration of the bloom species		
Macroalgae and phanerogams	Structural and functional characteristics of the community; sensitive species presence	Potentially toxic species and introduced species	3 years	Summer, annually
		Number of species in sample S		
		Shannon-Weaver Diversity Index H'		
	Abundance, sensitive species presence	Ecological Evaluation Index (EEI)	3 years	Summer, annually
		Relative surface index		
	Abundance, sensitive species presence	AMBI, M-AMBI	3 years	Summer, annually

Biological Quality Elements in Coastal waters				
Benthic invertebrate fauna	Biodiversity	Number of species in sample S Shannon-Weaver Diversity Index H'		

Table 1.2 - List of the physico-chemical parameters monitored under WFD

Physico-chemical parameters	
pH	Total N
Temperature	Total P
Salinity	TOC
Suspended substances	Si
Turbidity (FNU/NTU)	Chlorides
Transparency (Secchi disk)	Sulphates
Chlorophyll a	Permanganate oxidation
Eh	Total extractable substances
Dissolved O ₂	Ca
Oxygen saturation %	Mg
BOD5	Total water hardness
COD	Calcium carbonate hardness
NH ₄	H ₂ S
NO ₃	
NO ₂	
PO ₄	

The lists of priority substances and specific pollutants are given in Table 1.3 and Table 1.4, respectively. The monitoring of the priority substances is done according to the Ordinance for the environmental quality standards for priority substances, which transposes into the Bulgarian legislation Directive 2013/39/EC amending the WFD and Directive 2008/105/EC.

The monitoring frequency for the priority substances is once (1 year) during the 6-year management plan period with monthly measurements (altogether 12 times) during the year. The specific substances shall be measured four times per year.

Table 1.3 - List of priority substances monitored under WFD

Priority substances			
No.	CAS number	EU number	Name of priority substance
1	15972-60-8	240-110-8	Alachlor
2	120-12-7	204-371-1	Anthracene
3	1912-24-9	217-617-8	Atrazine
4	71-43-2	200-753-7	Benzene
5	n.a.	n.a.	Brominated diphenylethers*
6	7440-43-9	231-152-8	Cadmium and its compounds
6a		56-23-5	Tetrachloromethane
7	85535-84-8	287-476-5	C10 - 13 chloralkanes
8	470-90-6	207-432-0	Chlorfenvinphos
9	2921-88-2	220-864-4	Chlorpyrifos
9a		309-00-2	Cyclodien pesticides
		60-57-1	Aldrin
		72-20-8	Dieldrin
		465-73-6	Endrin
		n.a.	Isodrin
9b		n.a.	DDT-all
		50-29-3	P, p DDT
10	107-06-2	203-458-1	1,2-Dichloroethane
11	75-09-2	200-838-9	Dichloromethane
12	117-81-7	204-211-0	Di(2-ethylhexyl) phthalate (DEHP)
13	330-54-1	206-354-4	Diuron
14	115-29-7	204-079-4	Endosulfan
15	206-44-0	205-912-4	Flouranthene*
16	118-74-1	204-273-9	Hexachlorobenzene*

Priority substances			
No.	CAS number	EU number	Name of priority substance
17	87-68-3	201-765-5	Hexachlorobutadiene*
18	608-73-1	210-158-9	Hexachlorocyclohexane
19	34123-59-	251-835-4	Isoproturon
20	7439-92-1	231-100-4	Lead and its compounds
21	7439-97-6	231-106-7	Mercury and its compounds*
22	91-20-3	202-049-5	Naphthalene
23	7440-02-0	231-111-4	Nickel and its compounds
24	25154-52-3	246-672-0	Nonylphenols
	104-40-5	203-199-4	(4-(para)-nonylphenol)
	84852-15-3		4-nonylphenol-branched
25	1806-26-4	217-302-5	Octylphenols
	140-66-9	n.a.	(para-tert-octylphenol)
26	608-93-5	210-172-5	Pentachlorobenzene
27	87-86-5	201-778-6	Pentachlorophenol
28	n.a.	n.a.	Polyaromatic hydrocarbons*
	50-32-8	200-028-5	(Benzo(a) pyrene) *
	205-99-2	205-911-9	(Benzo(b) fluoroanthene)
	191-24-2	205-883-8	(Benzo (g,h,l)perylene)
	207-08-9	205-916-6	(Benzo(k)fluoroanthene)
	193-39-5	205-893-2	(Indeno(1,2,3-cd) pyrene)
29	122-34-9	204-535-2	Simazine
29a	127-18-4		Tetrachloroethylene
296	79-01-6		Trichloroethylene
30	688-73-3	211-704-	Tributyltin compounds
	36643-28-4	n.a.	(Tributyltin-cation)
31	12002-48-1	234-413-4	Trichlorobenzenes
	120-82-1	204-428-0	(1,2,4-Trichlorobenzene)
			(1,2,3-Trichlorobenzene)
			(1,3,5-Trichlorobenzene)
32	67-66-3	200-663-8	Trichloromethane (Chloroform)
33	1582-09-8	216-428-8	Trifluralin
34	115-32-2	204-082-0	Dicofol*
35	1763-23-1	217-179-8	Perfluorooctane sulfonic acid and its derivatives (PFOS)*
36	124495-18-7	n.a.	Quinoxifen
37	n.a.	n.a.	Dioxins and dioxin-like compounds*
38	74070-46-5	277-704-1	Aclonifen
39	42576-02-3	255-894-7	Bifenox
40	28159-98-0	248-872-3	Cybutryne
41	52315-07-8	257-842-9	Cypermethrin
42	62-73-7	200-547-7	Dichlorvos
43	n.a.	n.a.	Hexabromocyclododecane (HBCDD)*
44	76-44-8/1024-57-3	200-962-3/213-831-0	Heptachlor and heptachlor epoxide*
45	886-50-0	212-950-5	Terbutryne

* in biota compliant to Directive 2013/39/EC

Table 1.4 - List of specific pollutants monitored under WFD

Organic substances		
Phenols	Tetrachloroethane	Acenophthene
Oil products	Ethylene	Fluorine
Polychlorinated biphenyles	O, m, p-xylene	Pendimethalin
(PCB 28, PCB 52, PCB 101, PCB 105, PCB 118, PCB 138, PCB 153, PCB 156, PCB 180)	Toluene	Tributylamine
EOX (extractable)	Benzo (s) anthracene	Metolachlor
AOX (absorbable)	Pyrene	Vinyl chloride
Prometon	Phenanthrene	Dibenzo (a, h) anthracene
Prometryn	Hrisen	Paration-ethyl
Propazine	Ethylbenzene	Paration-methyl
Ametrin	Styrene	Methoxychlor

Simetryn	Acetone	2,4-D
Dichlor`odifluoromethane	DIBP	Dicamba
Chloromethane	Bentazon	Dimethoate
Bromomethane	DEP	Fenitrothion
Bromodichloromethane	DBP	Fention
1,4 - dichlorobenzene	Linuron	Malathion
1,2 - dichlorobenzene	MCPA	Diazinon
1,3- dichlorobenzene	Acetochlor	Mecoprop
Bromoform	Bisphenol A	
Trans-1,2-dichloroethene	Acafenylene	
Heavy metals and metalloids		
Zn	K	Co
Cu	Na	U
Cr 6 valent	F	Ra
Cr 3 valent	Sb	Total B radioactivity
As	Mg	Total Cr
Se	Al	Fe soluble
Ag	V	Mg soluble
Other		
SPANAN anionic activity	Carbonates	Hydrogen fluoride
Free cyanide	Bi carbonates	Lithium
Sulfides	Vegetable oils	

Water bodies and monitoring networks in the coastal waters

The water bodies are the basic management units for monitoring and assessment of the surface waters status. In the Bulgarian Black Sea, the coastal waters are subdivided into 17 water bodies as shown in Figure 1.1 The delineation is done according to the water typology (based on characteristics such as depth, bottom substrate and wave exposure) and the predominant human pressures that exert impact on the particular area.

The monitoring stations networks are presented in Figure 1.2, Figure 1.3 and Figure 1.4 for the biological quality elements, the physico-chemical parameters and the priority substances in sediments and biota, respectively¹.

The BQEs shall be monitored at altogether 65 stations in the coastal waters: 37 stations for zoobenthos, 22 stations for benthic macroalgae and 6 stations for seagrasses (Figure 1.2).

The basic physico-chemical parameters shall be monitored at 60 stations in the coastal waters, while a subset of 40 stations is designated for the monitoring of the priority substances and specific pollutants in the waters (Figure 1.3).

Finally, there are altogether 15 monitoring stations in the coastal waters designated for monitoring of priority substances in the sediments and biota (Figure 1.4).

¹ Source: https://www.bsbd.org/v2/bg/purb_razdel_4.html

SURFACE WATER BODIES
Black Sea region for rivers basins management

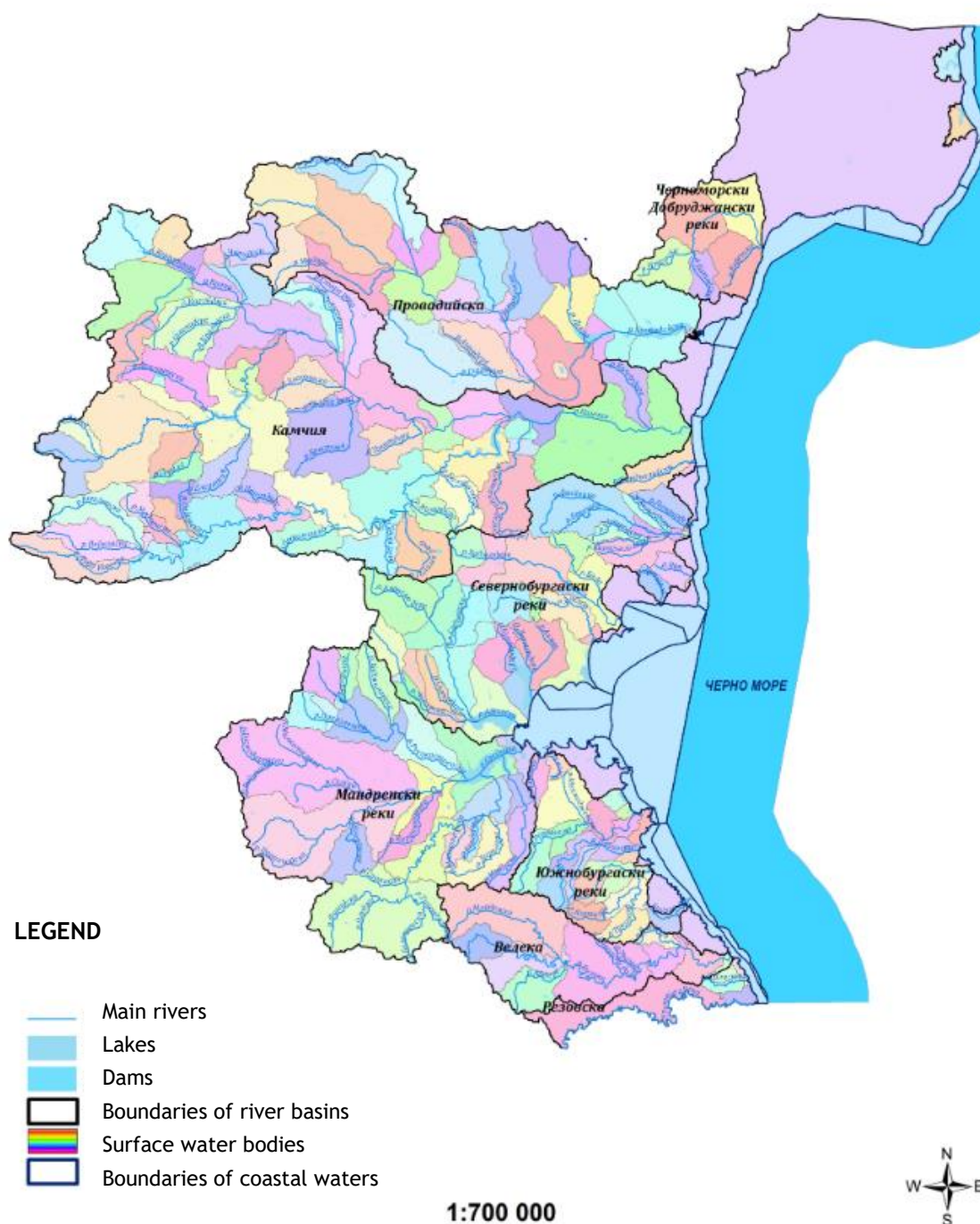


Figure 1.1 - Map of the water bodies in the surface waters of the Black Sea Basin management area

SURVEILLANCE AND OPERATIONAL HYDROBIOLOGICAL MONITORING POINTS OF SURFACE WATERS

Black Sea region for rivers basins management

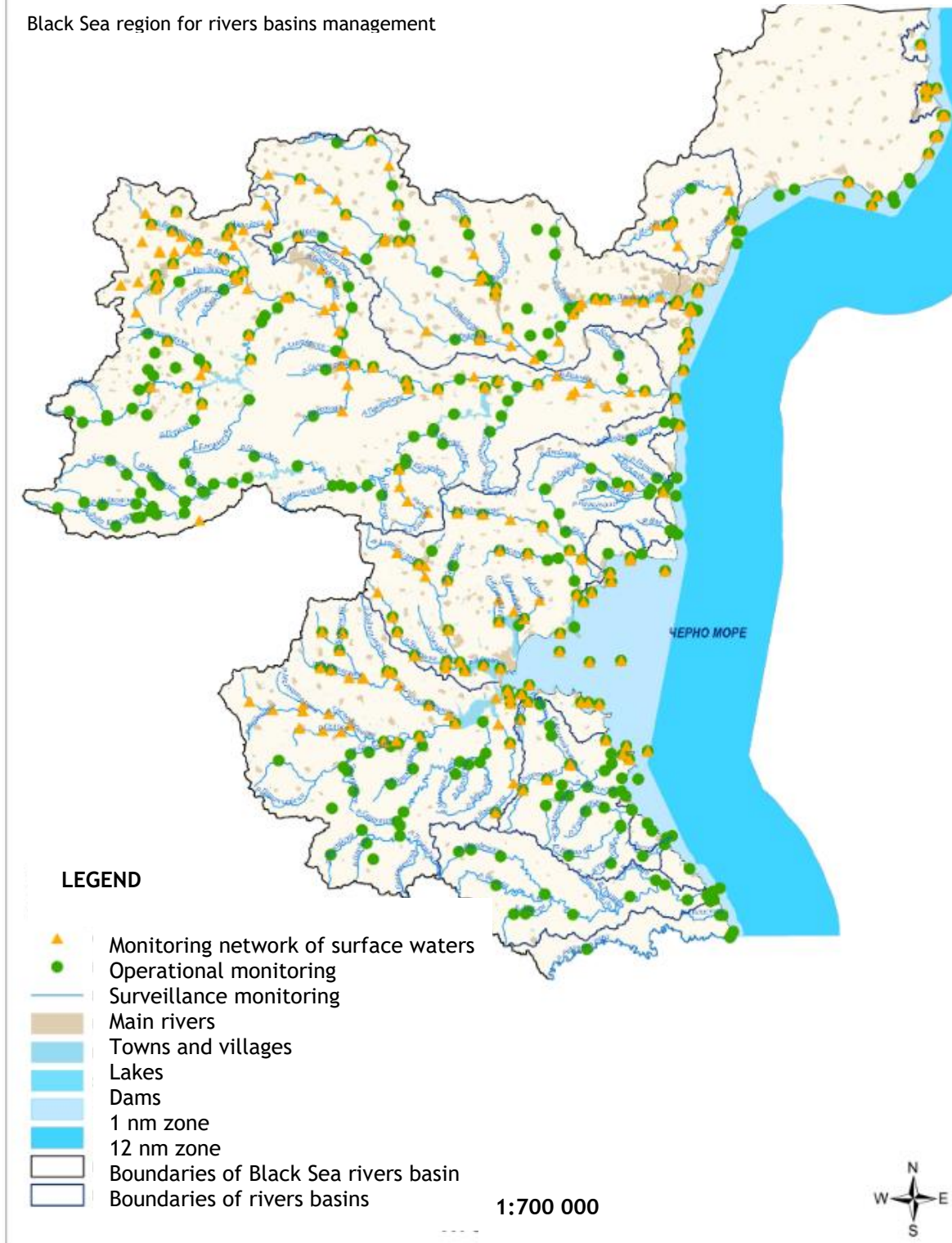


Figure 1.2 - Map of the network of stations for monitoring of the biological quality elements in the surface waters of the Black Sea Basin management area

SURVEILLANCE AND OPERATIONAL PHYSICO-CHEMICAL MONITORING POINTS OF SURFACE WATERS

Black Sea region for rivers basins management

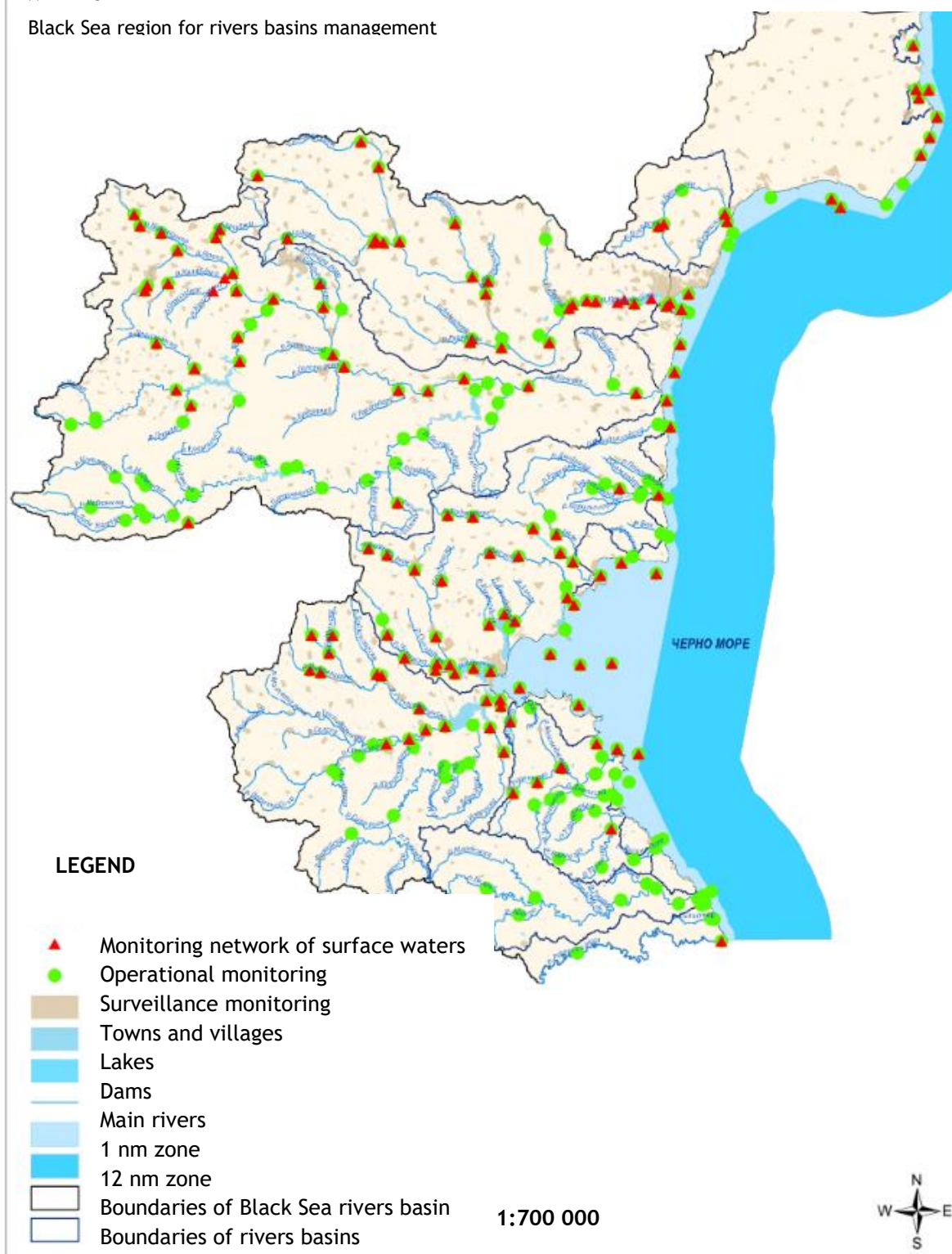


Figure 1.3 - Map of the network of stations for monitoring of the physico-chemical parameters, priority substances and specific pollutants in the surface waters of the Black Sea Basin management area

MONITORING POINTS FOR PRIORITY SUBSTANCES IN SEDIMENTS AND BIOTA

Black Sea region for rivers basins management

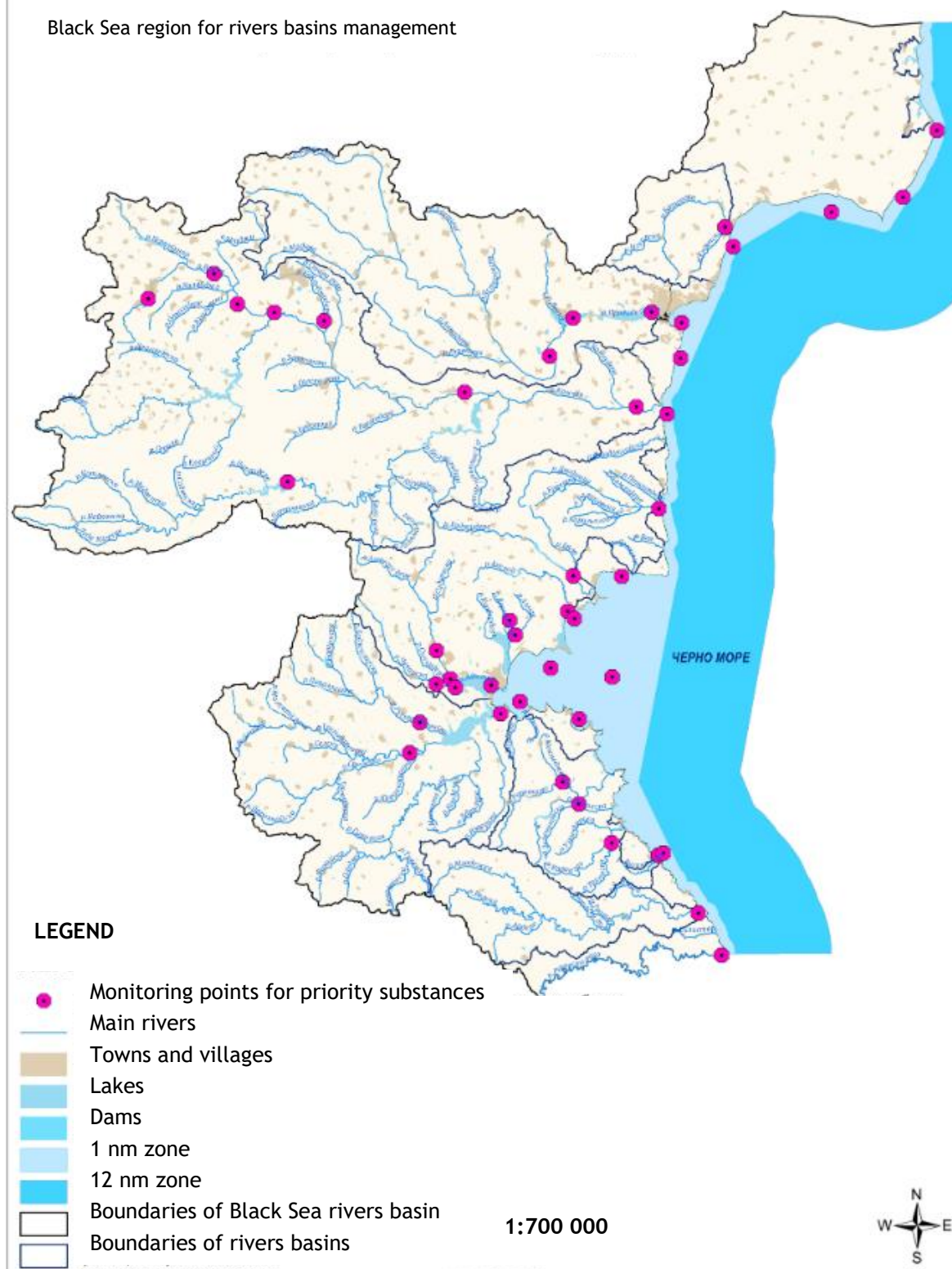


Figure 1.4 - Map of the network of stations for monitoring of the priority substances in the sediments and biota of the Black Sea Basin management area

1.1.2.2. Monitoring programmes under the MSFD

The Monitoring Programmes under MSFD were initially developed in 2014 and updated in 2016 based on improved information, data and knowledge acquired within the Project “Investigations on the State of the Marine Environment and Improving Monitoring Programs developed under MSFD - ISMEIMP” funded through the Financial Mechanism of EEA. The Programmes were aligned with the drafts of the Commission Decision (EU) 2017/848 on GES and Commission Directive (EU) 2017/845 (amended Annex III of MSFD) that were revised in the frame of the project ISMEIMP. Improvement of the programmes was achieved in terms of evolved definitions of GES, selection of relevant indicators under the amended criteria, more accurate qualitative thresholds and environmental targets set, and more representative monitoring networks designated.

There are altogether 13 thematic monitoring programmes developed for the implementation of MSFD listed in Table 1.5².

Table 1.5 - List of Monitoring programmes under MSFD

Descriptor	Monitoring programme under MSFD
1, 4	Biodiversity - Marine birds
1, 4	Biodiversity - Marine mammals
1	Biodiversity - Non-commercial fishes
1, 4	Pelagic habitats
1, 6	Biodiversity - Benthic habitats
2	Non-indigenous species
3	Commercial fish and shellfish
5	Eutrophication
7	Changes in the hydrographic conditions
8	Contaminants
9	Contaminants in fish and other seafood
10	Marine litter
11	Underwater noise

Selected monitoring programmes relevant to ANEMONE project objectives are presented with abridgement in Annex 1 (www.bsbd.org/bg/msfd_monitoring.html). In the Monitoring Fact Sheets complete information is presented regarding the monitoring data acquisition and assessment methods, sampling frequency and networks, parameters, indicators and thresholds where available, all of which monitoring aspects are highly miscellaneous depending on the methodological standards and requirements for different qualitative descriptors and criteria.

Marine reporting units (MRU) under MSFD

The Bulgarian Black Sea territorial waters and EEZ are subdivided into 8 MRUs for monitoring and assessment under MSFD: 5 coastal units, 2 shelf units and 1 open sea unit. These are shown on the map of Figure 1.5 - Map of the MRU under MSFD in the Bulgarian Black Sea and listed in Table 1.6 - Name, code depth range and area of the MRU under MSFD in the Bulgarian Black Sea. Initially, the boundaries between the coastal waters, the shelf area and the open sea are defined based on the pelagic habitats including hydrodynamic characteristics and chl a. The coastal waters are further split according to the hydrographic and morphological characteristics of the seacoast and the seabed, and the lithological and sedimentary characteristics of the seafloor. The shelf area is divided into northern and southern units in relation to the Danube influence and the seafloor morphology and sediments.

² Source: https://www.bsbd.org/bg/msfd_monitoring.html

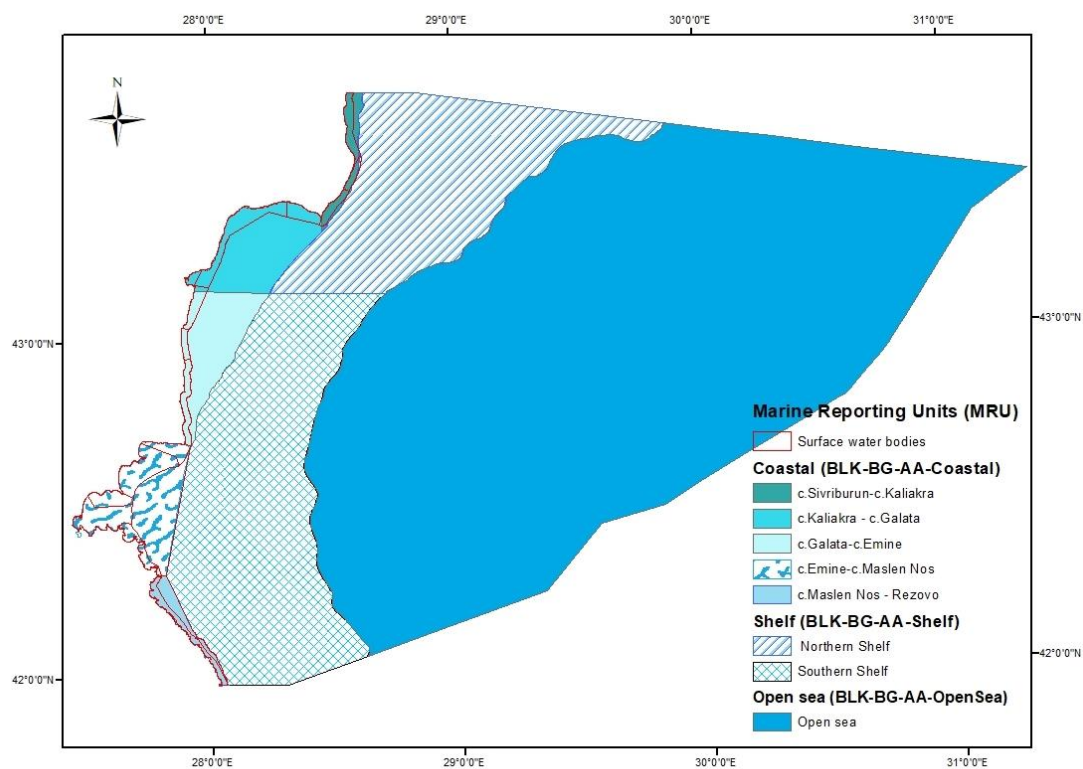


Figure 1.5 - Map of the MRU under MSFD in the Bulgarian Black Sea

Table 1.6 - Name, code depth range and area of the MRU under MSFD in the Bulgarian Black Sea

Name of MRU		Code of MRU	Depth range (m)	Area (km ²)
BLK-BG-AA-Coastal	c. Sivriburun - c. Kaliakra	BLK-BG-AA-Sivriburun Kaliakra	0-30	162
	c. Kaliakra - c. Galata	BLK-BG-AA-Kaliakra Galata	0-30	828
	c. Galata - c. Emine	BLK-BG-AA-Galata Emine	0-30	699
	c. Emine - c. Maslennos	BLK-BG-AA-Emine Maslennos	0-30	856
	c. Maslen nos - Resovo	BLK-BG-AA-Maslennos Rezovo	0-30	155
BLK-BG-AA-Shelf	Northern Shelf	BLK-BG-AA-Northern Shelf	30-200	3879
	Southern Shelf	BLK-BG-AA-Southern Shelf	30-200	5521
BLK-BG-AA-Open Sea	Open sea	BLK-BG-AA-Open Sea	>200	22423

1.2. Review of the existing monitoring programmes in Romania

1.2.1. National legal framework

No proper management of environment protection is possible without a regular and integrated monitoring and without robust scientific understanding of pressures, state, impact, and response of an ecosystem to the measures taken to prevent or mitigate undesirable change. Where there are gaps in monitoring, hence, in data, information and knowledge, there will be always gaps in environmental protection. The environment management approaches, such as the Integrated Coastal Zone Management, the Ecosystem-based and Integrated River Basin Management generated further challenges for scientists and decision-makers.

Ecosystem-based management is concerned with the processes of change within living systems, and with sustaining the goods and services that healthy ecosystems produce, adopting management frameworks that minimize impacts to marine environments while allowing for sustainable development, an integrated approach that recognizes humans are part of and have significant influences on their environments. Ecosystem-based management is therefore designed and executed as an adaptive, lessons-learned process that applies science-based decision-making. Logically, it requires changes in the existing old-fashioned monitoring programmes/systems which have been intended to meet the needs of the traditional management. In this relation, the MSFD stipulates in its Art. 11.1 on Monitoring Programmes: “On the basis of the initial assessment made pursuant to Article 8(1), Member States shall establish and implement coordinated monitoring programmes for the ongoing assessment of the environmental status of their marine waters on the basis of the indicative lists of elements set out in Annex III and the list set out in Annex V, and by reference to the environmental targets established pursuant to Article 10”.

The sustainability of each monitoring program (existing or deemed for upgrade) lies in the acting legal/policy framework of the country implementing it (and of course in its enforcement). Further this chapter gives information on the monitoring-related legal/policy documents developed at different levels and enacted in Romania. As EU Member State and apart from the national legislation, the European legislation is mandatory for implementation. There are also a large number of global and regional agreements which shape various kinds of monitoring activities required to enforce compliance. The MSFD stipulates: “The legislative framework should provide an overall framework for action and enable the action taken to be coordinated, consistent and properly integrated with action under other Community legislation and international agreements”.

The legislative and regulatory provisions governing inter alia the marine and other sea-related monitoring activities (e.g. pressures) in Romania versus the requirements of the MSFD were reviewed in the Diagnostic Report II guiding improvements in the Black Sea monitoring system (Velikova V., et al., 2013). New updated information was compiled and included in this report.

Relevant international (global) level legislation enforced in Romania legal framework is presented in Table 1.7. At European level, apart from the MSFD, for eutrophication, contaminants and contaminants in seafood, the existing EU legislation is the WFD, the Nitrates Directive, the Urban Wastewater Treatment Directive, the revised Bathing Water Directive and the Hazardous Substances Directive. Habitats are covered by the Habitat and Bird Directives and NATURE 2000. Fishery's management is covered by the Common Fishery Policy (CFP). In Romania, the environmental legislation is harmonized with the EU acquis, the actual implementation is reflected in measures taken to improve the environment and various types of monitoring organized to provide the decision-makers with data/information needed for science-based management of environmental protection. National monitoring-related legislation of Romania, transposing European relevant legislation and policies it is presented in Table 1.7.

Table 1.7 - Inventory of environment and monitoring-related national legal/policy documents in Romania

Title of National Legal Act/Policy
Laws ratifying international conventions: Law Nr. 22 of 22 February 2001 ratifying the Convention on Environmental Impact Assessment in a Transboundary Context, adopted in Espoo on 25 February 1991. Law no. 58 of 13 July 1994 ratifying the Convention on Biological Diversity, signed in Rio de Janeiro on 5 June 1992.

Title of National Legal Act/Policy
Law Nr. 265 of 15 May 2002 accepting the amendments to the Basel Convention (1989) on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Law no. 3/2001 ratifying the Kyoto Protocol to the United Nations Framework Convention on Climate Change, adopted on 11 December 1997. Law no. 261/2004 (16 June 2004) ratifying the Convention on Persistent Organic Pollutants adopted in Stockholm on 22 May 2001 (OJ nr.638 / 15.07.2004).
Environmental protection legislation: OUG nr. 195/2005 (MO nr. 1196/30.12.2005) on Environmental protection, approved with amendments by the Law nr. 265/2006 (MO nr. 586/06.07.2006), amended and supplemented by OUG nr. 57/2007 (MO nr. 442/29.06.2007), OUG nr. 114/2007 (MO nr. 713/22.10.2007) (approved by the Law nr. 70/2013), OUG nr. 164/2008 (MO nr. 808/03.12.2008) (approved by the Law nr. 226/2013), OUG nr. 71/2011 (MO nr. 637/06.09.2011) and OUG nr. 58/2012 (MO nr. 706/16.10.2012) (approved by the Law nr. 117/2013).
Water resources related legislation: Law no. 107/ 1996 (Water Law) Updated form of that legislation until 1 January 2012 to include all changes and additions made by: Decision no. 83 of March 15, 1997 repealed by Decision no. 948 of November 15, 1999, Law no. 192 of April 19, 2001, Emergency Ordinance no. 107 of September 5, 2002, Law no. 404 of October 7, 2003, Law no. 310 of June 28, 2004, Law no. 112 of May 4, 2006, Emergency Ordinance no. 12 of 28 February 2007, Emergency Ordinance no. 130 of November 12, 2007, Emergency Ordinance no. 3 of 5 February 2010, Law no. 146 of July 12, 2010, Emergency Ordinance no. 64 of 29 June 2011, Emergency Ordinance no. 71 of 31 August 2011; last update through Emergency Order nr. 78/2017. Order nr. 512/04-06-2018 on the modification and completion of the programme financing Guide for the protection of water resources, integrated water supply systems, treatment plants, sewage and sewage plants approved by the Order of the Minister of Environment and Forests Nr. 1450/2010.
Fishery resources related legislation: Order No. 179/2001 regarding the Registering and transmission of the data related with the marine fishing activity. Government Emergency Ordinance No. 23 /2008 on Fishing Fund, Fishery and Aquaculture, modified by Law No. 114/2016 to amend and supplement the Government Emergency Ordinance No. 23/2008 on fisheries and aquaculture, and Emergency Order No. 85/2016 to amend and supplement the Government Emergency Ordinance No. 23/2008 on fisheries and aquaculture. Order no. 449/2008 regarding the technical conditions for the use of commercial fishing gear and methods admitted to commercial fishing in marine waters and continental.
Pollution sources (pressures) related legislation: GD No 352/2005 (OJ 398, 11.05.2005) amending GD No 188/2002 (OJ 187, 20.03.2002) for the approval of norms concerning the conditions of discharging the wastewater into the aquatic environment. NTPA001 - Norms for setting charging with pollutants of industrial and urban waste from disposal in natural receivers (Regulatory limits on pollutants discharges). GD No. 1360/2005 (MO No. 1061/28.03.2005) for modification and completion of GD No. 964/2000 (MO No.526/25.10.2000) approving the action plan for the protection of water against nitrates pollution from agricultural sources. Governmental Decision H.G no. 1856/2005 (MOF.23/11.01.2006) on the national allowable emissions limits for specific atmospheric pollutants, modified by GD No. 283/2017 to amend the decision of the Government No. 1.856/2005 on national emission ceilings for certain atmospheric pollutants, and Law No. 293/2018 on the reduction of national emissions of certain atmospheric pollutants.
Normatives for the classification of the water quality: Order No. 161/2006 for the approval of the Normative for the classification of the quality of surface waters in order to establish the ecological status of water bodies. Order No. 1888/2007 for the approval of the list of organohalogenate substances and heavy metals, and the maximum admissible limits of the organohalogenate and heavy metals in water and sediments, applied for shellfish waters. GD. 201/2002 (OJ no. 196 / 22.03.2002) approving the technical norms on the quality of shellfish waters modified by GD. 467/2006 (OJ no. 349 / 18.04.2006) GD. 859/2007 (OJ no. 535 / 07.08.2007). H.G. No. 459 from 16 May 2002 regarding the approval of quality norms for waters in natural areas arranged for bathing. H.G. No. 88 from 29 January 2004 regarding the approval of norms for surveillance, sanitary inspection and control of natural areas used for bathing. GD No. 546 from 21 May 2008 regarding the management of bathing water. Order no. 183 of March 14, 2011 regarding the methodology for monitoring and evaluation of bathing areas.
Legal status of marine waters: Emergency Ordinance no. 51 of June 8, 2011, amending and supplementing Law no. 17/1990 on the legal status of marine waters, territorial sea, the contiguous zone and exclusive economic zones of Romania.
ICZM related legislation: Law no. 280/2003 approving Government Emergency Ordinance no. 202/2002 on integrated management of coastal areas, with subsequent amendments - Official Gazette no. 454/26.06.2003
Monitoring and control of hazardous priority/priority substances related legislation:

Title of National Legal Act/Policy
Ministry Order No. 44/2004 (MO No. 154/23.02.2004) approving the regulation on the performance of water quality monitoring for hazardous priority/priority substances. Order no 31/2006 for the approval of the Manual (Handbook) of the Modernization and Development of the Integrated Monitoring System of Waters in Romania (SMIAR), modified by GD No. 707/2013 to amend the programme of measures against pollution by chemical substances approved by government Decision No. 351/2005. Ministry Order nr. 245/2005 (MO nr. 565/01.07.2005) for the approval of the methodology for assessing the risk of hazardous substances and of the priority/priority substance in the aquatic environment through mathematical modelling, and the methodology for assessing the impact of hazardous substances and priority/priority substances in aquatic environment through ecotoxicological tests-green algae, daphnia, fish. Law No. 84/2006 (MO No. 327/11.04.2006) for the approval of the Government Emergency Ordinance No. 152/2005 on the Integrated pollution prevention and control, replaced by Law 278/2013 on industrial emissions. Law no. 205 / 2010, approving Government Emergency Ordinance no. 40/2010 for the amendment the Government Emergency Ordinance no. 152/2005 concerning integrated pollution prevention and control. GD nr. 570/2016 Approving the programme for the gradual elimination of discharges, emissions and losses of hazardous priority substances and other measures for the main pollutants.
Radioactivity monitoring related legislation: Ministry of Environment Order 1978/2010 on approval of the organization and functioning of the National Network of Environmental Radioactivity Surveillance.
Marine protected areas related legislation: Law 462/2001 on the EC Habitats Directive transposition, with further amendments. Order nr.46/12-01-2016 on the establishment of a protected natural area regime and the declaration of sites of community importance as an integral part of the European Ecological Network Natura 2000 in Romania.
Marine pollution incidents related legislation: Government Decision no. 1593/2002 on National Plan preparation, response, and cooperation in case of marine pollution by oil and other harmful substances, with subsequent amendments. Order No. 192 of 2 August 2012 for the approval of the Regulation on the management of emergency situations generated by floods, hazardous weather phenomena, accidents at hydrotechnical constructions and accidental pollution.
Environmental impact assessment related legislation: GD No. 1213/2006 (MO no 802/25.09.2006) on the setting of the framework procedure for assessing the impact on the environment for certain public and private projects, modified/repelled by GD 445/2009, and Law 292/2018 on assessing the impact of certain public and private projects on the environment.
Marine strategy framework directive transposing legislation: Law nr. 6/2011 for approving Emergency Government Ordinance (EGO) no. 71 of 30 June 2010 establishing the strategy for marine environment, modified by Law 205/2013 for amendment of the EGO 71/2010 on the establishment of the Marine Strategy.

Diagnostic Report II guiding improvements in the Black Sea monitoring system (Velikova et al., 2013) identified the main achievements and gaps encountered at the legal/policy level at that time. National policies of Romania are based on the precautionary approach, use of low and non-waste technologies, integrated marine environmental protection with other areas of policy, development of economic incentives for environmentally friendly industry and agriculture, as well as the polluter pays principle and user fees and application of environmental impact assessment procedures to all sectors. Licensing-monitoring-enforcement-compliance mechanism is well developed. Any water use is subject to authorization in the form of a water management permit and water management license. Consequently, the legal basis for compliance monitoring is in place.

Responsible organizations

Ministry of Environment, Water and Forests (MEWF) is the national authority responsible with MSFD implementation. The various organizations in the field of monitoring management identified (acc. to the Law 205/2013 for amendment of the EGO 71/2010 on the establishment of the Marine Strategy) are not yet organized in a functional network, including distribution of responsibilities and arrangements for data exchange, with respect to MSFD implementation. The national funding for the routine monitoring in the Black Sea needs to be substantially increased to cover the MSFD requirements. Besides, the funding should be ensured in time on an annual basis.

In Romania, the Ministry of Environment, Water and Forests (MEWF) provides funds (through competitive bidding) for marine monitoring (chemistry, biodiversity, contaminants). The National Institute for Marine Research and Development “Grigore Antipa” (NIMRD) is responsible for implementing the programme and maintaining its long-term endurance, including through additional

support from various research projects with a monitoring component, that might be financed by different ministries (especially Ministry of Education and Research), private sector, EU.

Fishery monitoring is financed by the National Agency for Fishery and Aquaculture (NAFA) through Ministry of Agriculture and Sustainable Development, and other projects. NAFA is designated for the implementation of the National Data Collection Programme and NIMRD is involved in the following activities:

- Evaluation of the fishing sector
- Data collection and processing on economic variables, on métier related variables, on recreational fisheries, on stock related variables and on transversal variables
- Research surveys at sea
- Evaluation of effects of the fishing sector on the marine ecosystem
- Management and use of data
- Participation with specialists in the co-ordination meetings, planning groups on data collection, planning groups on surveys at sea and stock assessment working groups.

Also, NIMRD has historical data (obtained from own projects) on qualitative and quantitative structure of the catches and landings, structure of fish populations, growth parameters and mortality rates, state of stocks, distribution of fishing agglomerations, spawning and recruitment intensity, etc.

WFD implementation is under responsibility of Dobrogea Littoral Water Basin Administration, Constanta, being affiliated to the MEWF. NIMRD elaborated and updated the methodologies for the evaluation of transitional and coastal waters ecological quality.

Compliance monitoring for sources of pollution is under the WEWF, conducted by its Environmental Protection Agencies (EPA - atmospheric pollution) and the MEWF, through Romanian National Waters Administration (RNWA) which monitor wastewater discharges of municipal and industrial sources, and the Danube River discharges.

Bathing water monitoring is under the Ministry of Health, conducted by its regional inspections in Constanta and Tulcea.

Fisheries monitoring is currently under the Ministry of Agriculture and Sustainable Development, through National Agency for Fishery and Aquaculture.

National Meteorological Administration (NMA) has information stored in the National Fund of Meteorological Data as follows: direct sunlight and ultraviolet, opacity of the atmosphere, carbon dioxide, ozone, nitrogen dioxide, rainfalls and precipitation acidity (pH), atmospheric electricity, the total amount of ozone, frequency of monthly and annual wind directions and atmospheric calm. NMA provides real-time data for wind and feeds the circulation models in the region.

DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) is transposed into Romanian legislation through Law 205/2013 for approving Emergency Government Ordinance (EGO) no. 71 of 30 June 2010 establishing the strategy for marine environment.

This document includes a list of competent authorities implementing MSFD, and their responsibilities, as follows (Table 1.8 and Table 1.9):

Table 1.8 - List of competent authorities implementing MSFD

No.	Competent authority	Responsibilities
1.	Ministry of Environment and Forests, currently Ministry of Water and Forests	Transposition and implementation of the directive
2.	Ministry of Agriculture and Rural Development	Protecting the living resource, eliminating fisheries in protected marine areas, controlling fisheries, giving up aggressive fishing gear for populations, sustainable farming practices
3.	Ministry of Administration and Interior/General Inspectorate of the Border Police	Control, accident intervention, protection of living resources and combating poaching, monitoring of ships in territorial waters, securing the perimeter with ships in the event of pollution
4.	Ministry of Transport and Infrastructure	It develops specific rules and regulations in transport, on environmental protection and approves ship-generated waste management plans and commodity residues.
5.	Ministry of Economy, Trade and Business environment	It develops specific rules and regulations with a view to harnessing the energy potential of the Black Sea.

Table 1.9 - List of MSFD working groups members

No.	Members	Responsibilities
1.	National Institute for Marine Research and Development "Grigore Antipa" (NIMRD)	Research and monitoring activities of the ecological status of marine ecosystems. The technical operator of the national network for the physical, chemical, biological monitoring of coastal marine waters and the supervision of coastal erosion, being empowered to propose Ministry of Environment and Forestry regulations in the field.
2.	National administration "Romanian Waters"	Harmonization of the Marine Strategy requirements with the requirements of the Water Framework Directive on the attainment of environmental objectives for the coastal zone. Monitoring and control of the quality of the transitional and Marine waters (Inland sea waters and the territorial sea), as well as other activities arising from the legislation in force
3.	"Danube Delta" Biosphere Administration	Protection of marine protected areas in the reserve law
4.	National Agency for Environmental Protection	Emission control, environmental opinions. At local level it performs the tasks and responsibilities of the Central Public Authority for environmental protection, according to the competences established by that authority, in accordance with the provisions of the Government Emergency Ordinance No. 195/2005, with subsequent modifications and additions, and other regulations in force.
5.	National Environmental Guard	Control and sanctions in case of pollution and destruction of the marine ecosystem
6.	National Agency for Fisheries and Aquaculture	Managing the living resource in marine protected areas
7.	National Agency for Mineral Resources	According to art. 2 lit. f) of Government Decision No. 1.419/2009, seeks to apply the measures established for the protection of the environment, during and after the execution of oil operations and mining activities.
8.	Romanian Naval Authority	Controls the management and delivery of all waste generated on board ships and residues of transported goods; Investigate events and navigational accidents, including accidental hydrocarbons and other harmful substances, produced by ships, in territorial waters; Coordinate intervention actions at sea in case of marine pollution.
9.	National company "Maritime Ports Administration"-S.A. Constanta	It pursues and coordinates naval transport activities in ports carried out by authorized economic operators; Manages the collection of waste from ships and cargo residues.
10.	Directorate of Public Health of Constanta County	Monitoring of bathing waters in areas of competence
11.	Directorate of Public Health of Tulcea County	Monitoring of bathing waters in areas of competence
12.	Local public administration authorities bordering the Black Sea, respectively Tulcea and Constanta counties	Ensuring proper quality of water discharged into the sea

1.2.2. National monitoring programmes description

Ecosystem components and parameters covered

In 2014, according to the provisions of art. 11 of the Marine Strategy Framework directive, Romania updated the national monitoring programme to meet the requirements of the directive in order to achieve the good ecological status of the Black Sea ecosystem by 2020 (NIMRD, 2014).

The revised marine Monitoring Programme has been developed in such a way as to meet the specific criteria and requirements of MSFD (Annexes I, II, IV and V), and is based on the structure of programmes/sub-programmes developed by the European Commission Working Group on "Data Information and Knowledge Exchange "(WG DIKE). For each descriptor/sub-programme, the NIMRD experts have developed distinct plans, comprising: General Information (Subprogram (s)/descriptors/criteria/monitored parameters; current stage); Brief description of the proposed monitoring plan according to MSFD (monitored elements/parameters; methods); Requirements for programme implementation, potential limitations/information gaps, recommendations to improve the programme in the future.

The revised Monitoring programme (<http://apepaduri.gov.ro/dezbateri-publice/>) is structured in 13 programmes corresponding to Descriptors (Annex II MSFD), each programme being structured in sub-programmes (62 in total). In updating the national monitoring programme, Romania took into account the provisions of Art. 11, Annex V of the MSFD, as well as the results obtained in the first reporting, i.e. the initial assessment of the marine environmental status (art. 8), the determination of Good environmental status of the marine environment (art. 9), as well as the setting of environmental targets for the marine environment (art. 10), obligations fulfilled by NIMRD by elaborating the corresponding studies with the beneficiary Ministry of Environment.

In 2014, the exhaustive and critical analysis of information, as well as the available historical data obtained from the monitoring of biological and physico-chemical components over a period of 30 years, through the current NIMRD system, highlighted the fulfilment of requirements for the majority of MSFD descriptors (D1, D3, D5, D7, D8, D10), as well as the need to complement information gaps in certain areas, by:

- Introducing new elements in the monitoring programme, for example: water masses characteristic of the western Black Sea area, upwelling processes, and frost phenomena in the coastal zone
- Expanding data collection on bioaccumulation of hazardous substances in living marine resources with commercial importance
- The introduction of the structure and composition of marine sediment substrates monitoring
- Increase in the number of biological elements studied, which are part of the marine ecosystem trophic network (macroalgae, zooplankton, ichthyofauna including non-commercial species, dolphin populations, marine birds) for the coverage of descriptor 1
- Collection of marine litter data (sea bottom, water column, beaches, microlitter) for the coverage of the Descriptor 10
- Initiating energy and noise monitoring activities that can affect the ecosystem structure to cover the Descriptor 11.

Thus, the criteria and indicators recommended for the determination of GES constitute an important component of the updated marine monitoring programme (Table 1.10), as well as initiating the process of completing the information gaps, through the significant contribution of the research projects carried out by NIMRD. The latest examples: Descriptor 11 - the activities of noise monitoring which may affect the ecosystem structure, by purchasing equipment, development of the method of acquisition and processing of data, have been initiated; Descriptor 8 - Criterion 8.2. Effects: Biomarkers of pollution, methods tested, under implementation; Descriptor 9 - Contaminants in the biota, significant expansion of the number of marine species investigated for the presence of hazardous substances; Descriptor 10 Marine litter - in recent years has begun gathering data on land and marine waste, etc.

- Setting up a network of sufficient number of sampling stations for regular seasonal monitoring and assessment of the environmental status of the national marine waters by maintaining and extending the current national network.

The national network of NIMRD marine monitoring covers the transitional, coastal and marine waters (territorial waters and part of the EEA) and is currently represented by 45 stations, with some transects reaching up to 100 m depth, respectively 65 nautical miles from the base line, responding to the MSFD implementation requirements. In addition, there are specific transects for the investigation of pelagic and demersal fishery resources and marine litter, also monitoring stations in the premises and vicinity of maritime ports (Constanta, Mangalia, Midia) - with relevance for non-indigenous species and pressures, as well as specific areas for monitoring macrophytobentos (shallow area of the southern coastline) and NATURA 2000 habitats, and, last but not least, the permanent monitoring station Cazino Mamaia (near shore), with daily sampling frequency that started in 1959, for physico-chemical and biological (phytoplankton) parameters, and data transmitted by the Oceanographic Measurement Station from the same location.

Table 1.10 - Parameters included in the national integrated marine monitoring programme (NIMRD)

Monitoring ecosystem components	Monitoring parameters	Relevance to MSFD Monitoring programme
Matrix: water column		
General physico-chemical and eutrophication indicators	Levels (concentrations); Trends Temperature, transparency, salinity, pH, dissolved oxygen and saturation, total suspended matter. Nutrients (P-PO ₄ , N-NO ₂ , N-NO ₃ , N-NH ₄ , N total, P total, Si-SiO ₄), Total organic Carbon (TOC), chlorophyll-a.	BLKRO-D5, BLKRO-D7
Synthetic and non-synthetic contaminants	Levels (concentrations); Trends; EQS compliance Heavy metals (copper, cadmium, lead, nickel, chromium). Persistent organic pollutants (organochlorinated pesticides, polychlorinated biphenyls, total petroleum hydrocarbons, polycyclic aromatic hydrocarbons).	BLKRO-D8
Bacterial indicators	Levels (concentrations); Trends; EQS compliance Pathogenic microbial organisms: total coliforms germ, fecal coliforms germ, fecal streptococci.	BLKRO-D8
Quality biological indicators, pelagic habitats	Taxonomic composition, abundance, biomass, trends Phytoplankton (species, seasonal and geographical variability). Zooplankton (microzooplankton, mesozooplankton, macrozooplankton gelatinous) (species, seasonal and geographical variability). Fish* (biodiversity and stocks) Mammals	D1, D2, D4, D5 BLKRO-D1, D4-W (Water column habitats), BLKRO-D2, BLKRO-D1, D4-Fish, BLKRO-D1, D4-Mammals
Matrix: sediment		
Synthetic and non-synthetic contaminants	Levels (concentrations); Trends; SQC compliance Heavy metals (copper, cadmium, lead, nickel, chromium). Persistent organic pollutants (organochlorinated pesticides, polychlorinated biphenyls, total petroleum hydrocarbons, polycyclic aromatic hydrocarbons). Total organic carbon (TOC), granulometry.	BLKRO-D8
Marine litter	Characterization, numbers, kg/km ² , items/km ² Bottom litter**, beach litter.	BLKRO-D10
Quality biological indicators, benthic habitats	Taxonomic composition, abundance, biomass, trends Macrozoobentos; Meiobentos Macrophytes*** Fish*	BLKRO-D1, D4, D6 - SBH (Seabed Habitats), BLKRO - D1, D4 -Fish
Matrix: biota (mollusks, fish)		
Synthetic and non-synthetic contaminants	Levels (concentrations); Trends; MAC compliance. The degree of contamination with hazardous chemicals: heavy metals (copper, cadmium, lead, nickel, chromium, mercury), persistent organic pollutants (total petroleum hydrocarbons, polynuclear aromatic hydrocarbons, organo-chlorinated pesticides, Polychlorinated biphenyl); Microbial pathogenic organisms;	BLKRO-D9
Other		

Monitoring ecosystem components	Monitoring parameters	Relevance to MSFD Monitoring programme
Fishery resources	Commercial species (pelagic and demersal) * Qualitative and quantitative structure of the catches and landings, structure of fish populations, growth parameters and mortality rates, state of stocks, distribution of fishing agglomerations, spawning and recruitment intensity	BLKRO-D3, BLKRO-D1, D4-Fish
Information on the change of the coastline, topography of the emerged and submerged beach	Modification of the shoreline line, topography of the emerged and submerged beach (especially in anthropogenic modified areas-ports, protection dams, borrowing areas, etc.), changes in sediment transport due to anthropogenic changes and topography and bathymetry of the marine substrate, physical loss of sediment, aerial imagery drone carried out along the Romanian shore;	BLKRO-D6, D7
Noise	Initiating energy and noise monitoring activities that can affect the ecosystem structure	BLKRO-D11

* The monitoring cruises related to the study of pelagic and demersal fishery resources (D3) are supported by the National Fisheries Data Collection Programme. Additional specific activities could be organized in the monitoring programme for the collection of the field data required to complete the parameters set out in Descriptor 1 - Fish.

** In the framework of research cruises for demersal fishery resources, above mentioned, data on the marine litter from the marine substrate (D10) are also collected, this activity being already regularly implemented since 2011. These cruises also provide samples of marine fish for contaminants' analyses (D9).

*** Specific observations and sampling campaigns related to monitoring of macrophytobenthos and specific habitats in shallow coastal areas (D1, D6).

Spatial allocation and geographical coverage

Monitoring frequency and seasonality

In order to comply with MSFD requirements, in the recent years, starting with 2009, NIMRD has gradually and significantly expanded the national monitoring network towards open sea area (from around 29 stations, currently the network has 45 monitoring stations).

The national marine monitoring network implemented by NIMRD covers the transitional, coastal and marine waters (territorial waters and part of the EEZ), and is represented by 45 permanent stations, which reach down to max. 100 m depth, positioned on 13 transects arranged along the Romanian coastline, as shown in Figure 1.6 and Table 1.11.

The stations in the shallow area (5 - 20 m) allow the assessment of the direct impact of terrestrial pressures such as the Danube mouths, the discharges of municipal and industrial sewage stations, ports, urban agglomerations, hydrotechnical works, etc.

Monitoring cruises are conducted as an average 2 times/year, although a seasonal frequency would be recommended for some important variables.

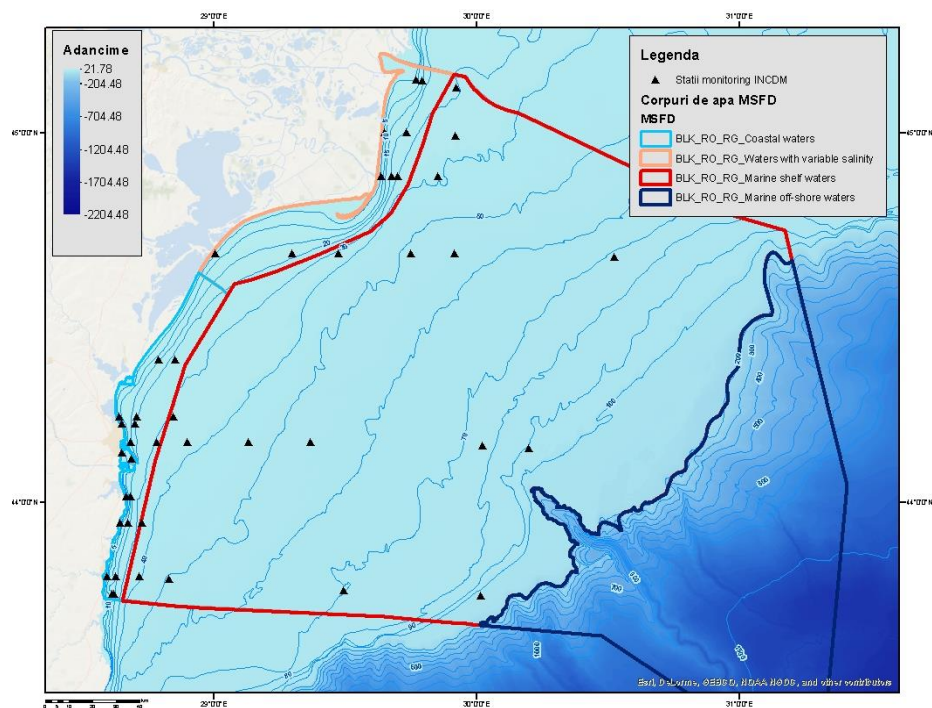


Figure 1.6 - Integrated Marine Monitoring Network and marine reporting units according to MSFD

Table 1.11 - Monitoring stations - D1 (except fish, macroalgae, dolphins), D2, D4, D5, D6, D7, D8, D9

Nr. crt	Station	Maximum Depth (m)	Latitude_N	Longitude_E
1	Sulina_1	10	45.1439	29.7717
2	Sulina_2	20	45.1411	29.7934
3	Sulina_3	30	45.1228	29.9242
4	Mila_9_1	5	45.0033	29.6517
5	Mila_9_2	20	45.0033	29.7333
6	Mila_9_3	30	45.0033	29.7928
7	Sf. Gheorghe_1	5	44.8836	29.6364
8	Sf. Gheorghe_2	20	44.8836	29.6783
9	Sf. Gheorghe_3	30	44.8836	29.7017
10	Sf. Gheorghe_4	40	44.8836	29.8529
11	Portita_1	5	44.6767	29.0067
12	Portita_2	20	44.6767	29.2992
13	Portita_3	30	44.6767	29.4742
14	Portita_4	50	44.6767	29.7500
15	Portita_5	57	44.6767	29.9167
16	Portita_6	70	44.6665	30.5246
17	G. Buhaz_1	5	44.3897	28.7890
18	G. Buhaz_2	20	44.3897	28.8530
19	Cazino Mamaia_1	5	44.2358	28.6394
20	Cazino Mamaia_2	20	44.2350	28.7061
21	Cazino Mamaia_3	30	44.2347	28.8472
22	Constanta Nord_1	5	44.2167	28.6500
23	Constanta Nord_2	20	44.2167	28.7003
24	Constanta Est_1	14	44.1667	28.6833
25	Constanta Est_2	28	44.1667	28.7833
26	Constanta Est_3	36	44.1667	28.9000
27	Constanta Est_4	47	44.1667	29.1333
28	Constanta Est_5	54	44.1667	29.3667
29	Constanta Est_6	70	44.1631	30.0239
30	Constanta Est_7	90	44.1634	30.2007
31	Constanta Sud_1	5	44.1383	28.6489

Nr. crt	Station	Maximum Depth (m)	Latitude_N	Longitude_E
32	Constanta Sud_2	20	44.1217	28.6850
33	Eforie Sud_1	5	44.0186	28.6662
34	Eforie Sud_2	20	44.0187	28.6816
35	Costinesti_1	5	43.9450	28.6442
36	Costinesti_2	20	43.9450	28.6739
37	Costinesti_3	30	43.9450	28.7267
38	Mangalia_1	5	43.8003	28.5947
39	Mangalia_2	20	43.7989	28.6278
40	Mangalia_3	39	43.7986	28.7156
41	Mangalia_4	53	43.7921	28.8290
42	Mangalia_5	70	43.7573	29.3983
43	Mangalia_6	100	43.7405	29.9644
44	Vama Veche_1	5	43.7511	28.6131
45	Vama Veche_2	20	43.7511	28.6211

In addition, there are specific transects for the investigation of pelagic and demersal fishery resources and marine litter, as well as specific areas for monitoring macrophytobentos and macrozoobenthos (shallow area along the coastline between Periboina and Vama Veche) and NATURA 2000 habitats, and, last but not least, the permanent monitoring station Cazino Mamaia (near shore), with daily sampling for physico-chemical and biological (phytoplankton) parameters, and data transmitted by Oceanographic Measurement Station from the same location.

Macrophytobentos samples are collected from depths ranging from 1 to 3 m (0-1m, 1-2m, 2-3m) from the maximum coverage area of the substrate and the maximum specific diversity, from a network of 12 representative stations in the coastal zone, during summer season. The available data are gathered from mediolittoral and infralittoral area (favorable for the development of phytobenthos communities at the Romanian shore), from hard, and sedimentary substrate. At each station, 3 replicates from each characteristic depth are collected. In the same time observations on macroalgae deposits on the shore, to observe their qualitative structure are carried out. Destructive sampling is accompanied by underwater photographs and filming.

Monitoring cruises related to the study of pelagic and demersal fishery resources in the continental shelf waters (at different depths, depending on the species concerned), are carried out along specific transects (Figure 1.7), 2 times/year, in the periods May - June and September-October.

Also, NIMRD and NAFA monitor the fishing activities carried out along the coast (in 18 fishing points between the Sulina-Vama Veche), either in the coastal area (depths between 3 and 11 m) with fixed tools (nets, drifts, longlines, etc.), or up to 40-60 m depth, with drift and longlines, especially for turbot and shark.

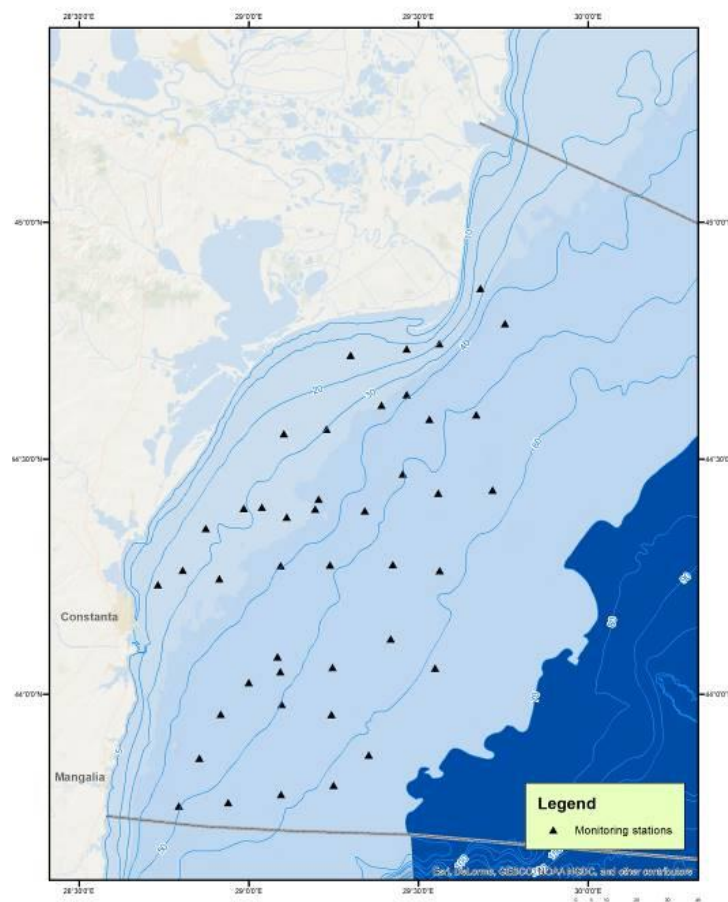


Figure 1.7 - Distribution of trawling zones in the waters of the Romanian Continental Shelf

Marine reporting units

The assessment of the ecological status based on criteria and indicators according to decision 2017/848/EU (NIMRD, 2018) was carried out on each of the water bodies delimited for MSFD, depending on data availability. From the spatial distribution of the average decennial values of salinity from the available data World Ocean data (<ftp://ftp.nodc.noaa.gov/>) and NIMRD (www.nodc.ro), but also from the average monthly amounts of chlorophyll a for the period 07.2002-10.2013 (<https://Disc.sci.gsfc.nasa.gov/giovanni>), the Romanian marine waters were classified in four water bodies (Table 1.6):

- BLK_RO_RG_TT03_Waters with variable salinity - waters with variable salinity located in the north, under the direct influence of the Danube, from the mouth of the river in the Black Sea, south to the Portița, at depths of up to 30m. The waters are delimited by the average seasonal salinity up to 8.0 PSU and an annual average up to 14.5 PSU.
- BLK_RO_RG_CT_Coastal waters - are the coastal water from the central to the south (from Portița to Vama Veche), from the base line to the isobath of 30m. The waters are delimited by the average seasonal salinity 8-16 PSU and an annual average up to 16.0 PSU.
- BLK_RO_RG_MT01_Marine Waters - the marine waters area from the 30 m isobath to 200m; The waters inside and outside the continental platform, delimited by the average seasonal and annual salinity in the range 16 - 17, 5PSU.
- BLK_RO_RG_MT02_Offshore Waters - The open area of marine waters, delimited by average seasonal and annual salinity greater than 17.5 PSU, perimeter set for water type with depths of at least 200 m.

Data acquisition methods

In the acquisition of data, usually laboratory analyses are being used. In situ methods employed are: CTD, current meter, oceanographic measurement station (located in Cazino Mamaia permanent station). Also, real-time measurements of sea level performed in the NIMRD maregraphs network, Constanta and Mangalia points. The sea-level hourly records in Constanta, with the tidal shaft encoder type thalimedes, are transmitted in real time in the UNESCO-IOC Tsunami Warning System (<http://ioc-sealevelmonitoring.org/station.php?code=csta>) and the National Oceanographic and Environmental Data Centre (NOEDC). Acoustic parameters are measured with the vibro-acoustic parameters measuring system with the type 8105 hydrophone.

Remote sensing is not yet developed/integrated in the monitoring programme.

The assessment methods are described in the Romanian national marine monitoring programmes factsheets included in Annex 2.

Programme name:	Programme ID:	Provided (Y/N)
Non-indigenous species	BLKRO-D2	N
Commercial fish and shellfish	BLKRO-D3	N
Eutrophication	BLKRO-D5	Y
Hydrographical changes	BLKRO-D7	N
Contaminants	BLKRO-D8	Y
Contaminants in seafood	BLKRO-D9	Y
Marine litter	BLKRO-D10	N
Energy, including underwater noise	BLKRO-D11	N
Biodiversity - mammals	BLKRO-D1, D4-M	N
Biodiversity-fish	BLKRO-D1, D4-F	N
Biodiversity - seabed habitats	BLKRO-D1, D4, D6-SBH	Y
Biodiversity - water column habitats	BLKRO-D1, D4-W	Y

1.3. Review of the existing monitoring programmes in Turkey

1.3.1. National legal framework

The marine monitoring activities in Turkey may be grouped in two basic categories:

- A. Monitoring of activities and pressures.
- B. Monitoring of state (including impact assessments in relation to the pressures).

The first group includes recording of both land and sea-based activities and monitoring of pressures related to them. Some of those are municipal and industrial effluents, rivers, ship accidents and spills, illegal discharges, coastal and offshore oil facilities, dredging and dumping activities, trawling activities, etc. Monitoring and control of them are under the responsibility of different ministries (MoEU, MoTI, MoAF), municipalities, firms, and companies; based on different elements of the national legislation.

The second group of monitoring activities aim at assessing the state of all surface waters, including inland waters, transitional, coastal, and marine waters. One branch of the waters state monitoring targets the river basins, including transitional waters and the coastal marine areas impacted by the river flows. This monitoring is organized under the river basin management plans (RBMP) developed for the implementation of the WFD (to which Turkey has committed) that is transposed into relevant national regulations. The second branch of the marine and coastal waters monitoring is implemented under the requirements of the RSCs (BSC, UNEP/MAP) and national legislations developed especially for the control of pollution.

The major responsible authority for the implementation of the RBMPs under the WFD (first branch of state monitoring) is the MoAF. GD of Water Management and RBM Committees for each basin are responsible for the monitoring of implementation of the plans and reporting to the Ministry. On the other hand, the major authority for the marine and coastal waters is the MoEU and its directorates, whose monitoring activities are supported by a range of national legislation (Table 1.12). The MoEU is the major coordinating body of the monitoring and reporting for our seas to the RSCs. In this context, the MoEU collaborates with different ministries (e.g. MoTI, MoAF) in order to achieve the reporting obligations under the Regional Sea Conventions and the Protocols. However, national legislation to coordinate the overall planning and implementation of the marine monitoring and assessment scheme is still absent. Such a tool will obviously not only avoid duplication of efforts of different organizations, but also provide an efficient data/information sharing and better assessments made. This will also support the national and international reporting procedures. These issues have been studied, recommendations made, and road maps prepared in several projects (DeKoS and MarinTurk Projects) with specific reference to MSFD and the evolving requirements of the RSCs.

Below, in Table 1.12 the level of monitoring, some of the related national legislation and the responsible authorities are listed for each group of monitoring components with reference to MSFD. Most of the information is synthesized from Marinturk Reports (Oral N., 2018; Polat-Beken Ç., et al; 2018).

Table 1.12 - Monitoring activities relevant to MSFD, national legislation and responsible authorities

MSFD monitoring element	Level of monitoring	National Legislation	Responsible authority
D 1, 4 - Biodiversity elements: Birds and mammals	On project basis for identified species. Not systematically accomplished. Implemented by NGOs and universities.	Law on National Parks (1983) By-law for the Law on National Parks (1986) By-law on the protection of wetlands (2014) Draft Law on Protection of Nature and Biodiversity	MoAF- GD of Nature Conservation and National Parks
D 1, 4, 6 - Biodiversity elements: Fish D3 - Commercial fish and shellfish	On projects basis. Systematically implemented for the Eastern-BS by the Central Fisheries Research Institute of MoAF. For the Western-BS projects are not systematic and mostly implemented by universities.	Law on Fisheries (No. 1380) (1971) By Law on Fisheries (1995) Bucharest Convention and the Protocol of Biodiversity and Landscape.	MoAF- GD of Fisheries and Aquaculture Products
D 1, 6 - Biodiversity elements: Fish	Monitored within National Integrated Monitoring Programme (NIMP) once every 3 years.	Law on Environment (No.2872) (1983) Decree law on the responsibilities of MoEU (2011)	MoEU-GD of EIA, Permits and Inspection
D 1, 4: Pelagic habitats (Phytoplankton, zooplankton, nutrients, chl-a, CTD, others)	Systematically monitored (twice/year: winter&summer) as part of NIMP.	Law on Environment (No.2872) (1983) Decree law on the responsibilities of MoEU (2011) Bucharest Convention and the Protocol of Biodiversity and Landscape	MoEU-GD of EIA, Permits and Inspection
D 1, 4: Pelagic habitats (Phytoplankton, nutrients, chl-a, CTD, others)	Monitored at river basins and the coastal waters under their influence -implemented with intervals at each basin as annual programmes of seasonal periodicity.	By-law on surface water and ground water monitoring (2014) By-law on the protection of water basins and management plan preparation (2012) By-law on quality of surface waters (2012/2016)	MoAF-GD of Water Management & GD of State Hydraulic Works
D 1, 6: Benthic habitats (Coastal Macrophytes, soft bottom macro-zoobenthos)	Systematically monitored (once/year: summer) as part of NIMP.	Law on Environment (No:2872) (1983) Decree law on the Responsibilities of MoEU (2011) Bucharest Convention and the Protocol of Biodiversity and Landscape	MoEU-GD of EIA, Permits and Inspection & GD of Environmental Management
D 1, 6: Benthic habitats	Monitored at river basins and the coastal waters under their influence -implemented with intervals at each basin as annual programmes being twice/year.	By-law on surface water and ground water monitoring (2014) By-law on the protection of water basins and management plan preparation (2012) By-law on quality of surface waters (2012/2016)	MoAF-DG of Water Management
D2: NIS	Monitored as part of NIMP for benthic and pelagic habitats. But specific monitoring strategy not applied. Records are made by researchers.	Law on Environment (2872) By-law for Water Pollution Control (2004)	MoEU-GD of Environmental Management & GD of EIA, Permits and Inspection
	VMS - Continuous monitoring of location of all ships	Int. Convention for the Control and the Management of Ships' Ballast water and Sediments (Law no: 6531/2014)	MoTI - DG for Regulation of Inland and Marine Waters
D3: Fishing pressures	VMS for fishing vessels >12 m (BAGİS), daily, Turkish EEZ: Fishing fleet records and landings data.	Law on Fisheries (No: 1380) (1971) By Law on Fisheries (1995)	MoAF- GD of Fisheries and Aquaculture Products

MSFD monitoring element	Level of monitoring	National Legislation	Responsible authority
D5: Human induced eutrophication	Systematically monitored (twice/year: winter&summer) as part of NIMP.	Law on Environment (2872) (1983) By-law for Water Pollution Control (2004) Draft by-law on integrated pollution prevention and control By-law on urban wastewater treatment (2006) By-law on waste management (2015) Communication on monitoring of sea-based fish farms (2009) Decree law on the Responsibilities of MoEU (2011) By-law on EIA (2014) By-law on SEA (2017) Bucharest Convention and the Protocol of LBSA	MoEU-GD of Environmental Management & GD of EIA, Permits and Inspection
	Monitored at river basins and the coastal waters under their influence -implemented with intervals at each basin as annual programmes of seasonal periodicity.	By-law on the protection of waters against pollution caused by nitrates from agricultural sources (2016) By-law on surface water and ground water monitoring (2014) By-law on quality of surface waters (2012/2016) By-law on the protection of water basins and management plan preparation (2012)	MoAF- GD of Water Management & GD of State Hydraulic Works
		By-law on taking wastes from ships and waste control (2004)	MoTI - GD for Regulation of Inland and Marine Waters
D6: Sea floor integrity (pressures /activities)		Law on Environment (1983) By-Law on Water Pollution Control (2004) By-Law on the Environmental Impact Assessment (2014) By-Law on the Purchase, Operation and Control of Sand, Gravel and Similar Materials (2007) Draft By-Law on the Dredging of the Seafloor and environmental management of dredged material	MoEU-GD of Environmental Management & GD of EIA, Permits and Inspection
	Physical disturbance - VMS for fishing vessels >12 m (BAGİS), daily, Turkish EEZ.	Fisheries Law no. 1380 By-Law on Fisheries By-law on aquaculture (2004)	MoAF -GD of Fisheries and Aquaculture Products
D8: Contaminants	Annual trends monitoring in sediments and biota as part of NIMP. Monitoring of bathing waters during swimming season implemented by MoH and reported to MoEU.	Law on Environment (2872) (1983) Law on emergency response and compensation for damages arising from the pollution of the marine environment by oil and other dangerous substances (No. 5312) (2005) By-law of Law No. 5312 (2006) By-law of bathing water quality (2006)	MoEU- GD of EIA, Permits and Inspection & GD of Environmental Management MoH (bathing waters)

MSFD monitoring element	Level of monitoring	National Legislation	Responsible authority
	Industrial wastewater characterization and loads' monitoring done routinely based on sectorial emission limits given in by-law for water pollution control (2004)	By-law for Water Pollution Control (2004) Draft by-law on integrated pollution prevention and control Decree law on the Responsibilities of MoEU (2011) Bucharest Convention and the Protocol of LBSA	MoEU: Ministry of Environment and Urbanization
	Monitored at river basins and the coastal waters under their influence -implemented with intervals at each basin as annual programmes being executed monthly /seasonally.	By-law on the protection of waters against pollution caused by nitrates from agricultural sources (2016) By-law on surface water and ground water monitoring (2014) By-law on quality of surface waters (2012/2016) By-law on the protection of water basins and management plan preparation (2012)	MoAF- DG of Water Management & DG of State Hydraulic Works
	Records of operations	By-law on the collection and control of wastes from ships (2004) By-law on Ports (2012)	MoTI - DG for Regulation of Inland and Marine Waters & Municipalities
	Records of ship accidents, Accidental spillages, and illegal discharges (if identified)		MoTI, MoEU and Municipalities
D9: Contaminants in sea food	Routine monitoring of contaminants in edible marine/aquaculture products *	Law on Fisheries (No. 1380) (1971) By Law on Fisheries (1995) By-law on aquaculture (2004) By-Law on Combating Illness and Health Conditions for Aquatic Animals (2012) By-Law on Food Safety, Quality Control and Inspection (2008) Food Codex By-Law on the Maximum Residue Limits of Pesticides (2016) Turkish Food Codex Communiqué on the Maximum Residue Limits of Contaminants (2008)	MoAF-GD of Fisheries and Aquaculture Products & GD of Plant Production & GD of Food and Control
	Trends monitoring of contaminants in few target species annually at limited locations and every 3 years with trawl surveys. As part of the NIMP components: biodiversity/fish and contaminants monitoring.	Law on Environment (2872) (1983) By-law for Water Pollution Control (2004) Communiqué on the Identification of Prohibited Areas for Fish Farms in Sensitive Enclosed Bays and Gulfs (2009)	MoEU- DG of EIA, Permits and Inspection & DG of Environmental Management
D10: Marine litter	As part of NIMP: Pilot monitoring at few beaches. Pilot monitoring of microplastics (in water and sediments) Monitoring of sea floor macro litter every 3 years with biodiversity study.	Law on Environment (2872) (1983) By-law for Water Pollution Control (2004) By-Law on the Environmental Impact Assessment By-Law on Proper Storage of Waste By-Law on taking waste from the ships and waste control	MoEU- DG of EIA, Permits and Inspection & GD of Environmental Management Municipalities

MSFD monitoring element	Level of monitoring	National Legislation	Responsible authority
		By-Law on Waste Management Ship Waste Reporting System Circular	
	Beach and sea floor clean up events / surveys		NGOs
D11: Energy, Underwater noise	None as monitoring of pressures and impacts	NA	MoEU- GD of Environmental Management

*Access to data is restricted.

1.3.2. National monitoring programmes description

Ecosystem components and parameters covered

In this section, the NIMP (namely DEN-İZ), developed under the responsibility of MoEU, will be considered to provide the required information in Table 1.13. This programme is originally called as “Integrated Pollution Monitoring Programme” however it includes substantial variety of components and ecosystem elements related to MSFD descriptors. Since this Programme is not yet integrated with other projects/programmes mentioned in Table 1.13 it does not present a complete picture. In “gaps and needs” section, these issues will be further analyzed.

Table 1.13 - Components of NIMP, monitoring parameters, indicators

Monitoring components and elements	Variables/ parameters	Indicators	Relevance to MSFD component to GES
Water column habitats: CTD, nutrients, oxygen, chlorophyll-a, transparency	Levels (concentrations)	Trends at levels, ratios. P-I analyses: LusiVal vs Chl	D1, D4, D5
Water column habitats: Phytoplankton	Taxonomic composition, abundance, (biomass)	Shifts among different groups, change in ratios of groups, HABs, indices	D1, D4, D5
Water column habitats: Zooplankton, Jellyfish	Taxonomic composition, abundance, biomass	Shifts, change in abundance of jellyfish and N. scintillans, indices	D1, D4
Benthic habitats: Macrozoobenthos	Taxonomic composition, abundance	Change in dominance of species/groups, no. of species, indices: TUBI (Turkish Benthic Index), m-AMBI, H'	D1, D6
Benthic habitats: Macrophytes	Taxonomic composition, coverage (%)	Change/shift in ESG I and ESG II groups, change in coverage, EEI	D1, D5, D6
Benthic habitats: Fish and shellfish	Taxonomic composition, abundance, biomass		D1, D6
Contaminants in sediments and biota	Levels (concentrations)	Trends in levels, ERL	D8, D9
Contaminants in sea food	Levels (concentrations)	Trends in levels, higher/lower than EU and national food codex	D9
Radionuclides in water and sediments	Levels (concentrations)	If there is any risk in the levels or not, trends	D8
Microplastics in water, sediments, and fish stomach (pilot)	Characterization, numbers, Pcs/km2, Pcs/m3	Baselines, ranges of levels	D10
Macro litter at sea floor and Macro litter at beaches	Characterization, numbers, kg/km2, items/km2	Baselines, ranges of levels	D10

Nevertheless, this is the only National Programme to cover most of the elements of ecosystem components (D 1, 4, 6) besides components of pressures and impacts (D5, D8, D9, D10). Monitoring of NIS is not covered separately but considered with biodiversity elements.

Spatial allocation and geographical coverage

NIMP intends to cover all coastal, shelf and open marine waters - under the national jurisdiction - and the underlying seabed under the pressure of human activities. At present, the Programme covers efficiently the coastal waters and partially the marine waters (up to 20-30 nm) being expanded from 12-15 nm from 2011 till 2017.

Coastal water bodies (in relation to WFD) were identified within DeKoS Project (TÜBİTAK-MAM, MoEU-GDEM, 2014) and used as a basis for the coastal waters monitoring under NIMP and the river basin monitoring activities (Table 1.14). Coastal water bodies extend beyond 1 nm (as defined by WFD) depending on the coastal morphology and structures like bays. Initially, 16 coastal water bodies were identified along the Black Sea coast of Turkey and later the Westernmost one was divided into two units after assessing the ecological quality for several years. As a result, there are now 17 units (Figure 1.8). It was recommended by DİSSP Project (MoEU, TÜBİTAK-MAM; 2017) that 1 nm or DeKoS units can both be considered in the assessments depending on the purpose of the assessment made, data aggregation principles, or the comparisons to be done with the neighboring countries.

In the DeKoS Project, marine assessment units (MAU) were also identified with expert views by considering the pressures and the ecological/hydrographic characteristics from West to East along the southern Black Sea (Figure 1.8). Five MAUs were identified initially, later the W-E borders of “Sinop” unit was modified by the experts in the DİSSP Project. The units are in fact assumptive and include coastal, transitional (at the river mouths) and marine waters. Each unit was also differentiated based on the depths in relation to the WFD relevant typologies, the benthic habitats, and the deep waters characteristics (Table 1.14).

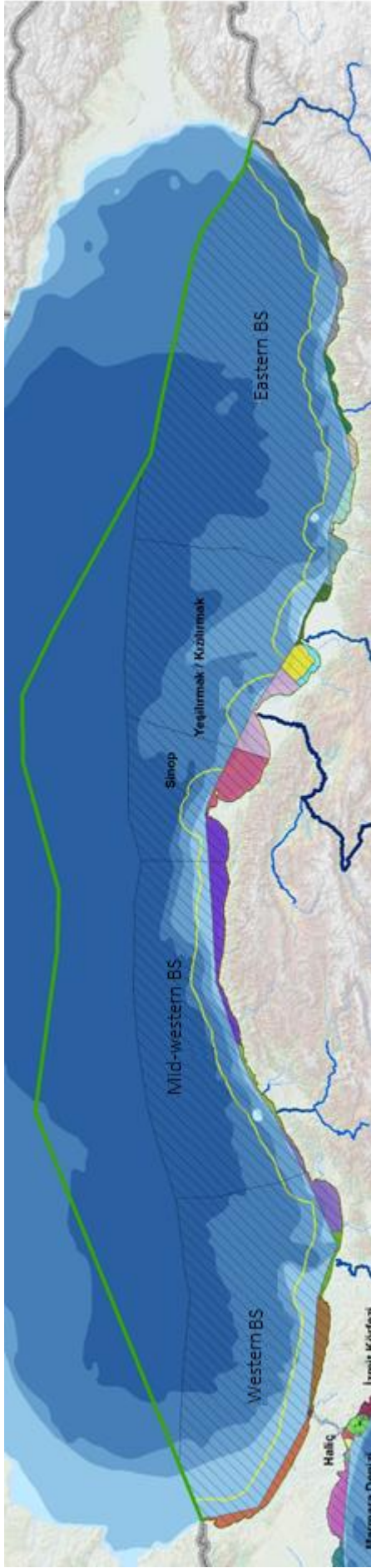


Figure 1.8 - Map showing the coastal water bodies (17 colored units), marine assessment units (5 sub-regions), 12 nm (yellow line) and EEZ (green line) of Turkish Black Sea

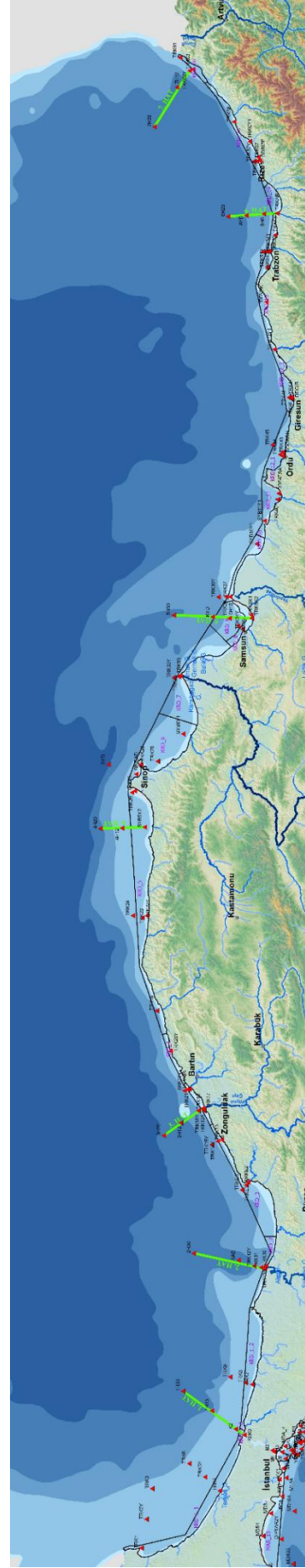


Figure 1.9 - Map showing 2017 monitoring stations and transects (polygons not included in this map)

Table 1.14 - Criteria for marine assessment units*

Marine Assessment Units		Name
1	a) <40 m*	Western Black Sea
2	b) 40-200 m**	Central -Western Black Sea
3	c) >200 m	Sinop area
4	* 30 m is the depth criteria for coastal typology (DeKoS) and later modified to 40 m with DISSP Project.	Yeşilırmak / Kızılırmak impact area
5	** 150-200 m is the suboxic-anoxic boundary changing with location. >200 m could be considered anoxic deep waters	Eastern Black Sea

*) DeKoS - Determination and Classification of Marine and Coastal Water Quality Status, DeKoS Project (2011-2014). TUBITAK MRC and MoEU.

DISSP - Provision of Standardisation in Marine Monitoring, DISSP (2015-2017) TUBITAK MRC and MoEU.

Station network as of 2017 is presented on Figure 1.9. About 69 stations represent the coastal water bodies and 34 stations represent the marine waters. Only 4 stations represent transitional waters as part of coastal waters and 1 station represents the Black Sea exit of İstanbul (Bosphorus) Strait. Overall, about 110 stations (points) have been monitored in the Turkish Black Sea waters. This number does not include the polygons / quadrats which include trawling (25-30) sites and macrophytes at 0-3 m depths (17 sites) of the coast. Pilot studies for litter on the sea surface and at the beaches are not included in these numbers.

Number of stations per each parameter group is given in Table 1.15 for the two years period of the NIMP.

Table 1.15 - Number of sampling stations (point and polygon) for each monitoring component in NIMP (DEN-İZ)

Monitoring components	No. of stations for 2017-2019	No. of stations in 2014-2016
Water column habitats: CTD, nutrients, oxygen, chlorophyll-a, transparency	97	79-94
Water column habitats: Phytoplankton	24	20
Water column habitats: Zooplankton, Jellyfish	21	-
Benthic habitats: Macrozoobenthos	20	22
Benthic habitats: Macrophytes	17	17
Benthic habitats: Fish and shellfish	20 trawls	26 trawls
Contaminants in sediments (trends)	38	12, 26
Contaminants in biota (trends)	6	6
Contaminants in sea food	20	10
Radionuclides in water and sediments	6	6
Microplastics in water (W), sediments (S) and fish (F) stomach (pilots)	-	2 (W, S); 10 (F)
Macro litter on the sea floor	20	26
Macro litter at sea floor and Macro litter at beach	1	-

Monitoring frequency and seasonality

Frequencies of monitoring activities are given in Table 1.5. It includes almost all monitoring or systematic field works. Here, a summary for NIMP monitoring frequencies is given.

In NIMP, the water column habitats have been monitored twice per year in winter and summer, since 2014. Collection of winter data was achieved only after the programme was planned for three years since 2014. Before 2014, usually summer and autumn data were sampled. Unfortunately, the NIMP does not cover the full seasonality due to funding limitations.

Benthic habitats (macrophytes and macrozoobenthos) are monitored annually in the summer period. NIMP studies fish only once in every 3-years, however, this is better covered by the projects of MoAF.

Contaminants in sediments had been monitored annually during the summer season. However, after comparing the annual levels it was found that the differences among the years is not significant and therefore the frequency of monitoring of sediments decreased to once in each 2-3 years.

Contaminants in biota have been held once a year for trends monitoring, whereas contaminants in sea food study is a bit more comprehensive than the trends monitoring since it covers several edible species obtained from the trawl surveys and being implemented once in every 3 years. Radionuclides have been monitored annually in summer.

Pilot microplastic studies were conducted annually during 2013-2016 and not continued during 2017-2019. In this period, macro litter at a pilot beach was included in the study. Macro litter on the sea floor was studied with trawl surveys every 3 years (2016 and planned for 2019).

Data acquisition methods

In the acquisition of data, usually in situ methods and laboratory analyses are used. Laboratories are both on board of R/V TUBITAK Marmara and at the MRC. Remote sensing images are produced for chlorophyll-a distribution using Modis/Aqua Level 2 data. Automated observing systems (buoys) have not been deployed in the Black Sea waters yet. In the context of NIMP, one buoy was deployed in the Marmara Sea as a pilot study in 2018 and the feasibility analyses were performed. In the feasibility report prepared for the MoEU, a number of sites for the Black Sea were proposed for new buoy sites that might be deployed in the future. The proposed sites are more related to risk areas/hot spots rather than oceanography focused areas.

Assessment methods

Assessments are made with various methodologies and specific indicators by Descriptors have been used as much as possible.

For the ecological quality classification of coastal waters, EQRs for the three biological quality elements (chlorophyll, macrophytes, macrozoobenthos) were studied in the DeKoS Project. Reference conditions and sites (for identified typologies) were studied. The class boundaries of the H', benthic indices were adjusted according to the developed national species database. This work is still ongoing, and the work done in DeKoS is being improved in the context of a new project on the identification of reference conditions for all biological quality elements run by MoAF. TUBI (Çınar et al., 2015) has been used since 2015 for the Turkish seas, which index was developed with national data obtained in research projects and monitoring.

Percentile method (10, 25, 50, 75 and 90 %) is applied for the water column data (especially for the first 10 meters) of nutrients and chlorophyll. 10 or 25 % value of the data was assumed as the "reference value" for the EQR and classification scaling. All available monitoring data (since 2004) were used in this method, however data with salinities less than 17 ppt was not included in the analysis to achieve the same typologies. BEAST, as a tool for the assessment of eutrophication status, was also run with reference values obtained with this approach, where thresholds were estimated as +50% ref value. However, BEAST is not yet used as a routine assessment tool of eutrophication status.

For the chemical quality (good/bad) assessment of sediments ERLs/ERMs (US EPA adopted assessment criteria, implying Effects Range Low and Medium) (Long et.al. 1995) values for safe limits and for trace metals enrichment factors (assessment implying contamination degree according to pristine conditions such as shale averages) are also being used. EQSs (Environmental Quality Standards for priority substances provided by WFD, Art.16) have not been published for the sediments yet, therefore, not used as an assessment tool. For the overall chemical status, one-out-all-out principle (according to the WFD) is used among the chemical compounds those ERL criteria applies. Studies are going on to adapt Background Assessment Concentration for specific contaminants in sediments using the methodology developed by OSPAR (2008) in order to use traffic light system for contaminants.

An overall assessment of the chemical status, the eutrophication status and ecosystem quality has not been done yet. In fact, with BEAST eutrophication (pressures) and ecosystem elements (direct and indirect effects) assessments could be made with a single tool. However, in our case, reference values and thresholds are still the weak points of this approach and further work is needed.

Another assessment tool required by the MoEU are trends for contaminants in sediments and biota and nutrient and chlorophyll levels in the surface layer of the water column. In this case, the data availability for long periods (e.g. few decades) obtained systematically (with seasonal and spatial

coherence) becomes important. Attempts have been made, with the data available since 2004, for the marine assessment units and only in few cases significant results have been obtained.

Data quality assurance

Data quality assurance (QA) is achieved in two steps with internal quality control of accredited laboratories and external quality controls. Lately, QA was basically performed as participation to intercalibration exercises (proficiency tests). Attended exercises during 2014-2017 are given in Table 1.16. Partners might agree on the terms of the use of these sheets during the workshops and data assessment exercises.

Table 1.16 - Participated intercalibration exercises for different parameter groups during 2014-2017

Matrix	Sample	Analyte	Proficiency test
Sea Water	QNU312SW QNU313SW QNU314SW	Ammonia, Phosphate Silicate Total-N; Total-P; TOxN	Quasimeme AQ1 Round 2017, 2 (Report Date: Feb.2018)
Chlorophyll and Phaeopigments in Seawater (Filter with natural algae)	QCH088SW QCH089SW	Chlorophyll-a	Quasimeme AQ11 Round 2017, 2 (Report Date: Feb.2018)
Sea Water	QNU298SW QNU299SW QNU300SW	Ammonia, Phosphate Silicate Total-N; Total-P; TOxN	Quasimeme AQ1 Round 2016, 2 (Report Date: Jan.2017)
Sea Water (North Sea)	QNU284SW QNU285SW QNU286SW	Ammonia, Nitrite Phosphate, Silicate Total-N; Total-P; TOxN	Quasimeme AQ1 Round 2015, 2 (Report Date: Feb.2016)
Estuarine water (North Sea)	QNU287EW QNU288EW	Ammonia, Nitrite Phosphate, Silicate Total-N; Total-P; TOxN	Quasimeme AQ2 Round 2015, 2 (Report Date: Feb.2016)
Low salinity seawater (Baltic Sea)	QNU289EW QNU290EW	Ammonia, Nitrite Phosphate, Silicate Total-N; Total-P; TOxN	Quasimeme AQ2 Round 2015, 2 (Report Date: Feb.2016)
Estuarine natural sample (Spuiikom, Oostend, Belgium)	QCH080SW	Chlorophyll-a	Quasimeme AQ11 Round 2015, 2 (Report Date: Feb.2016)
Freshwater natural sample (Markermeer, Netherlands)	QCH081SW	Chlorophyll-a	Quasimeme AQ11 Round 2015,2 (Report Date: Feb.2016)
Filter with natural algae from estuarine water (origin: Kinselmeer, the Netherlands)	Sample 41 Sample 37 Sample 51	Chlorophyll-a	Quasimeme AQ11 Round 2014, 2 (Report Date: Jan.2015)
Filter with natural algae from seawater (MUMM 4 NorthSea)			
Filter with neochloris oleoabundans (origin: AP1, Algea Parc, the Netherlands)			

1.4. Review of the existing monitoring programmes in Ukraine

1.4.1. National legal framework

The marine monitoring activities in Ukraine can be grouped in two basic categories.

- A. Monitoring of activities and pressures.
- B. Monitoring of state (including impacts assessments in relation with pressures).

The first group includes recording of both land and sea-based activities and monitoring of pressures related to them. Some of those are municipal and industrial effluents, rivers, ship accidents and spills, illegal discharges, coastal and offshore oil facilities, dredging and dumping activities, trawling activities, etc. Monitoring and control of them are under the responsibility of Ministry of Ecology and Natural Resources (MoENR), research institutions and universities based on different elements of the national legislation.

The second group of monitoring targets the national assessments of surface waters including the rivers, inland waters, transitional, coastal, and marine waters. One branch of this group of monitoring is the monitoring of river basins including transitional waters and the coastal area impacted by the river flows. This branch is carried out in relation to river basin management plans (RBMP) developed for the implementation of WFD (for which Ukraine has commitments) and the relevant national regulations. The second branch of this group is the monitoring of marine waters including coastal waters being implemented for the requirements of RSCs (BSC, UNEP) and national legislations developed especially for the control of pollution.

The major authority responsible for the implementation of RBMPs (first branch of state monitoring) is MoENR and the responsibilities have been split to different general directorates. It is the major coordinating body for the monitoring and reporting for our seas to the RSCs. In this context, MoENR has been collaborating with different ministries in order to achieve the reporting obligations for the Conventions and the Protocols. However, there is still a lack of national legislation to coordinate the overall planning and implementation of marine monitoring and assessment scheme. Such a tool will obviously not only avoid duplication of efforts of different organizations, but also provide an efficient data/information sharing and better assessments made. This will also support the national and international reporting procedures. These issues have been studied, recommendations made, and road maps prepared in several projects with specific reference to MSFD and the evolving requirements of the RSCs.

Below, in Table 1.17 level of monitoring, some of the related national legislations and the responsible authorities are listed for each group of monitoring components with reference to MSFD.

Table 1.17 - Monitoring activities relevant to MSFD, national and international legislation and responsible authorities

MSFD monitoring element	Level of monitoring	National and International Legislation	Responsible authority
D 1, 4: Biodiversity elements: Birds and mammals	On project basis for identified species and as a part SMMP	Rio Declaration on Environment and Development (1992) Decision of the Cabinet of Ministers "On Approval of the Concept of the National Program for the Conservation of Biodiversity for 2005-2025" (2004) Decision of the Cabinet of Ministers "On strengthening the protection of stocks of valuable species of fish, marine mammals, aquatic invertebrates and aquatic plants" (1992) Decision of the Cabinet of Ministers of Ukraine "On Approval of the national plan to protect the natural environment for 2011-2015" (2011) Decision of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for	MoENR

MSFD monitoring element	Level of monitoring	National and International Legislation	Responsible authority
		the Implementation of State Water Monitoring” (2018) European Marine Strategy Framework Directive (2008)	
D 1, 4, 6: Biodiversity elements: Fish D3 - Fisheries	On projects basis	State law “On Fisheries, Industrial Fisheries and the Protection of Water Bioresources” (2011) Decision of the Cabinet of Ministers of Ukraine “On Approval of the Procedure for the Implementation of State Water Monitoring “ (2018) Bucharest Convention and the Protocol of LBSA European Marine Strategy Framework Directive (2008).	MoENR
D 1, 6: Fish	On projects basis	State Low “On Fisheries, Industrial Fisheries and the Protection of Water Bioresources” (2011) Decision of the Cabinet of Ministers of Ukraine “On Approval of the Procedure for the Implementation of State Water Monitoring” (2018) European Marine Strategy Framework Directive (2008)	MoENR
D 1, 4: Pelagic habitats (Phytoplankton, zooplankton, nutrients, Chl-a, CTD, others)	Systematically monitored: coastal seasonal stations (twice/year summer and autumn) and weekly coastal stations as part of SMMP. Shelf waters annually as a part of SMMP and on the project basis	Bucharest Convention and the Protocol of LBSA Decision of the Cabinet of Ministers of Ukraine “On Approval of the Procedure for the Implementation of State Water Monitoring” (2018) European Marine Strategy Framework Directive (2008)	MoENR
D 1, 4: Pelagic habitats (Phytoplankton, nutrients, Chl-a, CTD, others)	At river basins implemented on projects basis, and regular monitoring of the coastal waters under their influence -at part of annual regional programs	Water Code of Ukraine (1995) Decision of the Cabinet of Ministers “On Approval of the Procedure for the Implementation of State Water Monitoring “(2018) European Marine Strategy Framework Directive (2008)	MoENR
D 1, 6: Benthic habitats (Coastal Macrophytes, soft bottom macro-zoobenthos)	Coastal station systematically monitored (twice/year: summer, autumn) as part of SMMP. Shelf waters annually as a part of SMMP and on the project basis	Decision of the Cabinet of Ministers of Ukraine “On Approval of the Procedure for the Implementation of State Water Monitoring “(2018) Bucharest Convention and the Protocol of LBSA	MoENR
D 1, 6: Benthic habitats	At river basins implemented on projects basis, and regular monitoring of the coastal waters under their influence -at part of annual regional programs	Decision of the Cabinet of Ministers of Ukraine “On Approval of the Procedure for the Implementation of State Water Monitoring” (2018), Marine Strategy Framework Directive (2008)	MoENR
D2: NIS	Monitored for benthic and pelagic habitats as part of SMMP on the project basis	International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004), Marine Strategy Framework Directive (2008)	MoENR
D3: Fish (pressures)	Coastal hot point stations systematically monitored (twice/year: summer, autumn) as part of SMMP.	Marine Strategy Framework Directive (2008)	MoENR

MSFD monitoring element	Level of monitoring	National and International Legislation	Responsible authority
D5: Human induced eutrophication	Monitored for benthic and pelagic habitats as part of SMMP on the project basis	Decision of the Cabinet of Ministers of Ukraine "On Approval of the Concept for the Implementation of the State Policy on Reduction of Pollutant Emissions into the Air, which leads to Acidification, Eutrophication and the Formation of Ground Ozone" (2003) The Protocol to Combat Alkylation, Eutrophication and Ground-level Ozone to the Convention on Long-range Transboundary Air Pollution over the Years 1979 (upd. 2010) Decision of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Implementation of State Water Monitoring" (2018) Marine Strategy Framework Directive (2008)	MoENR
D6: Sea floor integrity (pressures /activities)	No special monitoring activity	State Law "On the protection of the environment" (1991) Decision of the Cabinet of Ministers of Ukraine "On Approval of the National Action Plan on Environmental Protection for 2011-2015" (2011) State law "On Fisheries, Industrial Fisheries and the Protection of Water Bio resources" (2011) Decision of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Implementation of State Water Monitoring" (2018) Marine Strategy Framework Directive (2008)	MoENR
		Decision of the Cabinet of Ministers of Ukraine "On approval of the Concept of the National Program for the Conservation of Biodiversity for 2005-2025" (2004) Administrative regulation "On strengthening the protection of stocks of valuable species of fish, marine mammals, aquatic invertebrates and aquatic plants" (1992) Water Code of Ukraine (1995)	MoENR
D8: Contaminants	Coastal station systematically monitored (twice/year: summer, autumn) as part of SMMP. Shelf waters annually as a part of SMMP and on the project basis	State Law "On the protection of the environment" (1991) Bucharest Convention and the Protocol of LBSA Water Code of Ukraine (1995) State law "On drinking water, drinking water supply and drainage" (2002, 2017)	MoENR
	Industrial wastewater monitoring is done routinely by regional pollution control services. No monitoring of pressures and impacts	Water Code of Ukraine (1995) State law "On drinking water, drinking water supply and drainage" (2002, 2017) Bucharest Convention and the Protocol of LBSA Decision of the Supreme Court of Ukraine "On pollution of water bodies by discharges of return water and garbage" (1998)	MoENR
	At river basins implemented on projects basis, and systematic monitoring the coastal waters under their influence -at part of annual regional programs.	Decision of the Cabinet of Ministers of Ukraine "On Approval of Rules for the Protection of Surface Waters from Pollution by wastewaters" (1999) Water Code of Ukraine (1995) Decision of the Supreme Court of Ukraine "On pollution of water bodies by discharges of return water and garbage" (1998)	MoENR

MSFD monitoring element	Level of monitoring	National and International Legislation	Responsible authority
	Monitoring of contaminants in edible marine products - on project basis	Water Code of Ukraine (1995) Bucharest Convention and the Protocol of LBSA Decision of the Cabinet of Ministers of Ukraine "On approval of the Concept of the National Program for the Conservation of Biodiversity for 2005-2025" (2004) Decision of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Implementation of State Water Monitoring" (2018)	MoENR
	Monitoring of contaminants in few target species - on project basis and as a part of SMMP	Water Code of Ukraine (1995) Decision of the Supreme Court of Ukraine "On pollution of water bodies by discharges of return water and garbage" (1998)	MoENR
	Monitoring at few beaches - on project basis. Monitoring of microplastics (in water and sediments) -on project basis. Monitoring of sea bottom macro litter and floating litter - on the project basis.	Decision of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Implementation of State Water Monitoring" (2018) Bucharest Convention and the Protocol of LBSA Decision of the Cabinet of Ministers of Ukraine "On approval of the Concept of the National Program for the Conservation of Biodiversity for 2005-2025" (2004) Decision of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Implementation of State Water Monitoring" (2018)	MoENR
	Beach and sea floor clean up events / surveys - on project basis	Decision of the Supreme Court of Ukraine „On pollution of water bodies by discharges of return water and garbage“ (1998)	NGOs
D9: Contaminants in sea food	On project basis	Marine Strategy Framework Directive (2008)	
D10: Marine litter	Monitoring at few beaches - on project basis. Monitoring of microplastics (in water and sediments) -on project basis. Monitoring of sea bottom macro litter and floating litter - on the project basis.	Marine Strategy Framework Directive (2008) Decision of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Implementation of State Water Monitoring" (2018)	MoENR
D11: Noise	No special monitoring activity	Marine Strategy Framework Directive (2008) Decision of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Implementation of State Water Monitoring" (2018)	MoENR

1.4.2. National monitoring programmes description

In this section, the SMMP (State Marine Monitoring Programme of the Black and Azov seas), developed under the responsibility of MoENR, will be considered to provide the required information in Table 1.18. Since this Programme is not yet integrated with other projects/programs mentioned in Table 1.18, we added some components which were and will be monitored on project basis.

Nevertheless, SMMP cover most of the ecosystem components elements (D 1, 4, 6) but pay less attention to the pressures and impacts components (D5, D8, D9, D10). Monitoring of NIS is not covered separately but considered with biodiversity elements.

Table 1.18 - Components of SMMP, monitoring parameters, indicators

Monitoring components	Variables/ parameters	Indicators	Relevance to MSFD GES component
Water column habitats: Physical and chemical characteristics (temperature, salinity, transparency, pH, total nitrogen, organic nitrogen, NO ₂ ⁻ , NO ₃ ⁻ , total phosphorus, organic phosphorus, PO ₄ ⁻³ , oxygen, oxygen saturation, BOD ₅)	Levels (concentrations)	Trends at levels, ratios	D1, D4, D5
Water column habitats: Contaminants according to the list*	Levels (concentrations)	Trends at levels, ratios	D1, D4, D5
Water column habitats: photosynthetic pigments; phytoplankton	Concentration Taxonomic composition, abundance, biomass	Trends at levels, shifts among different groups, change in ratios of groups, indices	D1, D2, D4, D5
Water column habitats: mesozooplankton, macrozooplankton	Taxonomic composition, abundance, biomass	Shifts, change in abundance of jellies and <i>N. scintillans</i> , indices	D1, D2, D4
Water column habitats: bioassay by microalgae and <i>Mytilus</i> larvae	Levels	Trends at levels	D1, D4, D8
Benthic habitats: Macrozoobenthos, meiobenthos	Taxonomic composition, abundance	Change in dominance of species/groups, species number, indices: AMBI, m-AMBI, H', trophic structure	D1, D2, D4, D6
Benthic habitats: Macrophytes, microphytobenthos	Taxonomic composition, coverage (%), abundance, biomass	Change/shift in EEI / EEI-c, change in coverage. EEI	D1, D2, D5, D6
Biodiversity elements: Fish	Taxonomic composition, abundance, biomass	Fishing mortality, spawning stock biomass, size-age structure	D1, D2, D4
Biodiversity elements: Birds and mammals	Taxonomic composition, abundance	Trends in abundance, distribution, mortality rates	D1, D2, D4
Contaminants in sediments according to the list*	Levels (concentrations)	Trends in levels, emergency reference level	D8
Contaminants in biota and sea food	Levels (concentrations)	Trends in levels, higher/lower than EU and national food codex	D8, D9
Radionuclides in water and sediments	Levels (concentrations)	If there is any risk in the levels or not, trends	D8
Macro litter at sea floor and Macro litter at beaches	Characterization, numbers, kg/km ² , items/km ²	Baselines, ranges of levels	D10

*List from the Table 1.19

Table 1.19 - List of analyzed (+)/not analyzed (-) contaminants

Contaminant	Water	Sediment	Biota
Trace metals			
Al	-	-	-
Cd	+	-	+
Cr	+	+	+
Cu	+	+	
As	+	+	+
Hg	+	+	+
Pb	+	+	+
Zn	+	+	+
Fe	+	+	-
Ni	+	+	+
Co	+	+	+
Mn	+	+	-
Radioactive metals			
Cs137	+	+	+
Chlorinated pesticides			
DDE	+	+	+
DDD	+	+	+
DDT	+	+	+
DDT total	+	+	+
α -HCH	+	+	+
β -HCH	+	+	+
Lindane	+	+	+
HCH total	+	+	+
Hexachlorobenzene	+	+	+
Heptachlor	+	+	+
Aldrin	+	+	+
Dieldrin	+	+	+
Endrin	+	+	+
Polychlorinated biphenyls			
AR-1254	+	+	+
AR-1260	+	+	+
PCB_8	+	+	+
PCB_18	+	+	+
PCB_31	+	+	+
PCB_28	+	+	+
PCB_52	+	+	+
PCB_49	+	+	+
PCB_44	+	+	+
PCB_66	+	+	+
PCB_101	+	+	+
PCB_77	+	+	+
PCB_110	+	+	+
PCB_149	+	+	+
PCB_118	+	+	+
PCB_153	+	+	+
PCB_105	+	+	+
PCB_138	+	+	+
PCB_187	+	+	+
PCB_126	+	+	+
PCB_183	+	+	+
PCB_128	+	+	+
PCB_174	+	+	+
PCB_177	+	+	+
PCB_180	+	+	+
PCB_199	+	+	+
PCB_170	+	+	+
PCB_196	+	+	+
PCB_194	+	+	+
PCB_206	+	+	+
PCB_209	+	+	+

Contaminant	Water	Sediment	Biota
Polyaromatic hydrocarbons			
Naphthalene	+	+	+
Acenaphthylene	+	+	+
Fluorene	+	+	+
Acenaphthene	+	+	+
Phenanthrene	+	+	+
Anthracene	+	+	+
Fluoranthene	+	+	+
Pyrene	+	+	+
Benzo(a)anthracene	+	+	+
Chrysene	+	+	+
Benzo(b) fluoranthene	+	+	+
Benzo(k) fluoranthene	+	+	+
Benzo(a) pyrene	+	+	+
Dibenzo(a,h) anthracene	+	+	+
Indeno (1,2,3cd) pyrene	+	+	+
Benzo(g,h,i) perylene	+	+	+
Other organic pollutants			
TPHs	+	+	-
Phenols	+	+	-

Geographic coverage, assessment areas and sampling networks

Smmp aspires to cover all coastal, shelf and open marine waters under the national jurisdiction and the underlying seabed under the pressure of human activities. At present, the programme covers only coastal waters and part of the shelf waters, other types of marine waters being monitored on project basis.

Coastal water bodies (in relation to wfd) were identified as a part of state research program “basic estimation and determination of the good ecological status of biocenoses and biodiversity of the black sea within the exclusive maritime economic zone of ukraine” and will be used as a basis of coastal waters monitoring in smmp (Table 1.19). Coastal water bodies extend beyond 1 nm (as defined by wfd) depending on the coastal morphology and structures like bays and estuaries. 32 coastal water bodies that belong to 12 types had been identified along the black sea coast of ukraine (Figure 1.10, Table 1.20).

During the project “Baltic2Black”, 11 marine assessment regions were also identified with expert views by considering the pressures and the ecological/hydrographic characteristics at the north-western black sea shelf and other regions of coastal and deep waters within the exclusive maritime economic zone of Ukraine (Figure 1.11). The units are in fact assumptive and include coastal (at the river mouths transitional too) and marine waters. Each unit was also differentiated based on the influence of rivers, depth range that is related to the typologies and benthic habitats, and other hydrological and hydrochemical conditions.

Table 1.20 - List of delineated coastal water bodies

River basin district	Name	Type	Type code	Water body code
Danube	Marine waters around Zmiinyi island	Mesohaline exposed deep silt - sand	Ua_cw_m_ex_d_ss	Cw1
Dniester	Inside river basin district (from Zatoka to Karolina bugaz)	Mesohaline exposed shallow sand	Ua_cw_m_ex_s_s	Cw4
Black sea region	From Prymorske village to eastern point of Burnas (Lebedevka village)	Mesohaline exposed shallow silt - sand	Ua_cw_m_ex_s_ss	Cw2
	From to eastern point of Burnas (Lebedevka village) to Zatoka village	Mesohaline exposed shallow sand	Ua_cw_m_ex_s_s	Cw3
	From Karolina bugaz village to Lanzheron cape	Mesohaline exposed shallow silt - sand	Ua_cw_m_ex_s_ss	Cw5
	From Lanzheron cape to Fontanka village	Mesohaline sheltered shallow clay - silt	Ua_cw_m_sh_s_cs	Cw6
	From Fontanka village to south eastern point of Kinburn peninsula	Mesohaline exposed shallow silt - sand	Ua_cw_m_ex_s_ss	Cw7

River basin district	Name	Type	Type code	Water body code
	Yahorlyk bay and Tendra bay	Mesohaline sheltered shallow silt - sand	Ua_cw_m_sh_s_ss	Cw8
	From north point of Tendra spit to Dzharylhach island	Mesohaline exposed shallow silt - sand	Ua_cw_m_ex_s_ss	Cw9
	Dzharylhach bay and Karkinitzka bay (from eastern point of Dzharylhach island to Bakalska spit	Mesohaline sheltered shallow silt - sand	Ua_cw_m_sh_s_ss	Cw10
	From eastern point of Dzharylhach island to Bakalska spit to Mizhvodne village)	Mesohaline exposed shallow sand	Ua_cw_m_ex_s_s	Cw11
Crimea	From Mizhvodne village (Cherniy cape) to Uret cape	Mesohaline exposed intermediate silt - sand	Ua_cw_m_ex_i_ss	Cw12
	From Uret cape to Evpatoriyskiy cape	Mesohaline sheltered intermediate silt - sand	Ua_cw_m_sh_i_ss	Cw13
	From Evpatoriyskiy cape to Lukul cape (Kalamitskiy bay)	Mesohaline sheltered intermediate silt - sand	Ua_cw_m_sh_i_ss	Cw14
	From Lukul cape to Hersones cape	Mesohaline sheltered intermediate sand	Ua_cw_m_sh_i_s	Cw15
	From Hersones cape to Sarych cape	Mesohaline exposed deep clay - silt	Ua_cw_m_ex_d_c s	Cw16
	From Sarych cape to Aytodor cape	Mesohaline exposed deep silt - sand	Ua_cw_m_ex_d_ss	Cw17
	From Aytodor cape to Meganome cape	Mesohaline exposed deep clay - silt	Ua_cw_m_ex_d_c s	Cw18
	From Meganome cape to Kiik Atlama cape	Mesohaline exposed intermediate silt - sand	Ua_cw_m_ex_i_ss	Cw19
	From Kiik atlama cape to Chauda cape (Feodosiya gulf)	Mesohaline sheltered intermediate clay - silt	Ua_cw_m_sh_i_cs	Cw20
	From Chauda cape to Takil cape	Mesohaline exposed intermediate sand	Ua_cw_m_ex_i_s	Cw21
	From Takil cape to Borzovka cape	Mesohaline sheltered shallow silt - sand	Ua_cw_m_sh_s_ss	Cw22
	From Borzovka cape to Chagany cape	Mesohaline exposed shallow clay - silt	Ua_cw_m_ex_s_cs	Cw23
	From Chagany cape to Tashyk burun (Kazantip) cape (Kazantip bay)	Mesohaline sheltered shallow clay - silt	Ua_cw_m_sh_s_cs	Cw24
	From Tashyk burun cape to Arabat bay	Mesohaline sheltered shallow clay - silt	Ua_cw_m_sh_s_cs	Cw25
Azov sea region	From Arabat bay along Arabat Spit	Mesohaline exposed shallow clay - silt	Ua_cw_m_ex_s_cs	Cw26
	Utluktskiy liman	Mesohaline sheltered shallow silt - sand	Ua_cw_m_sh_s_ss	Cw27
	Obitochnyi gulf	Mesohaline sheltered shallow silt - sand	Ua_cw_m_sh_s_ss	Cw28
	Berdaynskiy gulf	Mesohaline sheltered shallow clay - silt	Ua_cw_m_sh_s_cs	Cw29
	From Berdyanska spit to Balosarayska spit	Mesohaline sheltered shallow silt - sand	Ua_cw_m_sh_s_ss	Cw30
	Taganrofskiy gulf (from Balosarayska spit to Kryva spit)	Mesohaline sheltered shallow silt - sand	Ua_cw_m_sh_s_ss	Cw31
	From Kryva spit to UA-RUS boarder	Mesohaline exposed shallow silt - sand	Ua_cw_m_ex_s_ss	Cw32

The SMMP number of sampling stations is presented in Table 1.21. 19 stations represent all types of coastal water bodies, at least one station situated in each water body. This number does not include the stations in the nwbs shelf waters and deep waters stations, which are supposed to be carried out within the international programmes. Studies for litter on the sea surface and on beaches are not included in these numbers as well.

Number of stations of SMMP per each parameter group is given in Table 1.21 for 2019-2025 period and map showing marine monitoring programme in the North-Western part of the Black Sea (NWBS) on Figure 1.10 and Figure 1.11.

Table 1.21 - Planned monitoring scheme of UkrSCES (for the North-Western part of the Black Sea)

Monitoring components	No. of stations	No. of indicators	Periodicity, per year	Since 2019
Water column habitats: physical and chemical indicators	37/2*	15	4/52*	4/52*
Water column habitats: specific pollutants	37	63	4	4
Water column habitats: pollutants in the water according to the list**	37	16	4	4
Water column habitats: photosynthesizing pigments (including chl a)	37/2*	4	4/52*	4/52*
Water column habitats: phytoplankton	37/2*	7	4/52*	4/52*
Water column habitats: zooplankton	37/2*	8	4/52*	4/52*
Water column habitats: microbiota	37	2	4	4
Water column habitats: bioassay	37	1	4	4
Benthic habitats: specific pollutants	37	63	4	4
Benthic habitats: pollutants in the water according to the list**	37	16	4	4
Benthic habitats: zoobenthos (macro- and meio)	37	8	4	4
Benthic habitats: macrophytes and microphytobenthos	37	9	4	4
Fish	37	11	4	2
Seabirds	37	11	4	2
Sea mammals	37	8	4	4
Marine litter	37	8	4	4
Noise	37	2	4	1
Hydromorphological indicators	37	4	4	2

* stations of weekly monitoring

** to determine the list of specific synthetic and non-synthetic pollutants, screening water samples and bottom sediments once every six years.

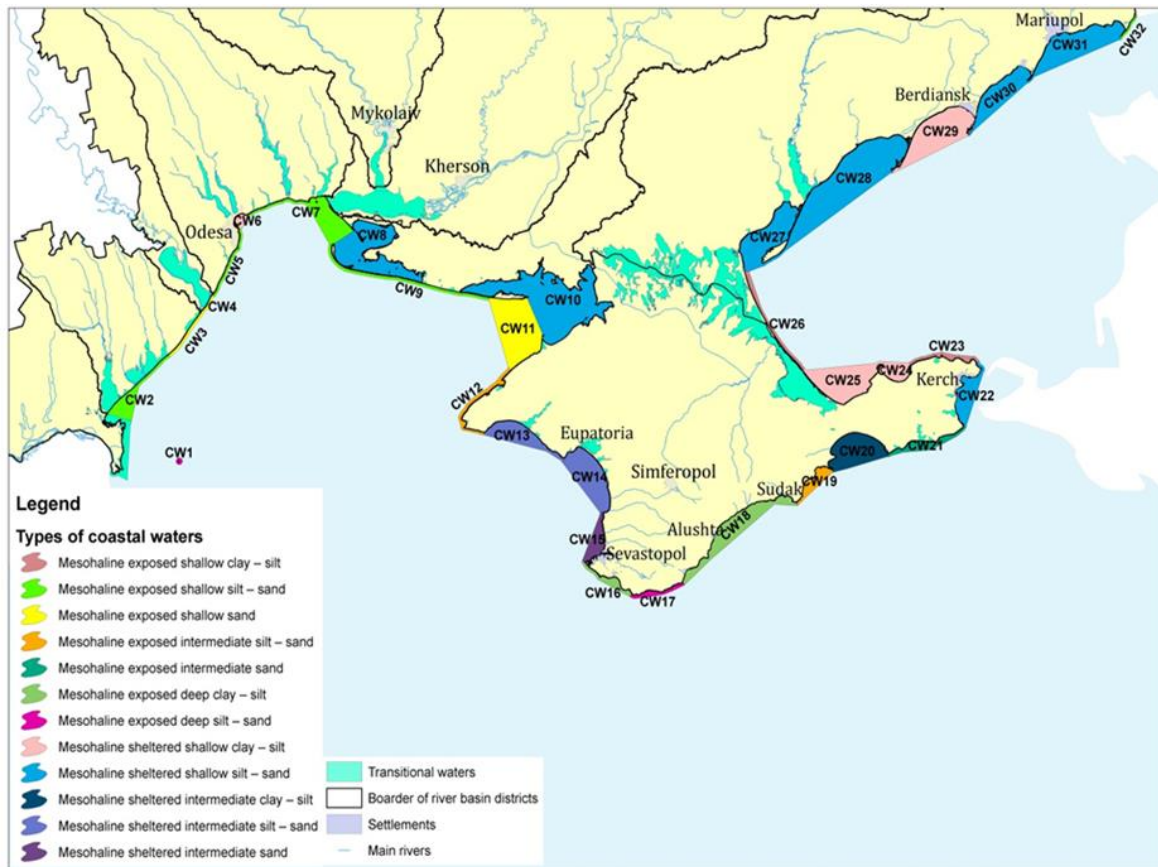


Figure 1.10 - Map of the coastal water bodies (32 colored units) which belong to 12 water types

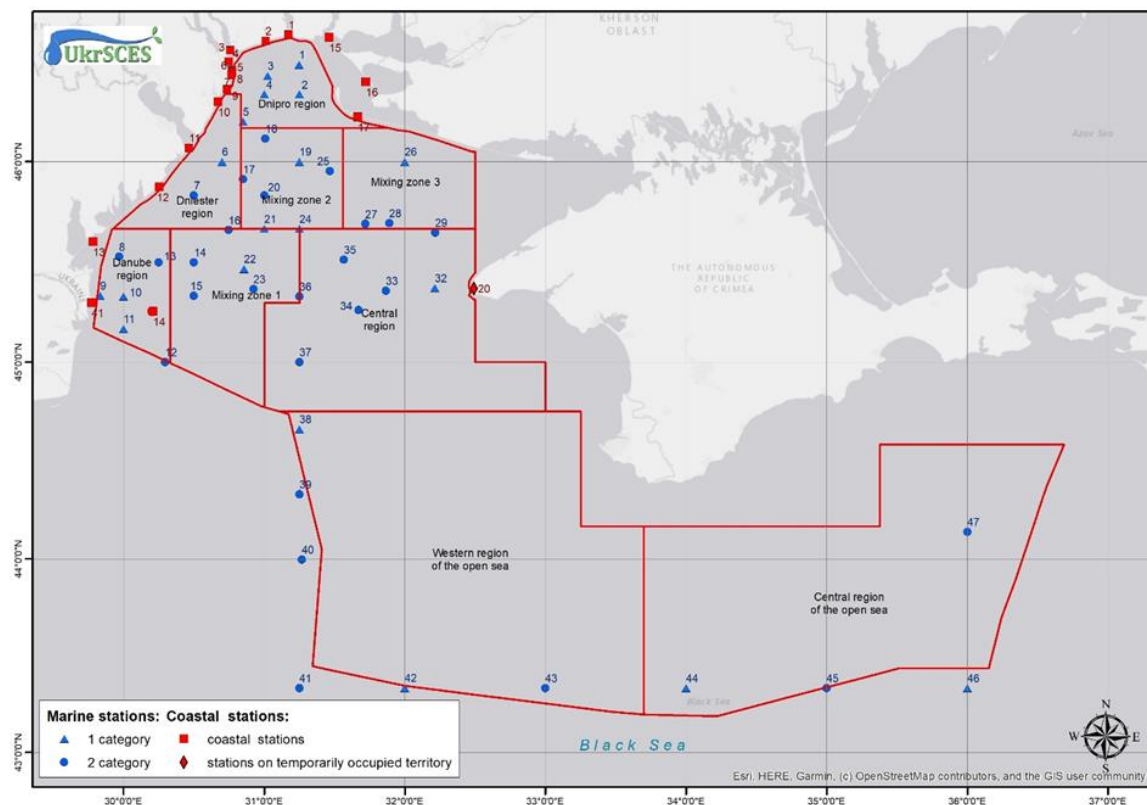


Figure 1.11 - Map showing 9 marine assessment units and monitoring network of UA part of Black Sea

Frequency and seasonality, data acquisition methods

The frequencies of the planned monitoring activities are given in Table 1.21, which includes almost all monitoring or systematic field works. Here, a summary for planned SMMP is given.

According to EMBLAS II and current monitoring scheme of UkrSCES, water column habitats should be monitored seasonally (i.e. four times per year) and for some indicators weekly monitoring should be carried out at two stations of long-term monitoring. Benthic habitats are monitored in the summer period of each year.

Contaminants in sediments has been monitored annually during the summer season.

For fish monitoring, data from observation on industrial fishing vessels and annual catch statistics are also taken into account.

For marine mammals, the registration from vessels on the transects is monitored four times a year (seasonally), and at least once every six years, the aircraft monitoring of abundance, and continuous registration of dead animals on the coast, database maintenance.

For seabirds, annual monitoring at nesting places, wintering places and on-site clusters during coastal migration during the relevant period, continuous monitoring of the findings of dead birds.

Macro litter recording at a pilot beach during the relevant period will be also included in the study.

For noise monitoring, continuous measurement by automatic hydrophones on a representative network of observation points (stations) in the water areas of all territories and objects of the nature reserve fund and in selected areas with high, medium and low anthropogenic load should be provided (15 stations).

In the acquisition of data, usually in situ methods and laboratory analyses have been used. Laboratories are both on board and at the UkrSCES. Remote sensing images are produced for chlorophyll-a distribution using Modis/Aqua Level 2 data. The proposed sites are more related to risk areas/hot spots rather than oceanography focused areas.

Assessment methods

Assessments are made with various methodologies. Indicators (some as given in Table 1.18) have been used as much as possible.

For the ecological quality classification of coastal waters, EQRs for the main biological quality elements (chlorophyll, phyto- and zooplankton, macrophytes, macrophyto-, meio- and macrozoobenthos) were studied in the State Research Program “Basic estimation and determination of the Good ecological status of biocenoses and biodiversity of the Black Sea within the exclusive maritime economic zone of Ukraine”. Reference conditions and sites (for identified typologies) were studied. The class boundaries of appropriate plankton and benthic indices were adjusted according to the developed national species database.

This work has still been ongoing, and the work done in EMBLAS II is being improved in the context of a new project on the identification of reference conditions for all biological quality elements run by MoENR. AMBI has been used since 2012 for Ukrainian seas with national data obtained in research projects and monitoring programme.

Percentile method is applied for the water column data of nutrients and chlorophyll, phytoplankton and zooplankton quantitative characteristics. The period 1950-1960 of “environmental standard” with the expert correction, taking into account the present state, was assumed as the “reference value” for the EQR and classification scaling. All available monitoring data (since 2000) were used in this method. TRIX and BEAST, as a tool for the assessment of eutrophication status, were also applied with reference values obtained with this approach, where thresholds were estimated as +50% reference values.

For the chemical quality status (Good/Bad) of sediments, ERL/ERM and enrichment factors are being used. EQSs have not been published for the sediments yet. In order to assess the quality of sediments, we use the Ecological Standards of Marine Environment Quality developed at UkrSCES in 2009.

Overall assessment of chemical, eutrophication and ecosystem/biodiversity status have not been used yet. In fact, with BEAST eutrophication (pressures) and ecosystem elements (direct/indirect effects)

assessments could be made with a single tool. However, in our case, reference values/thresholds are still the weak points of this approach and need further work.

Trends are another assessment tool required by the MoENR for contaminants in sediments, biota and nutrient, chlorophyll levels in the surface layer of the water column. In this case, the data availability for long periods (e.g. few decades) obtained systematically (with seasonal and spatial coherence) becomes important. Attempts have been made, with the data available since 2000, for the marine assessment units and only in few cases significant results have been obtained.

Data quality assurance

This has been achieved in two steps: with internal quality control and external quality controls. The later has been basically performed as participation in intercalibration and intercomparison exercises (proficiency tests). Attended exercises during 2012-2017 are given in Table 1.22.

Table 1.22 - Participated intercalibration exercises for different parameter groups during 2012-2017

Type	Matrix	Analyte	Proficiency test
intercalibration	Sediment	Trace Elements	Worldwide Interlaboratory Comparison IAEA-MESL-ILC-TE-SEDIMENT-2018
intercalibration	Fish tissues	Trace Elements	Worldwide Interlaboratory Comparison IAEA-MESL-ILC-TE-BIOTA-2017
intercalibration	Sediment	Trace Elements	Intercalibration exercises 2017 (EMBLAS-II)
intercalibration	Sediment	OCPs, PCBs, PAHs	Intercalibration exercises 2017 (EMBLAS-II)
intercalibration	Sediment	Trace Elements, OCPs, PCBs, PAHs	Intercalibration exercises 2016 (EMBLAS-II)
intercalibration	Mussels tissues	Trace Elements, OCPs, PCBs, PAHs	Intercalibration exercises 2016 (EMBLAS-II)
intercalibration	Sediment	Trace Elements	Intercalibration exercises 2015 (IAEA MESL - BLACK SEA-PT-TE)
intercalibration	Mussels tissues	Trace Elements	Worldwide Interlaboratory Comparison IAEA-461-TE-BIOTA-2014
intercalibration	Sediment	OCPs, PCBs, PAHs	Worldwide Laboratory Comparison on the Determination of Organochlorine Compounds, Polybrominated Diphenyl Ethers and Petroleum Hydrocarbons in IAEA-459 Sediment Sample 2013
intercalibration	Biota	Trace Elements	Certification for Trace Elements and Methyl Mercury Mass Fractions in IAEA-452 Scallop (Pecten maximus) Sample-2013
intercalibration	Sediment	Trace Elements	Worldwide Interlaboratory Comparison IAEA-458-TE-SEDIMENT-2012
intercomparison	water column habitats	Phytoplankton	Intercomparison exercises 2016 (EMBLAS II)
intercomparison	water column habitats	Mesozooplankton	Intercomparison exercises 2016 (EMBLAS II)
intercomparison	water column habitats	Macrozooplankton	Intercomparison exercises 2016 (EMBLAS II)
intercomparison	benthic habitats	Macrozoobenthos	Intercomparison exercises 2016 (EMBLAS II)
intercomparison	benthic habitats	Macrophytes	Intercomparison exercises 2016 (EMBLAS II)
intercomparison	water column habitats	Phytoplankton	Intercomparison exercises 2017 (EMBLAS II)
intercomparison	water column habitats	Mesozooplankton	Intercomparison exercises 2017 (EMBLAS II)
intercomparison	water column habitats	Macrozooplankton	Intercomparison exercises 2017 (EMBLAS II)
intercomparison	benthic habitats	Macrozoobenthos	Intercomparison exercises 2017 (EMBLAS II)
intercomparison	benthic habitats	Macrophytes	Intercomparison exercises 2017 (EMBLAS II)

2. Regional aspects in accordance with BSIMAP (2017-2022) requirements

Major regional agreements in the field of Black Sea environment protection are presented in Table 2.1.

Table 2.1 - Black Sea major regional agreements

Nr.	Title of Convention or Agreement or Policy	Date of ratification
1.	Convention on the Protection of the Black Sea Against Pollution and its four Protocols (Bucharest Convention) and Strategic Action Plan	Law no. 98/1992 ratifying the Convention on the Protection of Black Sea Against Pollution
2.	International Convention on the Protection of the Danube River (ICPDR)	1994
3.	Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS)	13.06.2000
4.	Agreement between the Ministry of Environment and Water Management of Romania and Ministry of Environment and Water of the Republic of Bulgaria on Cooperation in the Field of Water Management signed at Bucharest on 12 November 2004	12.11.2004

The Bucharest convention sets out the overall objectives and obligations of the contracting Parties (Bulgaria, Georgia, Romania, Russian Federation, Turkey and Ukraine), the actual implementation of each of these is to be ensured through more detailed and specific protocols. To date, the Black Sea States have ratified the following implementing protocols:

Protocol on Protection of the Black Sea Marine Environment against Pollution from Land-based Sources (the revised Protocol has been signed in 2009, in Sofia; ratified by the Law nr. 158/2014 (OJ nr. 894 / 9.12.2014).

- Protocol on Cooperation in Combating Pollution of the Black Sea marine Environment by Oil and Other Harmful Substances in Emergency Situations ratified in 10.11.1993.
- Protocol on the Protection of the Black Sea marine Environment against Pollution by Dumping ratified in 10.11.1993.
- Protocol on the Black Sea Biodiversity and Landscape Conservation (signed in Sofia, in 14 June 2004) ratified by Law nr. 218/2011.

Strategic action plan for the rehabilitation and protection of the Black Sea, signed in 1996 by all Black Sea states, amended and re-signed on 17th of April 2009. The SAP recognizes the same environment threats as those identified by the MSFD (loss/degradation of biodiversity/habitats, contamination by dangerous substances/nutrients and impacts of climate change), however, sets no environment targets, but only operational according to four Ecosystem Quality Objectives formulated as follow:

- Preserve commercial marine living resources through
- Sustainable use of commercial fish stocks and other marine living resources
- Restore/rehabilitate stocks of commercial marine living resources

Conservation of Black Sea Biodiversity and Habitats through:

- Reducing the risk of extinction of threatened species. Conserving coastal and marine habitats and landscapes
- Reducing and managing human mediated species introductions

Reduce eutrophication through:

- Reducing nutrients originating from land-based sources, including atmospheric emissions

Ensure Good Water Quality for Human Health, Recreational Use and Aquatic Biota through:

- Reducing pollutants originating from land-based sources, including atmospheric emissions
- Reducing pollutants originating from shipping activities and offshore installations.

Danube River Protection Convention is the legal instrument for co-operation and transboundary water management in the Danube River Basin, signed by eleven of the Danube Riparian States and the EC, including three Black Sea states: Bulgaria, Romania, and Ukraine. The International Commission for the Protection of the Danube River (ICPDR) is the implementing body under the Convention on Cooperation for the Protection and Sustainable Use of the Danube River (Danube River Protection Convention, DRPC) and serves as the platform for coordination to develop and establish the Danube River Basin Management Plan (DRBMP). The Danube River Basin District has been defined in the frame of the work of the ICPDR. It covers 1) the Danube River Basin, 2) the Black Sea coastal catchments on Romanian territory, and 3) the Black Sea coastal waters along the Romanian and partly the Ukrainian coast.

Black Sea integrated monitoring and assessment program for years 2017-2022 (BSIMAP 2017-2022) stated aim is to produce quality assured data for scientifically-based and validated indicators for policy-makers of the Contracting Parties of the Bucharest Convention consistent with the environmental quality objectives (EcoQs) of the BS SAP. The guiding document for the BSIMAP is the Strategic Action Plan for Environmental Protection and Rehabilitation of the Black Sea (BS SAP 2009). The coherence with the European Marine Strategy Framework Directive (MSFD) and other international commitments/agreements dealing with the Black Sea environment protection to which the Black Sea states are Contracting Parties shall be sought in order to introduce the best available practices, accumulated knowledge and harmonize approaches.

3. MSFD Compliance

3.1. MSFD Requirements

The Marine Strategy Framework Directive was adopted on 17 June 2008.

The Marine Strategy Framework Directive aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. It is the first EU legislative instrument related to the protection of marine biodiversity, as it contains the explicit regulatory objective that "biodiversity is maintained by 2020", as the cornerstone for achieving GES.

The Directive enshrines in a legislative framework the ecosystem approach to the management of human activities having an impact on the marine environment, integrating the concepts of environmental protection and sustainable use.

In order to achieve its goal, the Directive establishes European marine regions and sub-regions on the basis of geographical and environmental criteria. The Directive lists four European marine regions - the Baltic Sea, the North-east Atlantic Ocean, the Mediterranean Sea and the Black Sea - located within the geographical boundaries of the existing Regional Sea Conventions. Cooperation between the Member States of one marine region and with neighboring countries which share the same marine waters, is already taking place through these Regional Sea Conventions.

In order to achieve GES by 2020, each Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years.

What does a Marine Strategy include?

- The initial assessment of the current environmental status of national marine waters and the environmental impact and socio-economic analysis of human activities in these waters.
- The determination of what GES means for national marine waters.
- The establishment of environmental targets and associated indicators to achieve GES by 2020.
- The establishment of a monitoring programme for the ongoing assessment and the regular update of targets.
- The development of a programme of measures designed to achieve or maintain GES by 2020.

The process is cyclical, and the second cycle starts again in 2018 (NIMRD, 2018), (Figure 3.1).



Figure 3.1 - MSFD implementation cycle³

ANNEX I to MSFD defines the 11 qualitative descriptors for determining good environmental status:

Qualitative descriptors for determining good environmental status

- (1) Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.
- (2) Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.
- (3) Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.
- (4) All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.
- (5) Human-induced eutrophication is minimized, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.
- (6) Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.
- (7) Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.
- (8) Concentrations of contaminants are at levels not giving rise to pollution effects.
- (9) Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.
- (10) Properties and quantities of marine litter do not cause harm to the coastal and marine environment.
- (11) Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

³ http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm

Annex III to MSFD lays down the indicative ecosystem elements, anthropogenic pressures and human activities relevant to the marine waters and with particular relevance for assessment (Article 8(1) of that Directive) with regard to good environmental status (Article 9(1) of that Directive). It also provides the elements for monitoring (Article 11(1) of that Directive), the elements which are complementary to assessment (e.g. temperature, salinity), and the elements for consideration when setting targets (Article 10(1) of the Directive).

Annex III of the Directive was amended in 2017 to better link ecosystem components, anthropogenic pressures and impacts on the marine environment with the MSFD's 11 qualitative descriptors and with the new Decision on Good Environmental Status. Below, the Table 3.1 and Table 3.2 corresponding to Table 1 and 2 of the revised MSFD Annex III are included.

Table 3.1 - Structure, functions and processes of marine ecosystems with particular relevance for point (a) of Article 8(1), and Articles 9 and 11

Theme	Ecosystem elements	Possible parameters and characteristics (Note 1)	Relevant qualitative descriptors laid down in Annex I
Species	Species groups of marine birds, mammals, reptiles, fish and cephalopods of the marine region or subregion	Spatial and temporal variation per species or population: distribution, abundance and/or biomass size, age and sex structure fecundity, survival, and mortality/injury rates behavior including movement and migration habitat for the species (extent, suitability) Species composition of the group.	D1, D3
Habitats	Broad habitat types of the water column (pelagic) and seabed (benthic), or other habitat types, including their associated biological communities throughout the marine region or subregion	Per habitat type: habitat distribution and extent (and volume, if appropriate) species composition, abundance and/or biomass (spatial and temporal variation) size and age structure of species (if appropriate) physical, hydrological, and chemical characteristics Additionally, for pelagic habitats: chlorophyll a concentration plankton bloom frequencies and spatial extent	D1, D6
Ecosystems, including food webs	Ecosystem structure, functions, and processes, comprising: physical and hydrological characteristics chemical characteristics biological characteristics functions and processes	Spatial and temporal variation in: temperature and ice hydrology (wave and current regimes; upwelling, mixing, residence time, freshwater input; sea level) bathymetry turbidity (silt/sediment loads), transparency, sound seabed substrate and morphology salinity, nutrients (N, P), organic carbon, dissolved gases (pCO ₂ , O ₂) and pH links between habitats and species of marine birds, mammals, reptiles, fish and cephalopods pelagic-benthic community structure productivity	D1, D4

Table 3.2 - Anthropogenic pressures, uses and human activities in or affecting the marine environment

2a. Anthropogenic pressures on the marine environment with particular relevance for points (a) and (b) of Article 8(1), and Articles 9, 10 and 11			
Theme	Pressure (Note 1)	Possible parameters	Relevant qualitative descriptors laid down in Annex I (Notes 2 and 3)
Biological	Input or spread of non-indigenous species	Intensity of, and spatial and temporal variation in, the pressure in the marine environment and, where relevant, at source	D2
	Input of microbial pathogens		
	Input of genetically modified species and translocation of native species		
	Loss of, or change to, natural biological communities due to cultivation of animal or plant species		
	Disturbance of species (e.g. where they breed, rest and feed) due to human presence		
	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)		D3
Physical	Physical disturbance to seabed (temporary or reversible)	For assessment of environmental impacts of the pressure, select relevant ecosystem elements and parameters from Table 1	D6, D7
	Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)		
	Changes to hydrological conditions		
Substances, litter and energy	Input of nutrients – diffuse sources, point sources, atmospheric deposition		D5
	Input of organic matter – diffuse sources and point sources		D8, D9
	Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events		
	Input of litter (solid waste matter, including micro-sized litter)		D10
	Input of anthropogenic sound (impulsive, continuous)		D11
	Input of other forms of energy (including electromagnetic fields, light and heat)		
	Input of water – point sources (e.g. brine)		

2b. Uses and human activities in or affecting the marine environment with particular relevance for points (b) and (c) of Article 8(1) (only activities marked * are relevant for point (c) of Article 8(1)), and Articles 10 and 13	
Theme	Activity
Physical restructuring of rivers, coastline, or seabed (water management)	Land claim
	Canalization and other watercourse modifications
	Coastal defense and flood protection*
	Offshore structures (other than for oil/gas/renewables) *
	Restructuring of seabed morphology, including dredging and depositing of materials*
Extraction of non-living resources	Extraction of minerals (rock, metal ores, gravel, sand, shell)*
	Extraction of oil and gas, including infrastructure*
	Extraction of salt*
	Extraction of water*
Production of energy	Renewable energy generation (wind, wave and tidal power), including infrastructure*
	Non-renewable energy generation
	Transmission of electricity and communications (cables)*
Extraction of living resources	Fish and shellfish harvesting (professional, recreational)*
	Fish and shellfish processing*
	Marine plant harvesting*
	Hunting and collecting for other purposes*
Cultivation of living resources	Aquaculture – marine, including infrastructure*
	Aquaculture – freshwater
	Agriculture
	Forestry

2b. Uses and human activities in or affecting the marine environment with particular relevance for points (b) and (c) of Article 8(1) (only activities marked * are relevant for point (c) of Article 8(1)), and Articles 10 and 13	
Theme	Activity
Transport	Transport infrastructure*
	Transport – shipping*
	Transport – air
	Transport – land
Urban and industrial uses	Urban uses
	Industrial uses
	Waste treatment and disposal*
Tourism and leisure	Tourism and leisure infrastructure*
	Tourism and leisure activities*
Security/defense	Military operations (subject to Article 2(2))
Education and research	Research, survey, and educational activities*

The Commission also produced a set of detailed criteria and methodological standards to help Member States implement the Marine Strategy Framework Directive. These were revised in 2017 leading to the new Commission Decision on Good Environmental Status (COMMISSION DECISION (EU) 2017/848 of 17 May 2017). For each of the qualitative descriptors listed in Annex I to MSFD, and on the basis of the indicative lists in Annex III to that Directive, the criteria, methodological standards, specifications and standardized methods were defined for the monitoring and assessment of predominant pressures and impacts, and the environmental status of the essential features and characteristics.

Part I

Criteria, methodological standards, specifications and standardized methods for the monitoring and assessment of predominant pressures and impacts under point (B) of article 8(1) of directive 2008/56/EC

Part I considers the descriptors linked to the relevant anthropogenic pressures: biological pressures (Descriptors 2 and 3), physical pressures (Descriptors 6 and 7) and substances, litter and energy (Descriptors 5, 8, 9, 10 and 11), as listed in Annex III to Directive 2008/56/EC.

DESCRIPTOR 2		
<i>Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.</i>		
<i>Relevant pressure: Input or spread of non-indigenous species.</i>		
<i>Criteria, including criteria elements, and methodological standards.</i>		
Criteria elements	Criteria	Methodological standards
Newly introduced non-indigenous species.	D2C1 – Primary: The number of non-indigenous species which are newly introduced via human activity into the wild, per assessment period (6 years), measured from the reference year as reported for the initial assessment under Article 8(1) of Directive 2008/56/EC, is minimized and where possible reduced to zero. Member States shall establish the threshold value for the number of new introductions of non-indigenous species, through regional or sub regional cooperation.	Scale of assessment: Subdivisions of the region or subregion divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: the number of non-indigenous species newly introduced via human activity, in the 6-year assessment period and a list of those species.
Established non-indigenous species, particularly invasive non-indigenous species, which include relevant species on the list of invasive alien species of Union concern adopted in accordance with Article 4(1) of	D2C2 – Secondary: Abundance and spatial distribution of established non-indigenous species, particularly of invasive species, contributing significantly to	Scale of assessment: As used for assessment of the corresponding species groups or broad habitat types under Descriptors 1 and 6. Use of criteria:

Criteria elements	Criteria	Methodological standards
Regulation (EU) No 1143/2014 and species which are relevant for use under criterion D2C3. Member States shall establish that list through regional or sub regional cooperation.	adverse effects on particular species groups or broad habitat types.	Criterion D2C2 (quantification of non-indigenous species) shall be expressed per species assessed and shall contribute to the assessment of criterion D2C3 (adverse effects of non-indigenous species). Criterion D2C3 shall provide the proportion per species group and extent per broad habitat type assessed which is adversely altered, and thus contribute to their assessments under Descriptors 1 and 6.
Species groups and broad habitat types that are at risk from non-indigenous species, selected from those used for Descriptors 1 and 6. Member States shall establish that list through regional or sub regional cooperation.	D2C3 – Secondary: Proportion of the species group or spatial extent of the broad habitat type which is adversely altered due to non-indigenous species, particularly invasive non-indigenous species. Member States shall establish the threshold values for the adverse alteration to species groups and broad habitat types due to non-indigenous species, through regional or subregional cooperation.	

DESCRIPTOR 3

Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.

Relevant pressure: Extraction of, or mortality/injury to, wild species, including target and non-target species.

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Commercially exploited fish and shellfish. Member States shall establish through regional or subregional cooperation a list of commercially-exploited fish and shellfish, according to the criteria laid down under 'specifications'.	D3C1 – Primary: The Fishing mortality rate of populations of commercially exploited species is at or below levels which can produce the maximum sustainable yield (MSY). Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013.	Scale of assessment: Populations of each species are assessed at ecologically-relevant scales within each region or subregion, as established by appropriate scientific bodies as referred to in Article 26 of Regulation (EU) No 1380/2013, based on specified aggregations of International Council for the Exploration of the Sea (ICES) areas, General Fisheries Commission for the Mediterranean (GFCM) geographical sub-areas and Food and Agriculture Organisation (FAO) fishing areas for the Macaronesian biogeographic region. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: the populations assessed, the values achieved for each criterion and whether the levels for D3C1 and D3C2 and the threshold values for D3C3 have been achieved, and the overall status of the population on the basis of criteria integration rules agreed at Union level; the populations of commercially exploited species in the assessment area which were not assessed. The outcomes of these population assessments shall also contribute to the assessments under Descriptors 1 and 6, if the species are relevant for assessment of particular species groups and benthic habitat types.
	D3C2 – Primary: The Spawning Stock Biomass of populations of commercially exploited species are above biomass levels capable of producing maximum sustainable yield. Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013.	
	D3C3 – Primary: The age and size distribution of individuals in the populations of commercially exploited species is indicative of a healthy population. This shall include a high proportion of old/large individuals and limited adverse effects of exploitation on genetic diversity. Member States shall establish threshold values through regional or subregional cooperation for each population of species in accordance with scientific advice obtained pursuant to Article 26 of Regulation (EU) No 1380/2013.	

DESCRIPTOR 5

Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters. Relevant pressures: Input of nutrients; Input of organic matter.

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Nutrients in the water column: Dissolved Inorganic Nitrogen (DIN), Total Nitrogen (TN), Dissolved Inorganic Phosphorus (DIP), Total Phosphorus (TP). Within coastal waters, as used under Directive 2000/60/EC. Beyond coastal waters, Member States may decide at regional or subregional level to not use one or several of these nutrient elements.	D5C1 – Primary: Nutrient concentrations are not at levels that indicate adverse eutrophication effects. The threshold values are as follows: in coastal waters, the values set in accordance with Directive 2000/60/EC. beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.	Scale of assessment: within coastal waters, as used under Directive 2000/60/EC, beyond coastal waters, subdivisions of the region or subregion, divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: the values achieved for each criterion used, and an estimate of the extent of the assessment area over which the threshold values set have been achieved.
Chlorophyll a in the water column	D5C2 – Primary: Chlorophyll a concentration are not at levels that indicate adverse effects of nutrient enrichment. The threshold values are as follows: in coastal waters, the values set in accordance with Directive 2000/60/EC. beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.	in coastal waters, the criteria shall be used in accordance with the requirements of Directive 2000/60/EC to conclude on whether the water body is subject to eutrophication (5);
Harmful algal blooms (e.g. cyanobacteria) in the water column	D5C3 – Secondary: The number, spatial extent and duration of harmful algal bloom events are not at levels that indicate adverse effects of nutrient enrichment. Member States shall establish threshold values for these levels through regional or subregional cooperation.	beyond coastal waters, an estimate of the extent of the area (as a proportion (percentage)) that is not subject to eutrophication (as indicated by the results of all criteria used, integrated in a manner agreed where possible at Union level, but at least at regional or subregional level).
Photic limit (transparency) of the water column	D5C4 – Secondary: The photic limit (transparency) of the water column is not reduced, due to increases in suspended algae, to a level that indicates adverse effects of nutrient enrichment. The threshold values are as follows: in coastal waters, the values set in accordance with Directive 2000/60/EC. beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.	
Dissolved oxygen in the bottom of the water column	D5C5 – Primary (may be substituted by D5C8): The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse effects on benthic habitats (including on associated biota and mobile species) or other eutrophication effects. The threshold values are as follows: in coastal waters, the values set in accordance with Directive 2000/60/EC; beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.	Beyond coastal waters, the use of the secondary criteria shall be agreed at regional or subregional level. The outcomes of the assessments shall also contribute to assessments for pelagic

Criteria elements	Criteria	Methodological standards
Opportunistic macroalgae of benthic habitats	D5C6 – Secondary: The abundance of opportunistic macroalgae is not at levels that indicate adverse effects of nutrient enrichment. The threshold values are as follows: in coastal waters, the values set in accordance with Directive 2000/60/EC; should this criterion be relevant for waters beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.	habitats under Descriptor 1 as follows: the distribution and an estimate of the extent of the area (as a proportion (percentage)) that is subject to eutrophication in the water column (as indicated by whether the threshold values for criteria D5C2, D5C3 and D5C4, when used, have been achieved); The outcomes of the assessments shall also contribute to assessments for benthic habitats under Descriptors 1 and 6 as follows: the distribution and an estimate of the extent of the area (as a proportion (percentage)) that is subject to eutrophication on the seabed (as indicated by whether the threshold values for criteria D5C4, D5C5, D5C6, D5C7 and D5C8, when used, have been achieved).
Macrophyte communities (perennial seaweeds and seagrasses such as fucoids, eelgrass and Neptune grass) of benthic habitats	D5C7 – Secondary: The species composition and relative abundance or depth distribution of macrophyte communities achieve values that indicate there is no adverse effect due to nutrient enrichment including via a decrease in water transparency, as follows: in coastal waters, the values set in accordance with Directive 2000/60/EC. should this criterion be relevant for waters beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.	
Macrofaunal communities of benthic habitats	D5C8 – Secondary (except when used as a substitute for D5C5): The species composition and relative abundance of macrofaunal communities, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment, as follows: in coastal waters, the values for benthic biological quality elements set in accordance with Directive 2000/60/EC. beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.	

DESCRIPTOR 6

Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

Relevant pressures: Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate); physical disturbance to seabed (temporary or reversible).

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Physical loss of the seabed (including intertidal areas).	D6C1 – Primary: Spatial extent and distribution of physical loss (permanent change) of the natural seabed.	Scale of assessment: As used for assessment of the benthic broad habitat types under Descriptors 1 and 6. Use of criteria: The outcomes of assessment of criterion D6C1 (the distribution and an estimate of the extent of physical loss) shall be used to assess criteria D6C4 and D7C1. The outcomes of assessment of criterion D6C2 (the distribution and an estimate of the extent of physical disturbance pressures) shall be used to assess criterion D6C3. The outcomes of assessment of criterion D6C3 (an estimate of the extent of adverse effect by physical disturbance per habitat type in each assessment area) shall contribute to the assessment of criterion D6C5.
Physical disturbance to the seabed (including intertidal areas).	D6C2 – Primary: Spatial extent and distribution of physical disturbance pressures on the seabed.	
Benthic broad habitat types or other habitat types, as used under Descriptors 1 and 6.	D6C3 – Primary: Spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its functions (e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance. Member States shall establish threshold values for the adverse effects of physical disturbance, through regional or subregional cooperation.	

DESCRIPTOR 7

Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.

Relevant pressures: Physical loss (due to permanent change of seabed substrate or morphology or to extraction of seabed substrate); Changes to hydrological conditions.

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Hydrographical changes to the seabed and water column (including intertidal areas).	D7C1 – Secondary: Spatial extent and distribution of permanent alteration of hydrographical conditions (e.g. changes in wave action, currents, salinity, temperature) to the seabed and water column, associated in particular with physical loss ⁽⁷⁾ of the natural seabed.	Scale of assessment: As used for assessment of the benthic broad habitat types under Descriptors 1 and 6. Use of criteria: The outcomes of assessment of criterion D7C1 (the distribution and an estimate of the extent of hydrographical changes) shall be used to assess criterion D7C2. The outcomes of assessment of criterion D7C2 (an estimate of the extent of adverse effect per habitat type in each assessment area) shall contribute to the assessment of criterion D6C5.
Benthic broad habitats types or other habitat types, as used for Descriptors 1 and 6.	D7C2 – Secondary: Spatial extent of each benthic habitat type adversely affected (physical and hydrographical characteristics and associated biological communities) due to permanent alteration of hydrographical conditions. Member States shall establish threshold values for the adverse effects of permanent alterations of hydrographical conditions, through regional or subregional cooperation.	

DESCRIPTOR 8

Concentrations of contaminants are at levels not giving rise to pollution effects.

Relevant pressures: Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides).

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Within coastal and territorial waters: contaminants selected in accordance with Directive 2000/60/EC: contaminants for which an environmental quality standard is laid down in Part A of Annex I to Directive 2008/105/EC. River Basin Specific Pollutants under Annex VIII to Directive 2000/60/EC, in coastal waters. additional contaminants, if relevant, such as from offshore sources, which are not already identified under point (a) and which may give rise to pollution effects in the region or subregion. Member States shall establish that list of contaminants through regional or subregional cooperation. Beyond territorial waters: the contaminants considered under point (1), where these still may give rise to pollution effects. additional contaminants, if relevant, which are not already identified under point (2)(a) and which may give rise to pollution effects in the region or subregion. Member States shall establish that list of contaminants through regional or subregional cooperation	D8C1 – Primary: Within coastal and territorial waters, the concentrations of contaminants do not exceed the following threshold values: for contaminants set out under point 1(a) of criteria elements, the values set in accordance with Directive 2000/60/EC. when contaminants under point (a) are measured in a matrix for which no value is set under Directive 2000/60/EC, the concentration of those contaminants in that matrix established by Member States through regional or subregional cooperation. for additional contaminants selected under point 1(b) of criteria elements, the concentrations for a specified matrix (water, sediment or biota) which may give rise to pollution effects. Member States shall establish these concentrations through regional or subregional cooperation, considering their application within and beyond coastal and territorial waters. Beyond territorial waters, the concentrations of contaminants do not exceed the following threshold values: for contaminants selected under point 2(a) of criteria elements, the values as applicable within coastal and territorial waters. for contaminants selected under point 2(b) of criteria elements, the concentrations for a specified matrix (water, sediment or biota) which may give rise to pollution effects. Member States shall establish these concentrations through regional or subregional cooperation.	Scale of assessment: within coastal and territorial waters, as used under Directive 2000/60/EC, beyond territorial waters, subdivisions of the region or subregion, divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: for each contaminant under criterion D8C1, its concentration, the matrix used (water, sediment, biota), whether the threshold values set have been achieved, and the proportion of contaminants assessed which have achieved the threshold values, including indicating separately substances behaving like ubiquitous persistent, bioaccumulative and toxic substances (uPBTs), as referred to in Article 8a(1)(a) of Directive 2008/105/EC; for each species assessed under criterion D8C2, an estimate of the abundance of its population in the assessment area that is adversely affected. for each habitat assessed under criterion D8C2, an estimate of the extent in the assessment area that is adversely affected. The use of criterion D8C2 in the overall assessment of good environmental status for Descriptor 8 shall be agreed at regional or subregional level. The outcomes of the assessment of criterion D8C2 shall contribute to assessments under Descriptors 1 and 6, where appropriate.
Species and habitats which are at risk from contaminants. Member States shall establish that list of species, and relevant tissues to be assessed, and habitats, through regional or subregional cooperation.	D8C2 – Secondary: The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergetic effects. Member States shall establish those adverse effects and their threshold values through regional or subregional cooperation.	

Criteria elements	Criteria	Methodological standards
Significant acute pollution events involving polluting substances, as defined in Article 2(2) of Directive 2005/35/EC of the European Parliament and of the Council ⁽⁸⁾ , including crude oil and similar compounds.	D8C3 – Primary: The spatial extent and duration of significant acute pollution events are minimised.	Scale of assessment: Regional or subregional level, divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: an estimate of the total spatial extent of significant acute pollution events and their distribution and total duration for each year. This criterion shall be used to trigger assessment of criterion D8C4.
Species of the species groups, as listed under Table 1 of Part II, and benthic broad habitat types, as listed under Table 2 of Part II.	D8C4 – Secondary (to be used when a significant acute pollution event has occurred): The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated.	Scale of assessment: As used for assessment of the species groups or benthic broad habitat types under Descriptors 1 and 6. Use of criteria: The outcomes of assessment of criterion D8C4 shall contribute, where the cumulative spatial and temporal effects are significant, to the assessments under Descriptors 1 and 6 by providing: an estimate of the abundance of each species that is adversely affected. an estimate of the extent of each broad habitat type that is adversely affected. The use of criterion D8C4 in the overall assessment of good environmental status for Descriptor 8 shall be agreed at regional or subregional level.

DESCRIPTOR 9

Contaminants in fish and other seafood for human consumption do not exceed levels established by Union legislation or other relevant standards.

Relevant pressure: Input of hazardous substances.

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Contaminants listed in Regulation (EC) No 1881/2006. For the purposes of this Decision, Member States may decide not to consider contaminants from Regulation (EC) No 1881/2006 where justified on the basis of a risk assessment. Member States may assess additional contaminants that are not included in Regulation (EC) No 1881/2006. Member States shall establish a list of those additional contaminants through regional or subregional cooperation. Member States shall establish the list of species and relevant tissues to be assessed, according to the conditions laid down under 'specifications'. They may cooperate at regional or subregional level to establish that list of species and relevant tissues.	D9C1 – Primary: The level of contaminants in edible tissues (muscle, liver, roe, flesh or other soft parts, as appropriate) of seafood (including fish, crustaceans, mollusks, echinoderms, seaweed and other marine plants) caught or harvested in the wild (excluding fin-fish from mariculture) does not exceed: for contaminants listed in Regulation (EC) No 1881/2006, the maximum levels laid down in that Regulation, which are the threshold values for the purposes of this Decision. for additional contaminants, not listed in Regulation (EC) No 1881/2006, threshold values, which Member States shall establish through regional or subregional cooperation.	Scale of assessment: The catch or production area in accordance with Article 38 of Regulation (EU) No 1379/2013 of the European Parliament and of the Council ⁽⁹⁾ . Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: for each contaminant, its concentration in seafood, the matrix used (species and tissue), whether the threshold values set have been achieved, and the proportion of contaminants assessed which have achieved their threshold values.

DESCRIPTOR 10

*Properties and quantities of marine litter do not cause harm to the coastal and marine environment.
Relevant pressure: Input of litter.*

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Litter (excluding micro-litter), classified in the following categories ⁽¹³⁾ : artificial polymer materials, rubber, cloth/textile, paper/cardboard, processed/worked wood, metal, glass/ceramics, chemicals, undefined, and food waste. Member States may define further sub-categories.	D10C1 – Primary: The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities.	Scale of assessment: Subdivisions of the region or subregion divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each criterion separately for each area assessed as follows: the outcomes for each criterion (amount of litter or micro-litter per category) and its distribution per matrix used under D10C1 and D10C2 and whether the threshold values set have been achieved. the outcomes for D10C3 (amount of litter and micro-litter per category per species) and whether the threshold values set have been achieved.
Micro-litter (particles < 5mm), classified in the categories ‘artificial polymer materials’ and ‘other’.	D10C2 – Primary: The composition, amount and spatial distribution of micro-litter on the coastline, in the surface layer of the water column, and in seabed sediment, are at levels that do not cause harm to the coastal and marine environment. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities.	The use of criteria D10C1, D10C2 and D10C3 in the overall assessment of good environmental status for Descriptor 10 shall be agreed at Union level.
Litter and micro-litter classified in the categories ‘artificial polymer materials’ and ‘other’, assessed in any species from the following groups: birds, mammals, reptiles, fish or invertebrates. Member States shall establish that list of species to be assessed through regional or subregional cooperation.	D10C3 – Secondary: The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned. Member States shall establish threshold values for these levels through regional or subregional cooperation.	The outcomes of criterion D10C3 shall also contribute to assessments under Descriptor 1, where appropriate.
Species of birds, mammals, reptiles, fish or invertebrates which are at risk from litter. Member States shall establish that list of species to be assessed through regional or subregional cooperation.	D10C4 – Secondary: The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects. Member States shall establish threshold values for the adverse effects of litter, through regional or subregional cooperation.	Scale of assessment: As used for assessment of the species group under Descriptor 1. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as for each species assessed under criterion D10C4, an estimate of the number of individuals in the assessment area that have been adversely affected. follows: The use of criterion D10C4 in the overall assessment of good environmental status for Descriptor 10 shall be agreed at Union level. The outcomes of this criterion shall also contribute to assessments under Descriptor 1, where appropriate.

DESCRIPTOR 11

Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

Relevant pressures: Input of anthropogenic sound; Input of other forms of energy.

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Anthropogenic impulsive sound in water.	D11C1 – Primary: The spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities.	Scale of assessment: Region, subregion or subdivisions. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: for D11C1, the duration per calendar year of impulsive sound sources, their distribution within the year and spatially within the assessment area, and whether the threshold values set have been achieved. for D11C2, the annual average of the sound level, or other suitable temporal metric agreed at regional or subregional level, per unit area and its spatial distribution within the assessment area, and the extent (% km ²) of the assessment area over which the threshold values set have been achieved.
Anthropogenic continuous low-frequency sound in water.	D11C2 – Primary: The spatial distribution, temporal extent and levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities.	The use of criteria D11C1 and D11C2 in the assessment of good environmental status for Descriptor 11 shall be agreed at Union level. The outcomes of these criteria shall also contribute to assessments under Descriptor 1.

Part II

Criteria and methodological standards, specifications and standardised methods for monitoring and assessment of essential features and characteristics and current environmental status of marine waters under point (A) of article 8(1) of directive 2008/56/EC

Part II considers the descriptors linked to the relevant ecosystem elements: species groups of birds, mammals, reptiles, fish and cephalopods (Descriptor 1), pelagic habitats (Descriptor 1), benthic habitats (Descriptors 1 and 6) and ecosystems, including food webs (Descriptors 1 and 4), as listed in Annex III to Directive 2008/56/EC.

Theme - Species groups of birds, mammals, reptiles, fish and cephalopods (relating to Descriptor 1) Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Species of birds, mammals, reptiles and non-commercially exploited species of fish and cephalopods, which are at risk from incidental by-catch in the region or subregion. Member States shall establish that list of species through regional or subregional cooperation, pursuant to the obligations laid down in Article 25(5) of Regulation (EU) No 1380/2013 for data collection activities and taking into account the list of species in Table 1D of the Annex to Commission Implementing Decision (EU) 2016/1251.	D1C1 – Primary: The mortality rate per species from incidental by-catch is below levels which threaten the species, such that its long-term viability is ensured. Member States shall establish the threshold values for the mortality rate from incidental by-catch per species, through regional or subregional cooperation.	Scale of assessment: As used for assessment of the corresponding species or species groups under criteria D1C2-D1C5. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: the mortality rate per species and whether this has achieved the threshold value set. This criterion shall contribute to assessment of the corresponding species under criterion D1C2.
Species groups, as listed under Table 1 and if present in the region or subregion. Member States shall establish a set of species representative of each species group, selected according to the criteria laid down under ‘specifications for the selection of species and habitats’, through regional or subregional cooperation. These shall include the mammals and reptiles listed in Annex II to Directive 92/43/EEC and may include any other species, such as those listed under Union legislation (other Annexes to Directive 92/43/EEC, Directive 2009/147/EC or through Regulation (EU) No 1380/2013) and international agreements such as Regional Sea Conventions.	D1C2 – Primary: The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured. Member States shall establish threshold values for each species through regional or subregional cooperation, taking account of natural variation in population size and the mortality rates derived from D1C1, D8C4 and D10C4 and other relevant pressures. For species covered by Directive 92/43/EEC, these values shall be consistent with the Favorable Reference Population values established by the relevant Member States under Directive 92/43/EEC. D1C3 – Primary for commercially-exploited fish and cephalopods and secondary for other species: The population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity, and survival rates) of the species are indicative of a healthy population which is not adversely affected due to anthropogenic pressures.	Scale of assessment: Ecologically relevant scales for each species group shall be used, as follows: for deep-diving toothed cetaceans, baleen whales, deep-sea fish: region, for birds, small, toothed cetaceans, pelagic and demersal shelf fish: region or subdivisions for Baltic Sea and Black Sea; subregion for North-East Atlantic Ocean and Mediterranean Sea, for seals, turtles, cephalopods: region or subdivisions for Baltic Sea; subregion for North-East Atlantic Ocean and Mediterranean Sea, for coastal fish: subdivision of region or subregion, for commercially exploited fish and cephalopods: as used under Descriptor 3. Use of criteria: The status of each species shall be assessed individually, based on the criteria selected for use, and these shall be used to express the extent to which good environmental status has been achieved for each species group for each area assessed, as follows:

Criteria elements	Criteria	Methodological standards
	Member States shall establish threshold values for specified characteristics of each species through regional or subregional cooperation, taking account of adverse effects on their health derived from D8C2, D8C4 and other relevant pressures. D1C4 – Primary for species covered by Annexes II, IV or V to Directive 92/43/EEC and secondary for other species: The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic, and climatic conditions. Member States shall establish threshold values for each species through regional or subregional cooperation. For species covered by Directive 92/43/EEC, these shall be consistent with the Favorable Reference Range values established by the relevant Member States under Directive 92/43/EEC. D1C5 – Primary for species covered by Annexes II, IV and V to Directive 92/43/EEC and secondary for other species: The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species.	the assessments shall express the value(s) for each criterion used per species and whether these achieve the threshold values set; the overall status of species covered by Directive 92/43/EEC shall be derived using the method provided under that Directive. The overall status for commercially exploited species shall be as assessed under Descriptor 3. For other species, the overall status shall be derived using a method agreed at Union level, considering regional or subregional specificities. the overall status of the species group, using a method agreed at Union level, considering regional or subregional specificities.

Criteria elements - Species groups.

Ecosystem component	Species groups
Birds	Grazing birds
	Wading birds
	Surface-feeding birds
	Pelagic-feeding birds
	Benthic-feeding birds
Mammals	Small toothed cetaceans
	Deep-diving toothed cetaceans
	Baleen whales
	Seals
Reptiles	Turtles
Fish	Coastal fish
	Pelagic shelf fish
	Demersal shelf fish
	Deep-sea fish
Cephalopods	Coastal/shelf cephalopods
	Deep-sea cephalopods

Theme - Pelagic habitats (relating to Descriptor 1).

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Pelagic broad habitat types (variable salinity, coastal, shelf and oceanic/beyond shelf), if present in the region or subregion, and other habitat types as defined in the second paragraph. Member States may select, through regional or subregional cooperation, additional habitat types according to the criteria laid down under 'specifications for the selection of species and habitats'.	D1C6 – Primary: The condition of the habitat type, including its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values for the condition of each habitat type, ensuring compatibility with related values set under Descriptors 2, 5 and 8, through regional or subregional cooperation.	Scale of assessment: Subdivision of region or subregion as used for assessments of benthic broad habitat types, reflecting biogeographic differences in species composition of the habitat type. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as: an estimate of the proportion and extent of each habitat type assessed that has achieved the threshold value set; a list of broad habitat types in the assessment area that were not assessed.

Theme - Ecosystems, including food webs (relating to Descriptors 1 and 4).

Criteria, including criteria elements, and methodological standards.

Criteria elements	Criteria	Methodological standards
Trophic guilds of an ecosystem. Member States shall establish the list of trophic guilds through regional or subregional cooperation.	D4C1 – Primary: The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values through regional or subregional cooperation.	Scale of assessment: Regional level for Baltic Sea and Black Sea; subregional level for North-East Atlantic and Mediterranean Sea. Subdivisions may be used where appropriate. Use of criteria: Where values do not fall within the threshold values, this may trigger further research and investigation to understand the causes for the failure.
	D4C2 – Primary: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values through regional or subregional cooperation.	
	D4C3 – Secondary: The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values through regional or subregional cooperation.	
	D4C4 – Secondary (to be used in support of criterion D4C2, where necessary): Productivity of the trophic guild is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values through regional or subregional cooperation.	

3.2. Gap analysis

The analysis of the nationally identified gaps against MSFD monitoring requirements is summarized in several aspects such as legal compliance, data and information, resources and institutional capacity, scientific and technological development:

Legal compliance

At European level, apart from the MSFD, for eutrophication, contaminants and contaminants in seafood, the existing EU legislation is the WFD, the Nitrates Directive, the Urban Wastewater Treatment Directive, the revised Bathing Water Directive, and the Hazardous Substances Directive. Habitats are covered by the Habitat and Bird Directives and NATURE 2000. Fishery's management is covered by the Common Fishery Policy (CFP).

Depending on EU membership or pre-accession status, different riparian Black Sea countries have transposed fully or partially the EU environmental policies into their national legislation.

In Bulgaria, the legal basis for EU compliant marine monitoring is in place. Management plan of the Black Sea River Basin and Monitoring Programme under the WFD are devised and implemented on regular basis. A Marine Strategy is developed with a comprehensive set of Monitoring Programmes addressing all MSFD descriptors. The responsibilities of different institutions are clearly defined. Coordination between and within the responsible authorities is ensured through the established Consultative and Coordinative Council on the Marine Strategy that brings together representatives of all related sectors and other relevant stakeholders. The administrative capacity needs to be further increased.

In Romania, the environmental legislation is also harmonized with the EU, the actual implementation is reflected in measures taken to improve the environment and various types of monitoring organized to provide the decision-makers with data/information needed for science-based management of environmental protection. Different monitoring responsibilities are distributed among institutions from different sectors and better coordination of their activities is clearly needed.

In Turkey, national legislation to coordinate the overall planning and implementation of the marine monitoring and assessment scheme is still absent. While Turkey is committed to WFD implementation, MSFD is not fully adopted but effort is made through projects to promote its implementation. These are basically for the monitoring of coastal and transitional waters as well as for fisheries and pelagic/benthic biodiversity and contaminants in sea food. Better cooperation is required between the two responsible ministries, MoEU and MoAF, to increase the efficiency of the NIMP against the implementation of MSFD.

In Ukraine, the legal framework for coordinated marine planning and implementation of monitoring is not in place yet. The responsible authority is the Ministry of Ecology and Natural Resources who collaborate with other sectors in order to achieve the reporting obligations for the RSC. The national monitoring programme SMMP covers most of the elements and ecosystem components under MSFD D1, 4, 6, but is less adequate in terms of monitoring the pressures and impacts under MSFD D5, D8, D9, D10.

Data and information

Overall, all countries report that the implementation of the National Monitoring Programmes has been incomplete so far in terms of the spatial-temporal coverage and the parameters/components encompassed.

General observation has been made by all countries that the available monitoring data and information is dispersed among different research bodies and administrative institutions and therefore is not readily available for MSFD utilization. Data policy, storage, sharing and interoperability emerge as critical issues for the efficient MSFD implementation and resources shall be invested for the development of an integrated national databases for the marine environment.

Resources and institutional capacity

The countries point out that comprehensive marine monitoring and assessment during the second MSFD 6-year cycle in the Black Sea region require adequate funding and increased institutional and human capacities.

Scientific and technological

The review of the national monitoring programmes outlined a variety of gaps in the aspects of scientific knowledge and technological development, which are further addressed in the national gaps analysis that follows.

3.2.1. Gaps and requirements identified in Bulgaria

Legal and administrative

Overall, the setting up of the legal and administrative framework for coordinated implementation of the marine monitoring and assessment in Bulgaria is completed.

Bulgaria fully transposed the requirements of the MSFD into its national legislation and a Marine Strategy was developed with a comprehensive set of Monitoring Programmes addressing all MSFD descriptors and updated to the most recent European legislative documents - Commission Decision (EU) 2017/848 on GES and Commission Directive (EU) 2017/845 (amended Annex III of MSFD).

The responsibilities of the administrative and scientific bodies for the marine monitoring and assessment are well defined. Co-ordination between and within the responsible authorities and other stakeholders of the marine environment is established through the Consultative and Coordinative Council to the Council of Ministers on the Marine Strategy. Nevertheless, of the significant progress made so far, the administrative capacity needs to be further increased to meet the demanding requirements of the marine monitoring and assessment European policies.

Data and information

The implementation of the Monitoring Programmes has been incomplete so far in terms of the spatial-temporal coverage and the parameters/components encompassed. Thus, during the second MSFD 6-year cycle 2012-2017, the only extensive monitoring campaign was carried out in 2017 on the majority, but not all, MSFD required elements and parameters. Additional data were collected within research programmes and projects (e.g. funded by grants of the Financial Mechanism of the European Economic Area and EU).

The available data and information are dispersed among different research bodies and administrative institutions and not readily available for MSFD utilization. Data policy, storage, sharing, and interoperability emerge as critical issues for the efficient MSFD implementation and resources shall be invested for the development of an integrated national database for the marine environment.

Resources

Insufficient funding, in addition to institutional, technical, and human capacities continue to represent hindrance to the comprehensive marine monitoring and assessment during the second MSFD 6-year cycle.

Scientific and technological

Gaps in the scientific knowledge on GES - definitions, indicators, ecological thresholds, and environmental targets - have been duly identified in the Programmes and need to be filled in by focused research during the third 6-year cycle of MSFD implementation. Implementation of up-to-date monitoring technologies is necessary in order to increase the efficiency of the monitoring programmes.

The revised Monitoring Programmes outlined a variety of gaps in scientific and technological terms and provided recommendations for improved monitoring as summarized in Table 3.3.

Table 3.3 - Gaps in MSFD implementation in Bulgaria as identified by the Monitoring programmes and recommendations for improved monitoring

Descriptor element	Gaps	Recommendations
D1,6 Benthic habitats	Habitats of the seabed sediments Thresholds for good status according to dissolved oxygen concentration in bottom water (D5C5).	Scientific and technological:

Descriptor element	Gaps	Recommendations
	Thresholds for good status for S, H', AMBI and M-AMBI*n in infra- and circalittoral mud and offshore circalittoral mixed sediments. Thresholds for projected cover of seagrasses. Absent indicators based on functional groups of macrozoobenthos (e.g. longevity) for assessment of the adverse effects from physical disturbance (D6C3), especially by fisheries. Absent indicators and threshold definition for seagrass meadows of <i>Zostera marina</i> L., poly-dominant seagrass communities Absent indicators based on epiphytic growth on seagrass leaves. Absent indicators sensitive to chronic and acute contamination with hazardous substances. Habitats of the hard bottom (reefs) Absent indicators and thresholds for lower infralittoral and circalittoral rock broad habitat types. Absent indicators for chronic and acute contamination with hazardous substances.	Development of additional indicators and validation against the relevant pressures. Definition (determination where lacking), validation and revision of GES thresholds Adaptation and validation of sampling methods, e.g. for destructive and non-destructive sampling of macrophytes. Increase the technical capacity - purchase of new equipment Develop integration approaches at the level of parameters, indicators, criteria, and ecosystem components. Apply up-to-date technological and methodological monitoring approaches such as Full-Featured Flow Cytometer; Plankton Recorder; hydroacoustic methods; buoy stations equipped with chemical and biological sensors, etc.
D1 Non-commercially exploited species of fish	Absent data on the abundance / biomass, population structure and spatial distribution of non-commercially exploited fish species Indicators on criteria D1C1, D1C3 and D1C4 need further development. Development of indicators and criteria for assessing the changes in the components of the marine environment in relation to climate change and their differentiation from the effects of anthropogenic pressure.	Introduction in the monitoring programs of molecular methods for taxonomy of phytoplankton especially related to potentially toxic species. Experimental investigations. Making use of the biogeochemical ARGO profilers real time data for the broad pelagic habitats shelf and open sea.
D1 Marine mammals	Sporadic data on the abundance and distribution, and the demographic characteristics of the cetaceans.	Operational application of the unmanned airborne system model Spy Owl 200 (Project MARLEN) for monitoring and assessment of bloom events in the coastal and shelf pelagic habitats as well as for assessment of the spatial extent of sea grass meadows in the close coastal zone.
D1,4 Pelagic habitats	Absent indicators for the food webs assessment Absent thresholds for winter and autumn seasons for the indicators "Phytoplankton abundance" and "Phytoplankton biomass" in open sea habitat Undeveloped integration approaches	Operational application of the BEAST program as a tool for integrated assessment of eutrophication.
D2 Non-indigenous species	Absent indicators for <i>Beroe ovata</i> , <i>Rapana venosa</i> , etc. invasive pressure and impact.	Operational application of the Program NEAT (developed under Project Devotes, 7FP) for integrated assessment of eutrophication.
D3 Commercially - exploited fish and shellfish	Lack of data on the demographic characteristics of species, as well as assessment of their stock, abundance and biomass.	Development of analytical methods for some contaminants in the marine environment and biota such as dioxins, phthalates, dioxins, phthalates, organotin compounds and brominated diphenyl ethers.
D5 Eutrophication	Validation and revision of the identified thresholds for MSFD N species and P-PO₄ for Spring-Summer (D5C1) Validation and revision of the identified thresholds for WFD N species and P-PO₄ for Spring-Summer (D5C1) Determination of thresholds for the parameters Total N and P for the surface homogeneous layer for spring and summer (WFD and MSFD) (D5C1) Validation and revision of the identified thresholds for O₂ (surface and bottom) -WFD and MSFD for spring and summer (D5C5) Validation and revision of the identified thresholds for chlorophyll a, transparency, intensity, and spatial scale of phytoplankton blooms (D5C2, D5C3, D5C4) Determination of thresholds the parameter "bloom duration" (based on satellite data) (D5C3)	Data and information Regular monitoring with the required spatial resolution and temporal frequency to collect adequate data. Set up national database for marine environmental data. Data policy development and implementation for storage, sharing

Descriptor element	Gaps	Recommendations
	Revision of the threshold for Bac: Din biomass ratio in spring (additional for D5C3) Definition of threshold for epiphytes on sea grass Development of thresholds for the additional parameter Si (D5C1), Total organic carbon (TOC) as a measure of organic loads (D5C1) Development of classification system for: wet biomass of macroalgae from the first and second ecological group (ESGI & ESGII), ecological index EI, proactive coverage of <i>Cystoseira</i> spp. and other macroalgae from ESGI & ESGII for macroalgae communities at depths >3m Insufficient data of relevant spatio-temporal resolution to reflect the natural variability of the parameter (e.g. phytoplankton, macrophytes etc.) and differentiate the natural from anthropogenic impacts Development of thresholds and targets for an additional indicator for seagrass degradation: C%, N%, P% and their ratios in the leaves of genus <i>Zostera</i>	and interoperability of marine environmental data. Improving the data management and information related to the state of the marine environment; improving the access to national and regional databases and data from projects funded by the EC and other financial instruments. Administrative Better co-ordination between and within the responsible authorities and other stakeholders of the marine environment. Ensuring of sufficient capacity of competent authorities and organizations (such as human resources, expertise and equipment) to plan and conduct monitoring of the marine environment.
D8 Contaminants in the marine environment	Absent methods for analyses of some substances such as dioxins, phthalates, organotin compounds, and brominated diphenyl ethers	International cooperation - Cooperation at the regional Black Sea level for setting common ecological indicators and thresholds for GES, and environmental targets. The member state shall elaborate a common list of contaminants that shall be monitored through integration of the lists at the European, regional and national level. Common targets shall be set based on harmonized lists and indicators.
D9 Contaminants in biota	Absent methods for analyses of some substances such as dioxins	
D10 Marine litter	Currently available data for amount, composition, and spatial distribution of marine macro- and microlitter are particularly deficient. More data is needed to define the baseline and thresholds values of individual criteria and indicators.	Integration and improved implementation of all legal documents related to different litter types and their pathways into the marine environment. Completed national adaptation of the guidance provided by MSFD Technical Subgroup on Marine Litter („Guidance on Monitoring of Marine Litter in European Seas“ 2013). Develop the institutional capacity in marine litter monitoring;
D11 Energy and underwater noise	Data deficiency - sufficient datasets need to be gathered on the underwater noise level and its impact on marine fauna in the Bulgarian Black Sea. Currently, data absence does not allow for assessment of the situation and define good status thresholds for D11C1 Impulse noise and D11C2 Continuous low frequency noise. Acoustic surveys are necessary to assess the impact of anthropogenic sound on sensitive cetaceans and fish in the Black Sea.	National Underwater Noise Register to be established on the human activities that generate impulse noise and continuous noise. Establish operational communication between the institutions that will provide data for the National Noise Register. National and regional methodology adaptation or development for underwater noise monitoring, Implementation of standardized monitoring protocol.

3.2.2. Gaps and requirements identified in Romania

The environmental legislation is harmonized with the EU, the actual implementation is reflected in measures taken to improve the environment and various types of monitoring organized to provide the decision-makers with data/information needed for science-based management of environmental protection (MoE Order No. 1023/17.09.2019). Different monitoring responsibilities are distributed among institutions from different sectors and better coordination of their activities is clearly needed. The revised Monitoring Programmes outlined a variety of gaps in scientific and technological terms and provided recommendations for improved monitoring as summarized in Table 3.4.

The priority for the future is to improve the knowledge of the spatio-temporal variations of marine biodiversity and the consequences of global changes on marine ecosystems. In this context, innovative approaches in monitoring programs must be implemented through: standardized methods of sampling and processing; developing new indicators corresponding to the new approaches which will be useful in the decision-making process; integration in biodiversity monitoring campaigns with other data sources (CTD, remote sensing, multibeam, etc.) for the purpose of a complete assessment of the marine ecosystem (Danovaro et al., 2016).

The major challenges for the future are related to: •approaching new research areas, such as underwater noise, marine litter; •application of innovative techniques: remote sensing, molecular methods, modeling;•uncertainties related to: limited budget, effectiveness, integrated monitoring with combined evaluation purposes;•evaluation areas;•temporal variability;•combining MSFD monitoring with research projects dedicated to monitoring certain components;•strengthening comparability between EU Member States.

Table 3.4 - Gaps and requirements to MSFD implementation in Romania for selected qualitative descriptors

DESCRIPTOR 1 - Pelagic habitats	
Criteria	Gaps and recommendations
D1C6 Indicator: Phytoplankton biomass	In addition to the phytoplankton biomass indicator, other indicators for community structure assessment are under development and have not been addressed so far, mainly due to a lack of reliable information on the taxonomic composition description and difficulties in reference levels/values setting. Currently, the assessment is performed only for surface waters (0-10m) and no limit values have been set for the water column, the evaluation in the WFD being only for surface waters. It is necessary for the ecological status assessment to consider the water column stratification by the thermocline presence and the phytoplankton populations maximum development layer (DCM - deep chlorophyll maximum), if the stratification is formed and if there are equipments available for water column profile (CTD).
D1C6 Indicator: Mesozooplankton biomass Indicator: Copepoda biomass	There are no threshold values established for offshore waters. Sampling in the unassessed offshore waters would contribute to the database completion and would provide an overall analysis for all marine reporting units under MSFD.
DESCRIPTOR 1, 6 - Benthic habitats	
Criteria	Gaps and recommendations
D6C1: Spatial extent and distribution of physical loss (permanent change) of the natural seabed. Indicator 1: Extent of habitat physical loss in square kilometres (km ²) as a result of coastal defence works.	Monitoring of physical loss areas as a result of coastal defence works, especially due to their expansion in the southern sector; Lost submerged areas monitoring through upgrading the equipment, extending the measurements (e.g. area and frequency) and updating the analysis methods.

D6C1: Spatial extent and distribution of physical loss (permanent change) of the natural seabed. Indicator 2: Extent of habitat physical loss in square kilometres (km²) as a result of substrate extraction.	Information access on substrate extraction, Monitoring of areas where substrate extraction works are carried out (where applicable).
D6C2: Spatial extent and distribution of physical disturbance pressures on the seabed. Indicator 1: Extent of the physically disturbed area in square kilometres (km²), because of fishing activities impact.	Information access on fishing activities (VMS, logbook, AIS). Measuring equipment updating, monitoring expanding for the affected areas, analysis methods updating (e.g. modelling the impact on the seabed).
D6C2: Spatial extent and distribution of physical disturbance pressures on the seabed. Indicator 2: Emerged and submerged shore area, and the length of the shoreline affected by the morphodynamic processes (erosion/accumulation).	Continuation of the morphodynamic processes monitoring (i.e. shoreline, beach profiles, bathymetric profiles, aerial images, particle size) and introduction of new measurements types (e.g. side-scan, multibeam) and new analysis methods and modelling.
D6C3: Spatial extent of each habitat type which is adversely affected, through a change in its biotic and abiotic structure and its functions (e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance. Indicator 1: Extent of each habitat type adversely affected in square kilometres (km²) or as a proportion (percentage) of the total natural extent of the habitat in the assessment area.	Benthic habitat mapping.
D6C4: The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area. Indicator 1: Extent of habitat loss in square kilometres (km²) and as a proportion (percentage) of the total extent of the habitat type.	Benthic habitat mapping.
D6C5: The magnitude of adverse effects on the condition of benthic habitats caused by anthropogenic pressure. Indicator: M-AMBI*(n).	It is necessary to aggregate the results of the evaluations for the specified criteria in Decision 848/2017 to correctly evaluated the magnitude of the anthropogenic pressure effects . Also, it is necessary to aggregate the evaluation results from the associated descriptors (D2, D3, D5, D7 and D8).
D6C5: The magnitude of adverse effects caused by anthropogenic pressure on benthic habitats condition Indicator: Ecological Index (EI)	Limits are already established for the phytobenthic component of benthic communities, on the basis of which each broad habitat type with its related subtypes is assessed. The integration of the two components, phytobenthic and zoobenthic, is required, for an accurate evaluation of the ecological status of the benthic habitats and also the extension of the monitoring network with sampling from other habitats types and subtypes from the Romanian Black Sea coast. It is also necessary to take into account the pressures exerted on benthic habitats for a proper evaluation of their ecological status.
DESCRIPTOR 1 - Biodiversity - Fish	
Criteria	Gaps and recommendations

D1C1 The mortality rate per species from incidental by-catch	Establishing a list of common Black Sea species (non-commercial) to be included in the monitoring program in order to achieve the MSFD objectives. *For the coastal area, the species <i>Neogobius melanostomus</i> (round goby) was selected for study. *The species analyzed for the offshore area is <i>Squalus acanthias</i> (dog fish) considered a vulnerable species and for which urgent management measures are required.
D1C2 The population abundance (abundance and/or biomass)	Carrying out regular frequency monitoring studies for data evaluation and validation.
D1C3 Distribution by ages and sizes	There are currently no evaluation limits agreed and validated at regional level; it is proposed to establish agreed limits at the level of the Black Sea basin.
DESCRIPTOR 2 - Non-indigenous species	
Criteria	Gaps and recommendations
D2C2: Biomass of non-indigenous species <i>Mnemiopsis leidyi</i>	The biomass of the non-indigenous species <i>Mnemiopsis leidyi</i> was applied at the Romanian coast for four water bodies: coastal; variable salinity waters; marine and offshore, and it is used as a way of monitoring for gelatinous zooplankton populations. It is recommended to conduct expeditions in the season of maximum development of gelatinous zooplankton organisms.
DESCRIPTOR 3 - Commercial species	
Criteria	Gaps and recommendations
D3C1 Fishing mortality rate (F) of populations of commercially exploited species	The fish species being assessed for D3 to be the same with the fish species reported in the frame of DCF.
D3C2 Spawning Stock Biomass (SSB) by commercially exploited species	There is a need to review the limits within the regional Black Sea working groups.
D3C3 Distribution by ages and sizes	There are currently no evaluation limits agreed and validated at regional level; it is proposed to establish agreed limits at the level of the Black Sea basin.
DESCRIPTOR 5	
Criteria	Gaps and recommendations
D5C1: Nutrients in the water column: Dissolved Inorganic Nitrogen (DIN), Total Nitrogen (TN), Dissolved Inorganic Phosphorus (DIP), Total Phosphorus (TP).	Within coastal waters, as used under Directive 2000/60/EC is not applicable for DIN and TN - the thresholds values are not established. For marine waters no thresholds for TN and TP are not established, yet. The existing threshold values are set for surface waters, not water column.
D5C2: Chlorophyll a in the water column	The existing threshold values are set for surface waters, not water column. It is necessary for the ecological status assessment to consider the water column stratification by the thermocline presence and the phytoplankton populations maximum development layer (DCM - deep chlorophyll maximum), if the stratification is formed and if there are equipments available for water column profile (CTD).
D5C3: Harmful algal blooms (e.g. cyanobacteria) in the water column.	The criteria is covered only for <i>Noctiluca</i> biomass. The number, spatial extent and duration of harmful algal bloom events are not yet assessed.
D5C4: Photic limit (transparency) of the water column	The photic limit (transparency) of the water column is not correlated with the increases in suspended algae.
D5C5: Dissolved oxygen in the bottom of the water column	For coastal waters the criteria are developed only for surface.

	For marine waters it could be applied for limited bottom depths due to the natural hypoxic/anoxic conditions in the Black Sea.
D5C6: Opportunistic macroalgae of benthic habitats	Better integration the MSFD monitoring with monitoring requirements of other directives (WFD, Habitats)
D5C7: Macrophyte communities (perennial seaweeds and seagrasses such as fucoids, eelgrass and Neptune grass) of benthic habitats	Further indicators should be developed
D5C8: Except when used as a substitute for D5C5 Macrofaunal communities of benthic habitats	Better integration the MSFD monitoring with monitoring requirements of other directives (WFD, Habitats) Expand the monitoring network for zoobenthic communities in shallow waters
DESCRIPTOR 8	
Criteria	Gaps and recommendations
D8C1 Within coastal and territorial waters, the concentrations of contaminants do not exceed the threshold values.	The programme is fully adequate for data/information collection to assess the distance to GES, as it is defined at present. More research dedicated to interaction of substances (hazardous substances, especially synthetic chemicals, that occur in the environment as mixtures); development of tools/methods for their combined effect on organisms and the ecosystem); To develop monitoring and research on “novel” compounds such as hormones, veterinary medicines and pharmaceuticals; To develop radionuclides monitoring; more research related to pressures and impacts of radionuclides; New biota matrices (highly mobile species-fish, mammals, birds) have to be included in the programme for a better understanding of the effects at the higher levels of the food-web (link with the Descriptor 4). Development of new sampling and observation techniques (passive sampling, in situ voltammetry, satellite images, etc.); New modeling techniques (e.g. biogeochemical modeling, bioaccumulation modeling, etc.) to be developed; Tools for the integrative assessment of contaminants status need to be implemented (eg. HELCOM CHASE). Improving QA/QC; Improving data management.
D8C2 The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergetic effects.	Programme is partially covered. Early stages of research and development for implementing methods. Some biological effect techniques like oxidative enzymes, metallothionein's, lysosomal stability, etc. were tested, but not included yet in contaminants program. More research focusing on the assessment of biological effects of pollution based on biomarkers analyses needed. To develop ecotoxicology monitoring (will offer more information/knowledge for a better understanding of contaminants effects on biological components). New sampling technique and methods have to be developed (financial support and trainings are needed.). Chemical and biological effects monitoring data should be assessed and interpreted in an integrated manner, thus new tools and methods have to be developed (e.g. models, biomarkers, etc.).
D8C3 The spatial extent and duration of significant acute pollution events are minimized.	Not covered For covering this criterion, a subprogramme referring to incident-specific monitoring has to be developed (with the support of other authorities/organizations - e.g. ROSA, Port Authorities, offshore companies, etc.) and also more knowledge is needed for assessing the impact of acute pollution events on the ecosystem.
D8C4: To be used when a significant acute pollution event has occurred):	New tools and methods for assessing the origin, occurrence and extent of acute oil pollution (e.g. aerial and satellite images) need to be developed. The data/information coming from will be used for defining new pressure and impact-based targets, as well as operational targets.

DESCRIPTOR 9							
Criteria	Gaps and recommendations						
D9C1	The programme is adequate in terms of providing data and information needed to assess GES. Presently, the programme provides quite enough data for assessing GES, but some improvements have to be made so that the programme could be considered fully adequate for giving a more robust GES assessment. More data/information is needed either in terms of additional determinants (As, Hg, dioxins, radionuclides, etc. - to be included) or matrix (more commercial fish species- to be selected more species target). Also, the programme has to be improved in terms of data collection. The concentrations below the regulatory levels are not necessarily indicators of good environmental status, since environmental effects might be present at lower concentrations. In this respect, the MSFD - Task Group 9 recommends aggregation between descriptors 8 and 9 for more robust GES definition. The programme has to develop for more data/information acquisition (data regarding the number of contaminants for which exceeding levels have been detected in parallel, origin of the contamination, etc.) or increased knowledge (e.g. possible relations between contaminants in water/sediment and biota, new analytical procedures, improved QA/QC, etc.). Tools for the integrative assessment of contaminants status need to be implemented (eg. HELCOM CHASE).						
DESCRIPTOR 10 - Marine litter							
Criteria	Gaps and recommendations						
D10C1	Floating litter data are small in number and sporadic, so they cannot be used to assess the achievement of good ecological status of the marine ecosystem. Monitoring of microplastics on beaches or the seabed is necessary to be done in the long term (minimum 5 years).						
D10C2	It is necessary to implement long-term monitoring of the amount and composition of litter ingested by marine animals (eg analysis of stomach contents). Such activities have been tested in some species of marine fish, but it is necessary to continue and extend them to other species of marine organisms in the area of the Romanian coast.						
Colour codes <table border="1"> <tr> <td></td><td>Fully adequate</td></tr> <tr> <td></td><td>Partially adequate</td></tr> <tr> <td></td><td>Not covered</td></tr> </table>			Fully adequate		Partially adequate		Not covered
	Fully adequate						
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	Not covered						

3.2.3. Gaps and requirements identified in Turkey

One major gap is still the lack of a dedicated national legal framework to regulate the organization of the marine (including coastal) monitoring, assessment, and reporting activities. The Turkish seas exhibit many various features with great differences in the properties of these marine environments. Besides, the national responsibilities to two different RSCs and of having an internal sea require to achieve a harmonized and well-integrated programme, the coordination of which is not easy and certainly needs to be regulated.

Definitions of marine waters and areas as well as the assessment units need to be clearly made and adopted as part of the monitoring regulation.

Coordination of the monitoring activities needs to be better established and harmonization/integration of programmes and projects under the responsibility of different organizations should be achieved. These are basically between MoEU and MoAF for the monitoring of coastal and transitional waters as well as for fisheries and pelagic/benthic fish biodiversity and contaminants in sea food.

The cooperation between these two ministries and among different branches of them will obviously increase the efficiency of the NIMP against the implementation of MSFD (ecosystem-based management of our seas, hence the Black Sea in cooperation with the other countries). Cooperation with the NGOs and development of the necessary tools and techniques to establish the citizens' contribution to the observing and monitoring system would also improve the monitoring activities a lot especially for some of the components like litter, mammals and birds.

Monitoring of the pressures and activities needs to be established in connection with the ecosystem status/impact monitoring and assessment. NIMP is already hosting these components especially in relation to land-based activities. But the sea-based pressures and maritime activities have not been satisfactorily covered.

In Table 3.5, the proficiency of NIMP and other national efforts against each MSFD GES monitoring component is analyzed (Polat-Beken Ç. et al, 2018). The MarinTurk document is well advanced and includes the present situation for each monitoring component with proposed revisions. In Table 6, evaluations are made at three levels as practiced in EC, 2017. Additionally, a comparison with BSIMAP (2017-2022, with Oct 2018 amendments. Source: MoEU/GD EM) is provided.

Table 3.5 - Gaps of NIMP and recommendation of MarinTurk Project for improvements including the status of other monitoring activities of different ministries/NGOs and a comparison with BSIMAP (red: not covered, yellow: partially adequate, green: fully adequate)

MSFD Groups	GES Descriptor	NIMP MoEU	Other monitoring activities	MarinTurk major recommendations	Compared with BSIMAP
D 1, 4 - Birds - state				Systematic monitoring especially for 4 bird species. Habitats' condition should also be monitored together with the pressures.	Not included within biodiversity component. Related with litter (D10).
D 1, 4 - Cetaceans -state				Systematic monitoring programme or identified species at selected sites and transects should be developed.	Not included within biodiversity component. Related with litter (D10).
D 1, 4, 6 - Fish - state				Pelagic fish should also be monitored besides benthic fish / invertebrates. Need to be at least once a year (present frequency is in adequate)	Not included within biodiversity component. Related with fisheries (D3).
D 1, 4 - Water column habitats - state				Seasonal monitoring is required. Current frequency is inadequate. Should be supported with continuous monitoring sites.	Available. Nutrients, chlorophyll, light transparency, phytoplankton, zooplankton, are mandatory.
D 1, 6 - Benthic habitats-state				In addition to the current implementation of samplings at certain depth intervals, sampling transects from near shore to open waters should be included. Habitats' mapping is a must. Status of sea grass should be monitored as well as both hard and soft substratum.	Available. Macrophytobenthos and macrozoobenthos are mandatory.
D 2 - Non-indigenous species (NIS) - pressure				All related activities and vectors should be monitored and recorded.	Mandatory
D 2 - NIS - state				High risk areas should be focused with specific monitoring methodology.	Mandatory
D 3 - Commercial fish - Pressures				Monitoring system is adequately established. Needs to be integrated with NIMP.	Reporting is mandatory.
D 3 - Commercial fish - State				Stocks of pelagic and benthic species should be monitored on annual basis. Needs to be integrated with NIMP.	Reporting is mandatory.
D 5 - Eutrophication - pressure				River inputs should be systematically monitored (monthly). Regulations for monitoring should be better harmonized and unified, they are fragmented. Recommendations for D 1,4 (pelagic habitats) to be applied.	Available. CTD, DO, NUT, light, mandatory. Reporting on river inputs is required
D 6 - Sea floor integrity - Pressure				Activities exerting pressure on the seabed should be monitored. Impacts to be observed and studied. Recommendations for D 1,6 to be applied.	N/A
D 7 - Hydrographic changes - Pressure				Activities and pressures changing hydrographic conditions should be listed and monitored. EIA /SEA and modelling studies should be developed and enhanced.	N/A

MSFD Groups	GES Descriptor	NIMP MoEU	Other monitoring activities	MarinTurk major recommendations	Compared with BSJMAP
D 8, 9 - Contaminants - Pressure				River inputs should be systematically monitored (monthly / seasonally). EQSs should be developed/ used. Industrial emissions should be estimated with more reliable methodology.	Reporting on pressures is mandatory.
D 8 - Contaminants - State				Monitoring in sea water should be included in the programme.	Available. Some parameters are mandatory, others are optional.
D9 - Contaminants in sea food - State			*	Target edible species should be monitored every year. Numbers of cases exceeding food codexes should be reported.	
D 10 - Marine litter - Pressure / impact				Floating litter at rivers and coastal waters, litter on sea floor, entangled to or digested by marine organisms should be observed and investigated. Citizen science, efforts of NGOs should be developed and better coordinated.	This component is under development. Its impacts on marine life is considered.
D 11 - Noise - Pressure				Activities/pressures data should be collected. Capacity to be developed.	N/A. Pressures/impacts might be considered
D 11 - Noise - State			**	Monitoring improved and models applied.	N/A

* Studies and data is regularly obtained. Access restricted.

** Developing monitoring methodologies, calibration, capacity

3.2.4. Gaps and requirements identified in Ukraine

One of the major gaps is still the lack of a dedicated regulation for the organization of marine (including coastal) and river basin monitoring, assessment and reporting activities. Ukrainian seas exhibit many various features. At first, responsibilities to two different RSCs and having an internal sea, besides the differences in the properties of these marine environments are great. Consequently, to achieve a harmonized and well-integrated programme is required, but the coordination of it is not easy and certainly needs to be regulated.

Definitions of marine waters and areas as well as the assessment units need to be clearly made and adopted as part of the monitoring regulation.

Coordination of the monitoring activities need to be better established and harmonization/integration of programmes and projects under the responsibility of different organizations should be achieved.

Cooperation of MoENR with the NGOs and development of the necessary tools and techniques to establish the citizens' contribution to the observing and monitoring system would also improve the monitoring activities a lot, especially for some of the components like litter, mammals, birds, habitat mapping.

Monitoring of pressures and activities and their integration to status/impact monitoring and assessments need to be strongly established. NIMP is already hosting these components especially in relation to land-based activities. But the sea-based pressures and maritime activities have not been sufficiently covered.

In Table 3.6, the proficiency of SMMP and other national efforts against each MSFD GES monitoring component is analyzed.

Table 3.6 - Gaps of SMMP and recommendation for improvements including the status of other national activities and a comparison with BSIMAP

MSFD GES Descriptor Groups	Existed SMMP	Other monitoring activities/ organizations	UkrSCES major recommendations	Compared with BSIMAP
D 1, 4 - Birds - state	not covered	partially covered	Systematic monitoring program should be developed especially for bird species. Habitats' condition should also be monitored together with the pressures. There could be helpful the collaboration with NGOs and Ukrainian I.I. Mechnikov Anti-Plague Research Institute	Not included within biodiversity component. Related with litter (D10).
D 1, 4 Cetaceans - state	partially covered	not covered	Systematic monitoring programme or identified species at selected sites and transects should be developed.	Not included within biodiversity component. Related with litter (D10).
D 1, 4, 6 Fish - state	not covered	partially covered	Systematic monitoring program should be developed. Pelagic fish should also be monitored besides benthic fish / invertebrates. Need to be at least once a year.	Not included within biodiversity component. Related with fisheries (D3).
D 1, 4 Water column habitats - state	well covered	partially covered	Seasonal monitoring is required. Current frequency is inadequate. Should be supported with continuous monitoring sites not only on the coast but also on the shelf and in the open sea waters. Nutrients, chlorophyll, light transparency, salinity, temperature, phytoplankton, zooplankton are mandatory.	Available. Nutrients, chlorophyll, light transparency, phytoplankton, zooplankton, are mandatory.

MSFD Descriptor Groups	GES	Existed SMMP	Other monitoring activities/ organizations	UkrSCES major recommendations	Compared with BSIMAP
D1, 6 Benthic habitats- state		well covered	partially covered	Should be supported with continuous monitoring sites not only on the coast but also on the shelf and in the open sea waters. Sampling transects from near shore to open waters should be included. Macrophytobenthos and macrozoobenthos are mandatory.	Available. Macrophytobenthos and macrozoobenthos are mandatory.
D2 NIS - state		partially covered	partially covered	High risk areas should be focused with specific monitoring methodology.	Mandatory
D2 Non-indigenous species (NIS) - pressure		partially covered	partially covered	All related activities and vectors should be monitored and recorded. High risk areas should be focused with specific monitoring methodology	Mandatory.
D3 Commercial fish - State		not covered	partially covered	Stocks of pelagic and benthic species should be monitored on annual basis. Needs to be integrated with SMMP	Reporting is mandatory.
D3 Commercial fish - Pressures		not covered	not covered	Monitoring system needs to be integrated with SMMP. Stocks of pelagic and benthic species should be monitored on annual basis. The programme is possible to be carried out together with Research Institute of Marine Fisheries and Oceanography	Reporting is mandatory.
D5 Eutrophication - pressure		partially covered	partially covered	Seasonal monitoring of the river inputs is required. Current frequency is inadequate. Regulations for monitoring should be better harmonized and unified, they are fragmented. Recommendations for D 1,4 (pelagic habitats) to be applied.	Available. CTD, DO, NUT, light, mandatory. Reporting on river inputs is required
D6 - Sea floor integrity - Pressure		not covered	not covered	Systematic monitoring program should be developed. Activities exerting pressure on the seabed should be monitored. Impacts should be observed and studied. Recommendations for D 1,6 to be applied.	Not clearly defined
D7 Hydrographic changes - Pressure		not covered	not covered	Systematic monitoring program should be developed. Activities and pressures changing hydrographic conditions should be listed and monitored. EIA /SEA and modeling studies should be developed and enhanced.	Not clearly defined
D8, 9 Contaminants - Pressure		partially covered	partially covered	Seasonal monitoring of the river inputs is required. EQSs should be developed/ used. Monitoring of Industrial emissions should be integrated with SMMP with the using of appropriate hot point stations.	Reporting on pressures is mandatory.
D8 Contaminants - State		well covered	partially covered	Should be supported with continuous monitoring sites not only on the coast but also on the shelf and in the open sea waters. Seasonal monitoring is required. Current frequency is inadequate.	Available. Some parameters are mandatory, others are optional.
D9 contaminants in sea food – State		partially covered	partially covered	Target edible species should be monitored every year. Numbers of cases exceeding food codices should be reported.	Not clearly defined
D10 Marine litter - Pressure /impact		partially covered	partially covered	Floating litter at rivers and coastal waters, litter on sea floor, entangled to or digested by marine organisms should be observed and investigated. Citizen science, efforts of NGOs should be developed and better coordinated.	This component is under development. Its impact on marine life is considered.

MSFD GES Descriptor Groups	Existed SMMP	Other monitoring activities/ organizations	UkrSCES major recommendations	Compared with BSIMAP
D11 Noise	not covered	not covered	Systematic monitoring program should be developed. Activities/pressures data should be studied. Capacity to be developed. Modelling programs are needed.	N/A - Pressures / impacts might be considered, but not clear.

4. Research needs and recommendations

Based on the analysis of the nationally identified gaps, a summary of the regional research needs is provided in Table 4.1.

Table 4.1 - Research needs and priorities for improved MSFD implementation as identified by the national monitoring programmes

Descriptor - element	Research needs and priorities
D1,6 - Benthic habitats	Development of additional indicators for biodiversity status and seabed integrity assessment and validation against the relevant pressures: indicators based on functional groups of macrozoobenthos (e.g longevity) for assessment of the adverse effects from physical disturbance (D6C3), especially by fisheries. indicators based on epiphytic growth on seagrass. indicators sensitive to chronic and acute contamination with hazardous substances. Improve the assessment of physical disturbance from fisheries using newly developed tools and advice from ICES and Technical group SEABED for MSFD CIS. Definition (where lacking), validation and calibration against the relevant pressures of GES thresholds for biodiversity indicators: thresholds for S, H', AMBI and M-AMBI*n) e.g. for seabed sediments habitats beyond coastal waters. thresholds for indicators of seagrass meadows of <i>Zostera marina</i> and poly-dominant seagrass communities seagrass beds. thresholds for biodiversity indicators in lower infralittoral and circalittoral of the hard bottom habitats (reefs).
D1 - Non-commercially exploited species of fish	Further development of the indicators on criteria D1C1, D1C3 and D1C4 is need. Development of indicators and criteria for assessing the changes in the components of the marine environment in relation to climate change and their differentiation from the effects of anthropogenic pressure.
D1 - Marine mammals	Overcome data deficiency on abundance, distribution, and the demographic characteristics of the cetaceans.
D1,4 - Pelagic habitats	Development of indicators for the food web assessment. Definition, validation, and calibration of GES thresholds for winter and autumn seasons for the plankton indicators in open sea habitat.
D2 - Non-indigenous species	Development of indicators for pressure and impact by priority invasive species <i>Beroe ovata</i> and <i>Rapana venosa</i> .
D3 - Commercially-exploited fish and shellfish	Overcome data deficiency on the demographic characteristics of species, as well as assessment of their stock, abundance, and biomass.
D5- Eutrophication	Validation and revision of the identified thresholds for MSFD N species and P-PO₄ for Spring-Summer (D5C1). Validation and revision of the identified thresholds for WFD N species and P-PO₄ for Spring-Summer (D5C1). Determination of thresholds for the parameters Total N and P for the surface homogeneous layer for spring and summer (WFD and MSFD) (D5C1). Validation and revision of the identified thresholds for O₂ (surface and bottom) -WFD and MSFD for spring and summer (D5C5). Validation and revision of the identified thresholds for chlorophyll a, transparency, intensity and spatial scale of phytoplankton blooms (D5C2, D5C3, D5C4). Determination of thresholds for the parameter "bloom duration" (based on satellite data) (D5C3) Revision of the threshold for Bac: Din biomass ratio in spring (additional for D5C3). Definition of threshold for epiphytes on sea grass. Development of thresholds for the additional parameter Si (D5C1), Total organic carbon (TOC) as a measure of organic loads (D5C1). Development of classification system for: wet biomass of macroalgae from the first and second ecological group (ESGI & ESGII), ecological index EI, proactive coverage of <i>Cystoseira</i> spp. and other macroalgae from ESGI & ESGII for macroalgae communities at depths >3m. Development of thresholds and targets for an additional indicator for seagrass degradation: C%, N%, P% and their ratios in the leaves of genus <i>Zostera</i>.

Descriptor - element	Research needs and priorities
D8 - Contaminants in the marine environment	Development of methods for analyses of some substances such as dioxins, phthalates, organotin compounds and brominated diphenyl ethers. Development of monitoring and research on “novel” compounds such as hormones, veterinary medicines and pharmaceuticals. Development of radionuclides monitoring; more research related to pressures and impacts of radionuclides assessment of biological effects of pollution based on biomarkers analyses needed. Examine the interaction of substances (hazardous substances, especially synthetic chemicals, that occur in the environment as mixtures).
D9 - Contaminants in biota	Development of tools/methods for assessment of combined toxic effect on organisms and the ecosystem. Development of ecotoxicology monitoring (will offer more information/knowledge for a better understanding of contaminants effects on biological components). Inclusion of new biota matrices (highly mobile species-fish, mammals, birds) have to be included in the monitoring programme for a better understanding of the effects at the higher levels of the food-web (link with the Descriptor 4).
D10 - Marine litter	Overcome data deficiency on amount, composition and spatial distribution of marine macro- and microlitter. Define the baseline and thresholds values of individual criteria and indicators.
D11 - Energy and underwater noise	Overcome data deficiency on underwater noise level and its impact on the Black Sea fauna. Define good status thresholds for D11C1 Impulse noise and D11C2 Continuous low frequency noise.
General	Develop integration approaches at the level of parameters, indicators, criteria, and ecosystem components. Overcome data deficiency through systematic collection of monitoring data.

Recommendations

To overcome the gaps and address the monitoring needs the project partners suggest a range of recommendations as listed below:

Scientific and technological

- Apply up-to-date technological and methodological monitoring approaches such as: aerial and satellite imagery (bloom event, oil pollution, seagrass cover), plankton recorders (eutrophication, pelagic biodiversity), biogeochemical ARGO profilers, hydroacoustic methods (underwater noise, seabed habitat mapping, fish stocks assessment, cetacean diversity); buoy stations equipped with chemical and biological sensors (eutrophication), molecular methods for taxonomy of phytoplankton (pelagic biodiversity), etc.
- Develop experimental investigations to study causal relationships between pressures and environmental status.
- Develop and utilize new modeling techniques (e.g. biogeochemical modeling, bioaccumulation modeling, etc.).
- Operational application of the BEAST and NEAT programs as tools for integrated assessment of eutrophication.
- Implement integrative assessment of contaminants status using HELCOM CHASE.

Data and information

- Carry out regular monitoring with the ecologically relevant spatial resolution and temporal frequency to collect adequate data of the parameters and differentiate the natural from anthropogenic impacts.
- Set up national databases for marine environmental data and for the anthropogenic pressures.
- Establish national underwater noise registers on the human activities that generate impulse noise and continuous noise.
- Develop and implement data policy for storage, sharing and interoperability of marine environmental data, improve data and information management.
- Improve the access to national and regional databases and data from projects funded by the EC and other financial instruments.

Legal and administrative

- Adopt and fully implement nationally the European and regional legal documents related to marine monitoring and assessment.
- Where not present, develop legal framework to regulate the organization of the marine (including coastal) monitoring, assessment, and reporting activities.
- Improve the coordination between and within the responsible authorities and other stakeholders of the marine environment.
- Ensure sufficient capacity of the competent authorities and organizations (such as human resources, expertise, and equipment) to plan and conduct monitoring of the marine environment.
- Improve the existing monitoring programmes in line with the revised MSFD Annex III and Commission Decision of 2017 on the criteria and methodological standards.

International cooperation

- Adapt and implement at regional Black Sea level the methodologies and recommendations developed by EC MSFD Technical groups.
- Enhance the cooperation at the regional Black Sea level for setting common ecological indicators and thresholds for GES, and environmental targets.
- Enhance the collaboration between the Black Sea Commission and the European Commission, and their technical and expert groups on marine monitoring and assessment.
- The member state shall elaborate a common list of contaminants that shall be monitored through integration of the lists at the European, regional, and national level.

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ANNEX A Fact sheets of selected monitoring programmes under MSFD in Bulgaria

MONITORING PROGRAMME FOR DESCRIPTOR 1,6 - BENTHIC HABITATS	
1. General	
1.1 Subject area	Programme name: Monitoring Programme for Descriptor 1,6 - Benthic habitats Programme ID: BLKBG_D016-SeabedHabitats
1.2 Definition / Description	The Programmes addresses the following aspects of the Drivers-Pressures-State-Impact-Response (DPSIR) model: Drivers. The human activities that lead to physical pressures on the seabed are addressed by the Programme. These are indicated in Point 2.3 Pressures. The Programme implementation will assist in gathering and analyses of data on physical pressure (loss and disturbance) on the seabed. State and Impact. The Programme will monitor and assess the changes in the benthic habitats state under the impact of different anthropogenic pressures , including physical loss/disturbance (D6), invasive species (D2), commercial harvest of shellfish (D3), eutrophication (D5), hydrographic changes (D7) and contaminants (D8). Ecosystem elements, observed in the Programme are defined according to Table 2, Part II of COMMISSION DECISION (EU) 2017/848 and the amended ANNEX III of MSFD by COMMISSION DIRECTIVE (EU) 2017/845. These include: • Benthic broad habitat types and their associated biological communities • The natural habitat types of Community interest under Directive 92/43/EEC • The goal of the Programme is to provide: • Assessment of the spatial extent and distribution of the physical loss of the natural seabed (D6C1) and the benthic habitats (D6C4), and the physical disturbance on the seabed (D6C2); • Integrated assessment of the extent of the of adverse effects from anthropogenic pressures on the condition of the habitat types (D6C5) arising from the combined anthropogenic pressures and assessed separately under criteria D2C3 (adverse alteration by invasive species), D3C3 (adverse effects on shelfish populations by commercial exploitation), D5C4, D5C5, D5C6, D5C7, D5C8 (primary and secondary effects of eutrophication), D6C3 (adverse effects by physical disturber), D7C2 (adverse effects by hydrographical alterations) and D8C2, D8C4 (effects of chronic and acute pollution).
2. Monitoring requirements and purpose	
2.2 GES criteria and indicators	D6C1 - Primary: Spatial extent and distribution of physical loss (permanent change) of the natural seabed. <u>Relevant pressures:</u> Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate) <u>Indicator for pressure:</u> distribution and area of seabed physical loss (permanent change). <u>Assessment results:</u> distribution (GIS layer) and area (km²) of physical loss (permanent changes) of seabed. D6C2 - Primary: Spatial extent and distribution of physical disturbance pressures on the seabed. <u>Relevant pressures:</u> physical disturbance to seabed (temporary or reversible). <u>Indicator for pressure:</u> distribution and area of seabed under physical disturbance. <u>Assessment results:</u> distribution (GIS layer) and area (km²) of seabed under physical disturbance. D6C3: - Primary: Spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its functions (e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance. <u>Relevant pressures:</u> physical disturbance to seabed (temporary or reversible). <u>Indicators of state:</u> Macrozoobenthic community:

	• Number of species S, Shanno-Weaver community diversity H', Biotic index AMBI (Borja et al. 2000, 2003), multimetric index M-AMBI*ⁿ (average of the normalized S, H' and AMBI) (Sigovini et al. 2013, Todorova et al., 2015) • These and other habitat condition indicators need to be validated for physical disturbance sensitivity. Development of functional indicators (e.g. based on species longevity) is recommended. • % cover of mussel beds of <i>Mytilus galloprovincialis</i> on circalittoral sediment (Todorova et al., 2013) • Average height of <i>Mytilus galloprovincialis</i> (in mussel beds on sediment) (Todorova et al., 2013) Seagrass • Subsurface biomass of <i>Zostera noltei</i>, ratio surface/subsurface biomass <i>Zostera noltei</i>, shoot density of <i>Zostera noltei</i>, shoots length of <i>Zostera noltei</i> (Karamfilov et al. (in review) • Projected cover of seagrass (McKenzie, L.J., Collier, C. and Waycott, M. 2014) Assessment results: distribution (GIS layer), area (km²) and proportion (%) of each habitat type adversely affected by physical disturbance based on achieving the thresholds of the indicators under criterion D6C3. D6C4 - Primary: The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area. Member States shall establish the maximum allowable extent of habitat loss as a proportion of the total natural extent of the habitat type, through cooperation at Union level, taking into account regional or subregional specificities. Relevant pressures: Physical loss. Indicator of state: distribution (GIS layer), area (km²) and proportion (%) of loss of each habitat type. D6C5 - Primary: The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), does not exceed a specified proportion of the natural extent of the habitat type in the assessment area. Member States shall establish threshold values for adverse effects on the condition of each habitat type, ensuring compatibility with related values set under Descriptors 2, 5, 6, 7 and 8, through cooperation at Union level, taking into account regional or subregional specificities. Member States shall establish the maximum allowable extent of those adverse effects as a proportion of the total natural extent of the habitat type, through cooperation at Union level, taking into account regional or subregional specificities. Assessment results: distribution (GIS layer), area (km²) and proportion (%) of cumulative adverse effects from different pressures addressed under Descriptors 2, 5, 6, 7 and 8, including habitat loss of each habitat type, and assessment if the spatial threshold for maximum allowable extent of adverse effects is reached. The assessment under D6C5 combines the assessments of the adverse effects from pressures, including under criteria D2C3, D3C3, D5C4, D5C5, D5C6, D5C7, D5C8, D6C3, D7C2, D8C2 and D8C4 as follows: D2C3 – Secondary: Proportion of the spatial extent of the broad habitat type which is adversely altered due to non-indigenous species, particularly invasive non-indigenous species. Member States shall establish the threshold values for the adverse alteration to species groups and broad habitat types due to non-indigenous species, through regional or subregional cooperation. Relevant pressure: Input or spread of non-indigenous species. Indicator of state: Biomass ratio of bivalve prey/invasive predator <i>Rapana venosa</i> (Todorova, this document) Assessment results: distribution (GIS layer), area (km²) and proportion (%) of each habitat type adversely altered due to invasive non-indigenous species. D3C3: The age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population. This shall include a high proportion of old/large individuals and limited adverse effects of exploitation on genetic diversity. Relevant pressure: Extraction of, or mortality/injury to, wild species, including target and non-target species
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	<u>Indicator of state:</u> 95 percentile of the height (H) and length (L) of the commercially exploited bivalves <i>Donax trunculus</i>, and <i>Chamelea gallina</i> (Todorova et al., 2016) D5C4 - Secondary: The photic limit (transparency) of the water column is not reduced, due to increases in suspended algae, to a level that indicates adverse effects of nutrient enrichment. <u>Relevant pressures:</u> Input of nutrients; Input of organic matter <u>Indicator of state:</u> water transparency depth (m) D5C5 - Primary: The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse effects on benthic habitats (including on associated biota and mobile species) or other eutrophication effects. <u>Indicator of state:</u> concentration (mg/l) of dissolved oxygen in the bottom of the water column D5C6 – Secondary: The abundance of opportunistic macroalgae is not at levels that indicate adverse effects of nutrient enrichment. <u>Indicators of state:</u> % wet biomass of the tolerant macroalgae (ESGII), standardised for infralittoral rock down to 3 m depth (Dencheva K., Doncheva V., 2014, Berov D., 2015); Ecological index EI, standardised for infralittoral rock down to 3 m depth (Dencheva, Doncheva, 2014, Berov D., 2015); Epiphyte growth on seagrass leaves (Brush M. and S. Nixon, 2002) D5C7 Secondary: The species composition and relative abundance or depth distribution of macrophyte communities achieve values that indicate there is no adverse effect due to nutrient enrichment including via a decrease in water transparency. <u>Indicators of state:</u> • % wet biomass of the macroalgae from ESGI, standardised for infralittoral rock down to 3 m depth (Dencheva K., Doncheva V., 2014, Berov D., 2015) • Ecological index EI, standardised for infralittoral rock down to 3 m depth (Dencheva, Doncheva, 2014, Berov D., 2015); • Projected cover of <i>Cystoseira</i> spp and other macroalgae from ESGI, standardised for infralittoral rock down to 3 m depth (Orfanidis et al. 2011, with modifications from Berov, 2013, for upper infralittoral at depth 2-3 m; • Lower distribution depth of <i>Cystoseira barbata</i> и <i>C. bosporica</i> (if suitable substrate is available) (Lundalv et al., 1986, Norderhaug et al., 2015, Milchakova & Petrov, 2003, Berov, 2013); • Lower distribution depth of seagrass beds (Petrova-Karadjova V., 1982) • Lower distribution depth of <i>Phyllophora crispa</i> (if suitable substrate is available); • Total projected cover by the species <i>Phyllophora crispa</i>, <i>Apoglossium ruscifolium</i>, <i>Zanardinia typus</i>, <i>Gelidium spinosum</i> as well as species from ESGI for lower infralittoral. • Subsurface wet biomass of <i>Zostera noltei</i>, ratio surface/subsurface biomass <i>Zostera noltei</i>, shoot density of <i>Zostera noltei</i>, shoots length of <i>Zostera noltei</i> (Karamfilov et al., in review) D5C8 – Secondary (except when used as a substitute for D5C5): The species composition and relative abundance of macrofaunal communities, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment. <u>Indicators for state:</u> Number of species S, Shannon-Weaver community diversity H', Biotic index AMBI (Borja et al. 2000, 2003), multimetric index M-AMBI*n (average of the normalized S, H' and AMBI) (Sigovini et al. 2013, Todorova et al., 2015) with thresholds standardised for each habitat type and subtype as necessary. D7C2 – Secondary: Spatial extent of each benthic habitat type adversely affected (physical and hydrographical characteristics and associated biological communities) due to permanent alteration of hydrographical conditions. <u>Relevant pressures:</u> Physical loss (due to permanent change of seabed substrate or morphology or to extraction of seabed substrate); Changes to hydrological conditions <u>Indicators for state:</u> Indicators for the adverse effects on the physical and hydrological characteristics are given in the Programme for D7.
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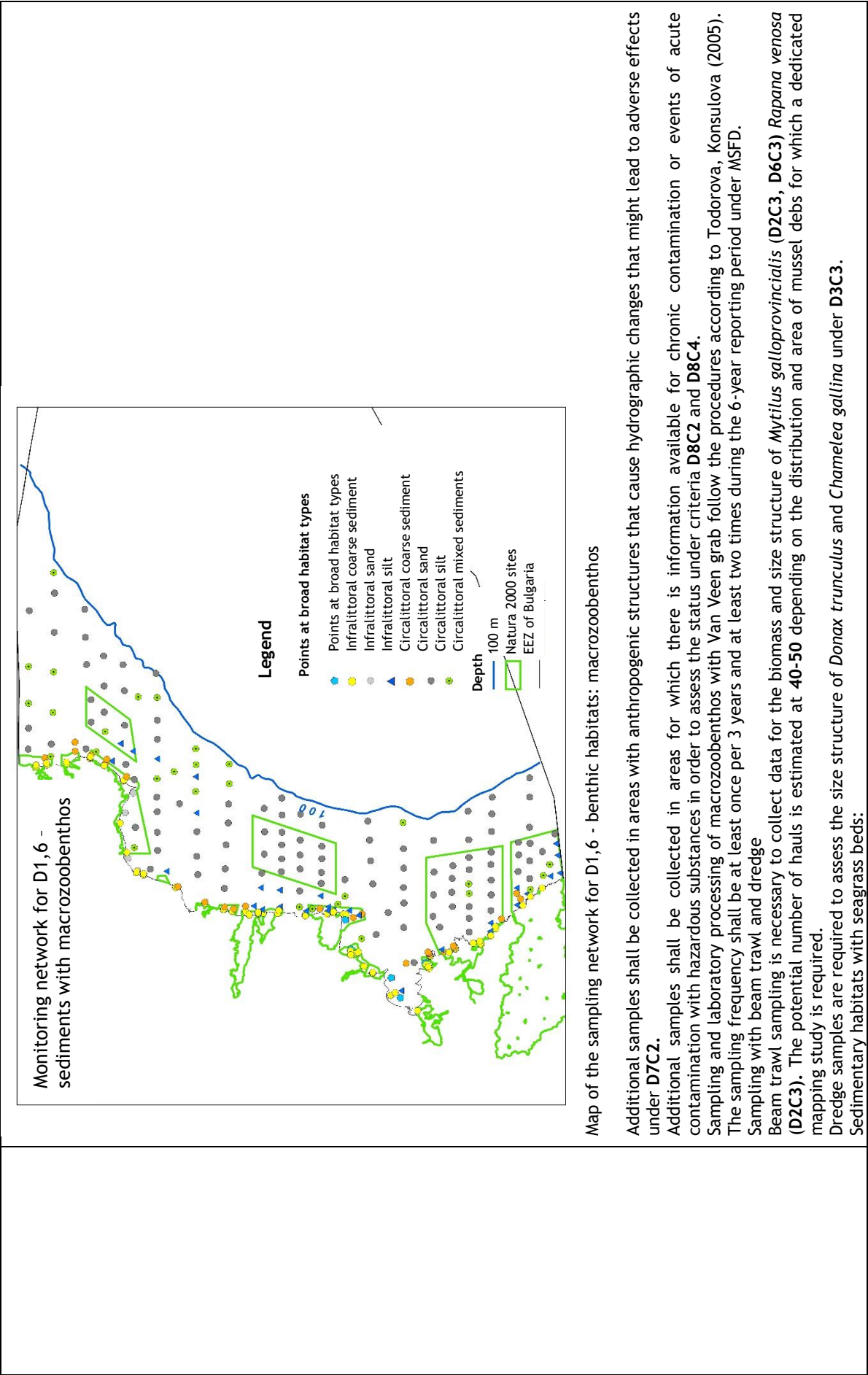
	Macrozoobenthic communities: • Number of species S, Shannon-Weaver community diversity H', Biotic index AMBI (Borja <i>et al.</i> 2000, 2003), multimetric index M-AMBI*ⁿ (average of the normalized S, H' and AMBI) (Sigovini <i>et al.</i> 2013, Todorova <i>et al.</i>, 2015) with thresholds standardised for each habitat type and subtype as necessary.; • Abundance, biomass and size structure of <i>Donacilla cornea</i> (Todorova <i>et al.</i>, 2013) Macrophytobenthic communities: • % wet biomass of the macroalgae from ESGI, standardised for infralittoral rock down to 3 m depth (Dencheva K., Doncheva V., 2014, Berov D., 2015) • Ecological index EI, standardised for infralittoral rock down to 3 m depth (Dencheva, Doncheva, 2014, Berov D., 2015); • Lower distribution depth of seagrass beds (Petrova-Karadjova V., 1982); • Epiphyte growth on seagrass leaves (Brush M. and S. Nixon, 2002); • Subsurface wet biomass of <i>Zostera noltei</i>, ratio surface/subsurface biomass <i>Zostera noltei</i>, shoot density of <i>Zostera noltei</i>, shoots length of <i>Zostera noltei</i> <u>Assessment results:</u> distribution (GIS layer), area (km²) and proportion (%) of each benthic habitat type adversely affected due to changes in the hydrological conditions base on achieving the indicators. D8C2 – Secondary: The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergetic effects. <u>Relevant pressures:</u> Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) <u>Indicators of state:</u> Macrozoobenthic communities: • Number of species S, Shannon-Weaver community diversity H', Biotic index AMBI (Borja <i>et al.</i> 2000, 2003), multimetric index M-AMBI*ⁿ (average of the normalized S, H' and AMBI) (Sigovini <i>et al.</i> 2013, Todorova <i>et al.</i>, 2015) with thresholds standardised for each habitat type and subtype as necessary.; • The indicators need to be validated against the pressure from contaminants. Macrophytobenthic communities: Indicators are not developed yet. <u>Assessment results:</u> distribution (GIS layer), area (km²) and proportion (%) of each benthic habitat type adversely affected due to chronic contamination with hazardous substances based on achieving the indicators thresholds. D8C4 – Secondary (to be used when a significant acute pollution event has occurred): The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated. Macrozoobenthic communities: • Number of species S, Shannon-Weaver community diversity H', Biotic index AMBI (Borja <i>et al.</i> 2000, 2003), multimetric index M-AMBI*ⁿ (average of the normalized S, H' and AMBI) (Sigovini <i>et al.</i> 2013, Todorova <i>et al.</i>, 2015) with thresholds standardised for each habitat type and subtype as necessary.; • The indicators need to be validated against the pressure from contaminants. Macrophytobenthic communities: Indicators are not developed yet. <u>Assessment results:</u> distribution (GIS layer), area (km²) and proportion (%) of each benthic habitat type adversely affected due to acute contamination with hazardous substances based on achieving the indicators thresholds. Monitoring is carried out in cases of acute pollution events.
2.3 Features, pressures and impacts	Ecosystem elements (according to Table 2, Part II of COMMISSION DECISION (EU) 2017/848 and Annex III, Tabl. 1 of COMMISSION DIRECTIVE (EU) 2017/845): Broad habitat types and their associate biological communities

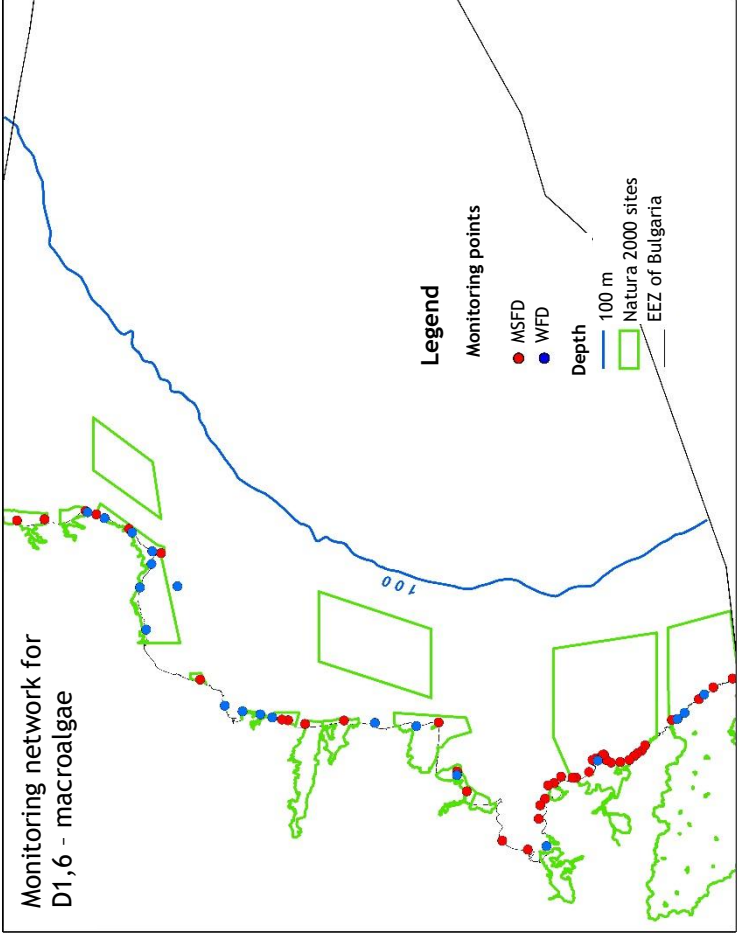
	The natural habitat types of Community interest under Directive 92/43/EEC. The representative national broad habitat types include: Mediolittoral sediments (Annex I HD: 1140) Infralittoral rock (Annex I HD: 1170) Infralittoral sand (Annex I HD: 1110) Circalittoral rock and biogenic reef (Annex I HD: 1170) Circalittoral sand and coarse sediments (Annex I HD: 1110) Circalittoral mud Circalittoral mixed sediments Habitat characteristics: distribution and area species composition, abundance and/or biomass (spatial and temporal variability) size structure of the species physical characteristics (grainsize of sediment, depth, transparency) chemical characteristics (dissolved oxygen, nutrients, organic carbon in sediments) Pressures Physical loss Physical disturbance Other relevant pressures as described under Descriptors 2, 3, 5, 7 and 8. Uses and human activities:																																
	<table><tr><th colspan="2">Uses and human activities</th><th rowspan="2">Activities in the Bulgarian Black Sea relevant to D6</th></tr><tr><th>Theme</th><th>Activity</th></tr><tr><td rowspan="2">Physical restructuring of coastline or seabed (water management)</td><td>Land claim</td><td>dikes, beach nourishing</td></tr><tr><td>Coastal defence and flood protection</td><td>groins, dikes, wave-breakers, incl. floating and underwater</td></tr><tr><td rowspan="2">Extraction of non-living resources</td><td>Extraction of oil and gas, including infrastructure</td><td>Oil/gas platforms and pipelines</td></tr><tr><td>Extraction of minerals (rock, metal ores, gravel, sand, shell)</td><td>Dredging</td></tr><tr><td rowspan="2">Production of energy</td><td>Renewable energy generation (wind, wave and tidal power), including infrastructure</td><td>Platforms of wind and wave farms, cables</td></tr><tr><td>Transmission of electricity and communications (cables)</td><td>Underwater cables</td></tr><tr><td>Extraction of living resources</td><td>Fish and shellfish harvesting</td><td>Bottom trawling, near-bottom pelagic trawling, beam-trawling, dredging, hydraulic dredging</td></tr><tr><td>Transport</td><td>Transport infrastructure</td><td>Ports and marinas</td></tr><tr><td>Urban and industrial uses</td><td>Urban and industrial uses</td><td>Water treatment plants discharges</td></tr><tr><td>Tourism and leisure</td><td>Tourism and leisure infrastructure</td><td>Bridges, yacht marinas, artificial islands</td></tr></table> Definition of GES under Descriptors 1, 6 The extent, area and condition of the benthic habitat types, including their biotic structure (the typical species composition of the associated biological communities and the relative abundance of the species, the size structure of the typical species) and abiotic characteristics	Uses and human activities		Activities in the Bulgarian Black Sea relevant to D6	Theme	Activity	Physical restructuring of coastline or seabed (water management)	Land claim	dikes, beach nourishing	Coastal defence and flood protection	groins, dikes, wave-breakers, incl. floating and underwater	Extraction of non-living resources	Extraction of oil and gas, including infrastructure	Oil/gas platforms and pipelines	Extraction of minerals (rock, metal ores, gravel, sand, shell)	Dredging	Production of energy	Renewable energy generation (wind, wave and tidal power), including infrastructure	Platforms of wind and wave farms, cables	Transmission of electricity and communications (cables)	Underwater cables	Extraction of living resources	Fish and shellfish harvesting	Bottom trawling, near-bottom pelagic trawling, beam-trawling, dredging, hydraulic dredging	Transport	Transport infrastructure	Ports and marinas	Urban and industrial uses	Urban and industrial uses	Water treatment plants discharges	Tourism and leisure	Tourism and leisure infrastructure	Bridges, yacht marinas, artificial islands
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2.4 GES																																	

	correspond to the physical geographic and climatic conditions, taking into consideration the sustainable use of the marine environment and climate change. The natural extent and area of the benthic broad habitat types do not decrease significantly and there is no likelihood to decrease in the future. The physical loss of habitats is minimized. The human activities do not exert significant physical disturbance of the seabed substrate and biological structures leading to adverse alteration of the associated biological communities' status. The associated biological communities (species composition and relative abundance, size structure of the typical species) are not adversely affected due to human activities. The specific ecological conditions necessary for the longterm maintenance of the typical species and biological communities exist and will continue to exist in the future. The extent, area and condition of the benthic habitat types are sufficient for the natural ecological functions and processes to occur, that ensure the ecosystem goods and services such as food production, water quality regulation, recreation and tourism conditions. The habitats of conservation importance categorized as threatened or vulnerable at the national level (RedBook of R Bulgaria, v. III Habitats) or listed by the European regulations (e.g. Directive 92/43/EEC) are effectively protected through suitable national and regional mechanisms.									
2.5 Environmental targets MSFD HD WFD	Target under D6C4: The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed 5 % of the natural extent of the habitat type in the assessment area. If in a particular assessment area (MRU) this proportion was already exceeded at the time of the Initial assessment under MSFD (Moncheva, Todorova et al., 2013), further loss of the habitat type it is not permissible. The natural habitat types of Community interest under Directive 92/43/EEC have stable or increasing spatial extent, which is not smaller than the favourable habitat range, do not have smaller area than the area at the year of enforcement of the Habitats Directive (2007 for Bulgaria) and the distribution within the range is not alternated significantly. Target under D6C5: The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), does not exceed 20 % of the natural extent of the habitat type in the assessment area, including the proportion lost. Thresholds of GES indicators D2C3 Biomass ratio bivalves/<i>Rapana venosa</i> ≥ 10 D3C3: <table><tr><td>95th percentile</td><td>H95 (mm)</td><td>L95 (mm)</td></tr><tr><td><i>Chamelea gallina</i></td><td>≥ 22.22</td><td>≥ 23.92</td></tr><tr><td><i>Donax trunculus</i></td><td>≥ 20.91</td><td>≥ 33.78</td></tr></table> D5C4: Average annual Secchi transparency ≥ 6 m in coastal waters в крайбрежните води, especially in the habitat of seagrass beds (Denisson W. C., 1987). D5C5: Concentration of dissolved oxygen in bottom water: saturation 75 % in the coastal waters down to depth of 40 m. D5C6: % wet biomass of macroalgae from ESGII is < 40 % El > 6 D5C7: % wet biomass of macroalgae from ESGI > 60 % El > 6 Total projected cover of <i>Cystoseira</i> spp. and other ESGI macroalgae ≥ 40%	95 th percentile	H95 (mm)	L95 (mm)	<i>Chamelea gallina</i>	≥ 22.22	≥ 23.92	<i>Donax trunculus</i>	≥ 20.91	≥ 33.78
95 th percentile	H95 (mm)	L95 (mm)								
<i>Chamelea gallina</i>	≥ 22.22	≥ 23.92								
<i>Donax trunculus</i>	≥ 20.91	≥ 33.78								

Max. depth distribution of <i>Cystoseira barbata</i> ≥ 10 m, <i>Cystoseira bosphorica</i> ≥ 4 m (if suitable substrate is available) Max. depth distribution of seagrass beds ≥ 6 m Depth of distribution of <i>Phyllophora crispa</i> and other perennial sciophyllid macroalgae is ≥ 17 m (if suitable substrate is available (Berov et al., под печать) Total projected cover of <i>Phyllophora crispa</i>, <i>Apoglossium ruscifolium</i>, <i>Zanardinia typus</i>, <i>Gelidium spinosum</i> ≥ 35% ; Total projected cover of ESG II macroalage - <i>Cladophora albida</i>, <i>Cladophora coelothrix</i>, <i>Chaetomorpha linum</i>, <i>Ulva rigida</i> ≤ 15%	seagrass beds:			
	Z. noltei parameters	Subsurface biomass bg [g·m ⁻²]	Ratio surface-subsurface biomass ag-bg ratio	leaf length [mm]
	thresholds	≥ 105.2	≤ 2.4	≥ 151.5 ≤ 270.5
				[shoots·m ⁻²] ≥ 500.6 < 1696.6
D5C8				
Macrozoobenthic communities				
Upper infralittoral meadium and fine sands dominated by <i>Donax trunculus</i>				
Ecological status	EQR	AMBI	H'	S
Reference conditions	1	0.5	3.1	18
Good status	0.68	2.26	2.11	12
Infralittoral fine and medium sands dominated by <i>Chamelea gallina</i> , <i>Lentidium mediterraneum</i> , <i>Tellina tenuis</i>				
Reference conditions	1	0.3	3.4	30
Good status	0.68	2.12	2.31	20
Infralittoral coarse and medium sands dominated by <i>Upogebia pusilla</i>				
Reference conditions	1	2.5	3.4	35
Good status	0.68	3.62	2.31	24
Circalittoral shelly sands and gravel with diverse variable fauna				
Reference conditions	1	1.9	3.8	42
Good status	0.68	3.28	2.58	29
D6C3				
Macrozoobenthic communities:				
% cover of <i>Mytilus galloprovincialis</i> beds within their natural range of distribution over circalittoral sediments вьрpxy ≥ 20 %.				

	Average height of <i>Mytilus galloprovincialis</i> is maintained or increasrelative to 2011 baseline (Todorova et a., 2013):				
	Assessment area	Northern shelf	Kaliakra-Galata coastal area	Galata-Emine coastal area	Maslen nos-Resovo coastal area
	H average (mm)	40.84	49.97	56.32	52.41
	For the sandy habitats the thresholds for S, H', AMBI and M-AMBI*n under D5C8 are applicable. Validation deeded against the physical disturbance. Seagrass communities: Thresholds as for D5C7 are applicale.				
	D7C2 Macrozoobenthic communities: Thresholds for S, H', AMBI & M-AMBI*n under D5C8 are applicable. Thresholds for good status of <i>Donacilla cornea</i> population				
	Indicator / Species	Average abundance (ind·m ⁻²)	Average biomass (g·m ⁻²)	Average length (mm)	
	<i>Donacilla cornea</i>	≥ 4500	≥ 2500	≥ 16	
	Macrophyte communities: Thresholds for the indicators under D5C6 and D5C7 are applicable. D8C2 & D8C4 Macrozoobenthos communities: Thresholds for S, H', AMBI и M-AMBI*n under D5C8 are applicable. The indicators need validation against chronic and acute contamination.				
3 Monitoring concept					
3.2 Description of monitoring network	Sedimentary habitats dominated by macrozoobenthic communities: Sampling with Van Veen grab (0.1 m ²) Van Veen grab sampling is used to collect point data for the species composition and abundance of the macroinvertebrate fauna in the sediments needed for the calculation of the indices under criteria D3C3, D5C8, D6C3, D7C2, D8C2, D8C4 , which contribute to the assessment of overall adverse effects under D6C5 . The sampling network includes 290 stations distributed proportionately among the broad habitats types and MRUs. In the coastal waters the network is complementary to the existing monitoring network under the WFD.				



	The monitoring network complements the existing network for monitoring of seagrasses under the WFD. The sampling locations cover the natural extent of the known seagrass beds. Sampling methodologies: Destructive sampling - for <i>Z. noltei</i> biomass and shoot density at depth 2 - 3 m (D5C7) Visual assessment of distribution and boundaries - assessment of the extent and area (D6C4). Methodology according to Cogan R. et al. (2007) using diving and DGPS. Depth lower limit measurement - through diving. Sampling shall be done in June -July. Map of the sampling network for D1,6 - benthic habitats: seagrass Infralittoral rock with macroalgae: The monitoring network complements the existing network for monitoring of macroalgae under the WFD and includes 61 transects with start points as shown on the map.  Map of the sampling network for D1,6 - benthic habitats: macroalgae
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	Sampling methodologies include: <u>Destructive sampling</u> - stratified approach at different depth strata for collection of data on the species composition and biomass. <u>Under water photo- and video records</u> - for % cover of macroalgae determination. <u>Visual assessment of the distribution boundaries</u> (extent and area) and depth lower limit - by diving. Sampling shall be done in summer (July-August).
6. Activities required to implement the concept	
6.1 Changes to the current monitoring programme	Recommendations for filling in gaps in knowledge and information • Habitats of the seabed sediments • Thresholds for good status according to dissolved oxygen concentration in bottom water (D5C5) shall be defined, especially in circalittoral and offshore circalittoral habitats. • Development of indicators and thresholds based on functional groups of macrozoobenthos (e.g longevity) for assessment of the adverse effects from physical disturbance (D6C3), especially by fisheries. • Definition of thresholds for S, H', AMBI and M-AMBI* in circalittoral mud and offshore circalittoral mixed sediments. • Development of indicators and threshold definition for seagrass meadows of <i>Zostera marina</i> L., poly-dominant seagrass communities • Definition of thresholds for projected cover of seagrasses. • Development of indicators based on epiphytic growth on seagrass leaves. • Development and validation of indicators sensitive to chronic and acute contamination with hazardous substances. • Habitats of the hard bottom (reefs) • Development of indicators and thresholds for lower infralittoral and circalittoral rock broad habitat types. • Adaptation and validation of methods for destructive and non-destructive sampling of macrophytes. • Adaptation and validation of indicators for chronic and acute contamination with hazardous substances.

MONITORING PROGRAMME FOR DESCRIPTOR 1 - NON-COMMERCIALY-EXPLOITED SPECIES OF FISH	
1. General	
1.1 Subject area	Programme name: Monitoring program on Descriptors D 1, 4 - Non-commercially-exploited species of fish Programme ID: BLKBG- D1, 4 - Non-commercially-exploited species of fish
1.2 Definition / Description	Monitoring program on Descriptor 1 is aimed at assessing the current status of non-commercially exploited fish populations and assessing the negative impact on ichthyological communities as a result of anthropogenic activity (accidental by-catch, non-native species, fishing, pollutant inputs and marine litter). The scope of the assessment for the Bulgarian area will include the following fish groups: coastal fish, pelagic shelf fish and demersal shelf fish species. The aforementioned groups are related to the pelagic habitats: coastal, shelf and open sea waters and to bottom habitats: infralittoral rocks and biogenic reefs, infralittoral coarse sediments, infralittoral mixed sediments, infralittoral sands, infralittoral mud, circalittoral coarse sediments, circalittoral mixed sediments, circalittoral sands, circalittoral mud. For assessment of species status, indicators will be applied according to the relevant criteria defined at national level or agreed at the regional level. The program will provide data for monitoring programs on descriptors: D3 - Populations of all commercially-exploited fish and shellfish; D4 - Ecosystems, including food webs, D8 - Contaminants, D10 - Marine litter and D11 - Underwater noise. Monitoring program on Descriptor 1 is integrated with programs on D2, D3, D8, D10 and D11. The monitoring program will include coastal survey (at depths of up to 20m by gillnets for coastal fish species), demersal trawl survey in shelf area (for demersal shelf fish species) and hydroacoustic survey in the Bulgarian EEZ (for pelagic shelf fish species). At national level, the monitoring program under MSFD will use the research data from the National Program for the collection, management and use of data in the Fisheries sector in accordance with Regulation (EC) No 199/2008 of 25.02.2008 and as well as data from the NAFA fishing statistics for incidental by-catches of non-target species.
2. Monitoring requirements and purpose	
2.2 GES criteria	D1C1 – Primary: The mortality rate per species from incidental by-catch is below levels which threaten the species, such that its long-term viability is ensured. Pressure indicator: Accidental by-catch per species per fishing metier - abundance and biomass per species. D1C2 - Primary: The population abundance (abundance and/or biomass) of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured. State indicators: Mean value of abundance (number of individuals/biomass (t)) per species and MRUs; Mean value of abundance/biomass per species groups and MRUs; D1C3 – Primary for commercially- exploited fish and cephalopods and secondary for other species: The population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity, and survival rates) of the species are indicative of a healthy population which is not adversely affected due to anthropogenic pressures. State indicators: Mean length of the fish (Lmean, cm) per species, as observed in research vessel or other surveys; the 95th percentile of the fish-length distribution of each population, as observed in research vessel or other surveys. D1C4 – Primary for species covered by Annexes II, IV or V to Directive 92/43/EEC and secondary for other species: The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions. State indicator: area and distribution by species (GIS layer); D1C5 – Primary for species covered by Annexes II, IV and V to Directive 92/43/EEC and secondary for other species: The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species. Pressure indicator: Assessment of area, negatively affected, expressed in square kilometers (km²) per habitat type or as proportion (percent, %) from the total extent of the habitat.

	D2C3 – Secondary: Proportion of the species group or spatial extent of the broad habitat type which is adversely altered due to non-indigenous species, particularly invasive non-indigenous species. Pressure indicator: the proportion of the species group (ratio of indigenous species to non-indigenous species, as number of species and/or their abundance within the group) or the spatial extent of the broad habitat type (km²) which is adversely altered. D3C1 – Primary: The Fishing mortality rate of populations of commercially-exploited species is at or below levels which can produce the maximum sustainable yield (MSY). Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013. Pressure indicator: Fishing mortality (F), corresponding to the achievement of maximum sustainable yield (F_{MSY}) per species. D3C2(1) – Primary: The Spawning Stock Biomass of populations of commercially-exploited species are above biomass levels capable of producing maximum sustainable yield. Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013. <u>State indicators:</u> • spawning stock biomass (SSB) per species; • precautionary reference point for spawning stock biomass (Bpa) by species; • catch/biomass ratio per species. D3C3 – Primary: The age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population. This shall include a high proportion of old/large individuals and limited adverse effects of exploitation on genetic diversity. <u>State indicators:</u> • the proportion of fish larger than mean size of first sexual maturation - Lm. • the 95th percentile of the fish-length distribution of each population, as observed in research vessel or other surveys (L95.) D8C2 – Secondary: The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergetic effects. Pressure indicator: Abundance of affected individuals by species; spatial extent in km² per each affected broad habitat type. D8C4 – Secondary (to be used when a significant acute pollution event has occurred): The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated. Pressure indicator: Abundance (number) of affected individuals per species; spatial extent in km² per each affected broad habitat type. D10C3 – Secondary: The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned. Pressure indicators: Amount of litter > 2,5 cm in grams and in number of items per individual and species. Size (in grams or length) of the studied individual. Amount of micro-litter (< 5mm) in grams and in number of items per individual and species Size (in grams or length) of the studied individual. D10C4 – Secondary: The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects. Pressure indicators: number of individuals lethally affected per species. number of individuals sub-lethally affected per species due to entanglement, injury of other health effect. D11C1 – Primary: The spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.
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	Pressure indicator: impulsive sound, described as the sound pressure level generated by a point energy source in units dB re 1μPa2 or from zero to a maximum sound pressure level generated by a point source in units dB re 1μPa m set for the frequency range from 10 Hz to 10 kHz. D11C2 – Primary: The spatial distribution, temporal extent and levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals. Pressure indicator: average annual value or other appropriate measure agreed at regional or sub-regional level of the sound pressure square in each of two "1/3 octave bands", one centered at 63 Hz and the other at 125 Hz, expressed as sound pressure level in decibels, in units dB re 1μPa. It can be measured directly, or it can be derived from a model used to interpolate between or extrapolate from the measurements.		
2.3 Features, pressures and impacts	Anthropogenic pressures, uses and human activities in or affecting the marine environment (according to Annex III, Table 2a)		
	Theme	Pressure	Activity
	Biological	Input or spread of non-indigenous species	Transport – shipping (ballast waters)
		Input of genetically modified species and translocation of native species	Aquaculture – marine, including infrastructure
		Loss of, or change to, natural biological communities due to cultivation of animal or plant species	Aquaculture – marine, including infrastructure
		Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Tourism, Transport – shipping
	Physical	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	Fish and shellfish harvesting
		Physical disturbance to seabed (temporary or reversible)	Fish and shellfish harvesting
		Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)	Solid waste disposal, incl. dredging masses
		Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events	Industry (loads, emissions)
Substances, litter and energy	Input of litter (solid waste matter, including micro-sized litter)	Agriculture and Forestry (оток, емисии) Urban uses (sewage loads)	
	Input of anthropogenic sound (impulsive, continuous)	Shipping (underwater noise and pollutants)	
	Input of other forms of energy (including electromagnetic fields, light and heat)		
2.4 GES	Overall definition of GES - populations of non-commercially exploited fish and groups of fish species are characterized by unchanged or increasing distributional range, the species abundance/biomass of the species is high and stable, demographic characteristics of populations are not adversely affected due to anthropogenic pressures, and rare and threatened species, included in the existing legislation and international conventions are protected to the level required. Definition of GES for D1C1: Accidental by-catch - reduction in abundance/biomass of accidental by-catch per species and fishing métiers. Definition of GES for D1C2: Abundance/biomass of species - Abundance of populations of non-commercially exploited fish species is high and stable or increases. Each of the representative fish populations must be in condition, corresponding to the individual targets, and the assessment should include a statistically significant part of the groups of species subject to monitoring. Definition of GES for D1C3: Demographic characteristics of species - population characteristics of representative species and group of species are not adversely affected by anthropogenic pressure. Each of the representative species must be in condition, corresponding to the individual targets, and the assessment should include a statistically significant part of the groups of species subject to monitoring.		

2.5 Environmental targets MSFD HD BD WFD	Definition of GES for D1C4: Distributional range of non-commercially exploited fish species and group of species in assessment areas according to MSFD is not adversely affected by anthropogenic pressure and is in line with prevailing physiographic, geographic and climatic conditions. Each of the of representative species must be in condition, corresponding to the individual targets, and the assessment should include a statistically significant part of the groups of species subject to monitoring. Definition of GES for D1C5: State of species habitats: - The habitat of the species has the necessary extent and condition to support the different stages in the life history of the species and group of species. Each of the habitats must be in the condition, corresponding to the individual needs of the species. Marine Strategy Framework Directive (Directive 2008/56/EC) Pressure targets D1C1. Accidental by-catch. Mortality by species as a result of accidental by-catch is very low. No targets and threshold values have been set due to lack of information on the values of accidental by-catch by species and by fishing metters. State targets D1C2: Abundance/biomass of species. Target: maintaining or increasing the abundance/ biomass of representative fish species and species groups in the assessment areas according to the MSFD and defined thresholds. Threshold values for abundance/biomass of representative fish species in coastal area. The set thresholds refer to the coastal area (up to 20 m depth) during the summer season, valid for sampling with bottom-set gillnets.																																																																																																																																	
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<i>Gobius paganellus</i> Linnaeus, 1758	1.180	0.076	increase
<i>Ponticola cephalargoides</i> (Pinchuk, 1976)	1.459	0.119	increase
<i>Neogobius melanostomus</i> (Pallas, 1814)	11.863	0.662	increase
<i>Mesogobius batrachocephalus</i> (Pallas, 1814)	1.775	0.196	increase
<i>Arnoglossus kessleri</i> Schmidt, 1915	0.029	0.000	increase
<i>Platichthys flesus</i> (Linnaeus, 1758)	0.030	0.001	increase
<i>Pegusa lascaris</i> (Risso, 1810)	66.696	2.015	increase

Thresholds values for abundance/biomass of representative fish species in shelf area. **The set thresholds refer to the shelf area (20 - 100m depth) during the summer season, valid for sampling with demersal trawl.**

Shelf area	Mean abundance (ind/km ²)	Mean biomass (kg/km ²)	Target
<i>Dasyatis pastinaca</i> (Linnaeus, 1758)	20.45	67.70	increase
<i>Acipenser stellatus</i> Pallas, 1771	1.70	0.03	increase
<i>Gaidropsarus mediterraneus</i> (Linnaeus, 1758)	5.11	0.14	increase
<i>Syngnathus variegatus</i> Pallas, 1814	1.70	0.01	increase
<i>Hippocampus guttulatus</i> Cuvier, 1829	17.04	0.09	increase
<i>Trachinus draco</i> Linnaeus, 1758	161.53	6.32	increase
<i>Uranoscopus scaber</i> Linnaeus, 1758	11.93	0.23	increase
<i>Parablennius tentaculatus</i> (Brunnich, 1768)	8.52	0.03	increase
<i>Coryphoblennius galerita</i> (Linnaeus, 1758)	5.11	0.02	increase
<i>Ophidion rochei</i> Muller, 1845	3.41	0.06	increase
<i>Callionymus pusillus</i> Delaroche, 1809	1.70	0.00	increase
<i>Scorpaena porcus</i> Linnaeus, 1758	5.11	0.11	increase
<i>Gobius niger</i> Linnaeus, 1758	1218.16	8.16	increase
<i>Gobius cobitis</i> Pallas, 1814	3.41	0.19	increase
<i>Neogobius melanostomus</i> (Pallas, 1814)	6849.42	74.53	increase
<i>Mesogobius batrachocephalus</i> (Pallas, 1814)	66.47	4.26	increase
<i>Platichthys flesus</i> (Linnaeus, 1758)	37.50	4.87	increase
<i>Pegusa lascaris</i> (Risso, 1810)	11.93	0.29	increase

D1C3: Demographic characteristics of species. Target: maintaining the population characteristics of representative fish species in the assessment areas, according to MSFD, stable or higher than the defined threshold values.
Classification scheme for assessment of the state of populations of non-commercially exploited fish in coastal area according to mean length (L_{mean} , cm) and 95-th percentile per species.

Species	Coastal zone
	Good
	Not good
	Rocky habitats
<i>S. porcus</i>	
Mean value	>13.93
	<13.93

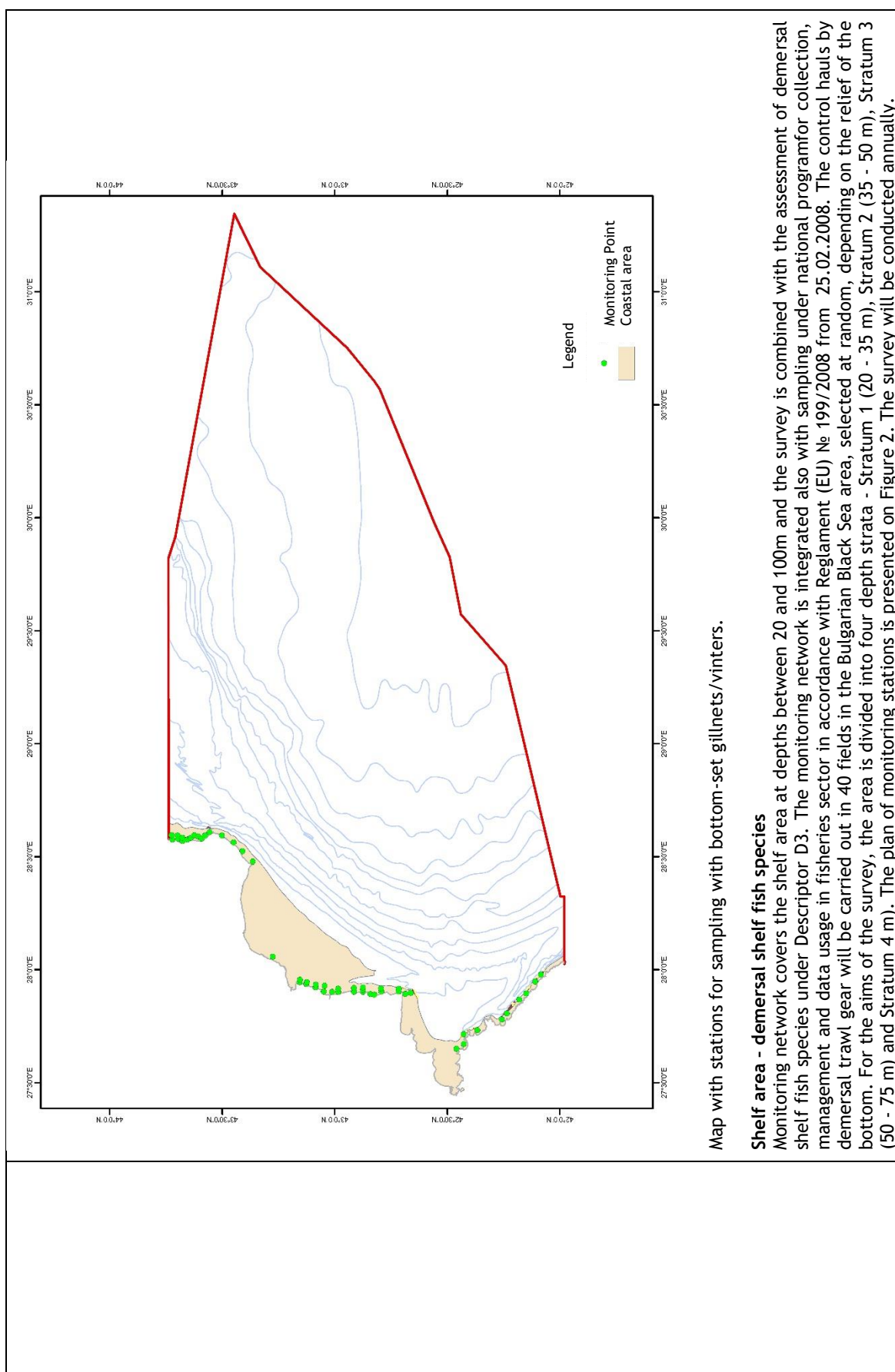
95th percentile	>18.09	<18.09
<i>N. melanostomus</i>		
Mean value	16.44	<16.44
95th percentile	>19.00	<19.00
<i>P. lascaris</i>		
Mean value	16.20	<16.20
95th percentile	>20.70	<20.70
<i>U. scaber</i>		
Mean value	14.91	<14.91
95th percentile	>18.37	<18.37
	Sandy bottoms	
<i>P. lascaris</i>		
Mean value	15.20	<15.20
95th percentile	>18.62	<18.62
<i>U. scaber</i>		
Mean value	14.51	<14.51
95th percentile	>18.00	<18.00
<i>T. draco</i>		
Mean value	17.59	<17.59
95th percentile	>24.79	<24.79
<i>N. melanostomus</i>		
Mean value	13.28	<13.28
95th percentile	>17.47	<17.47

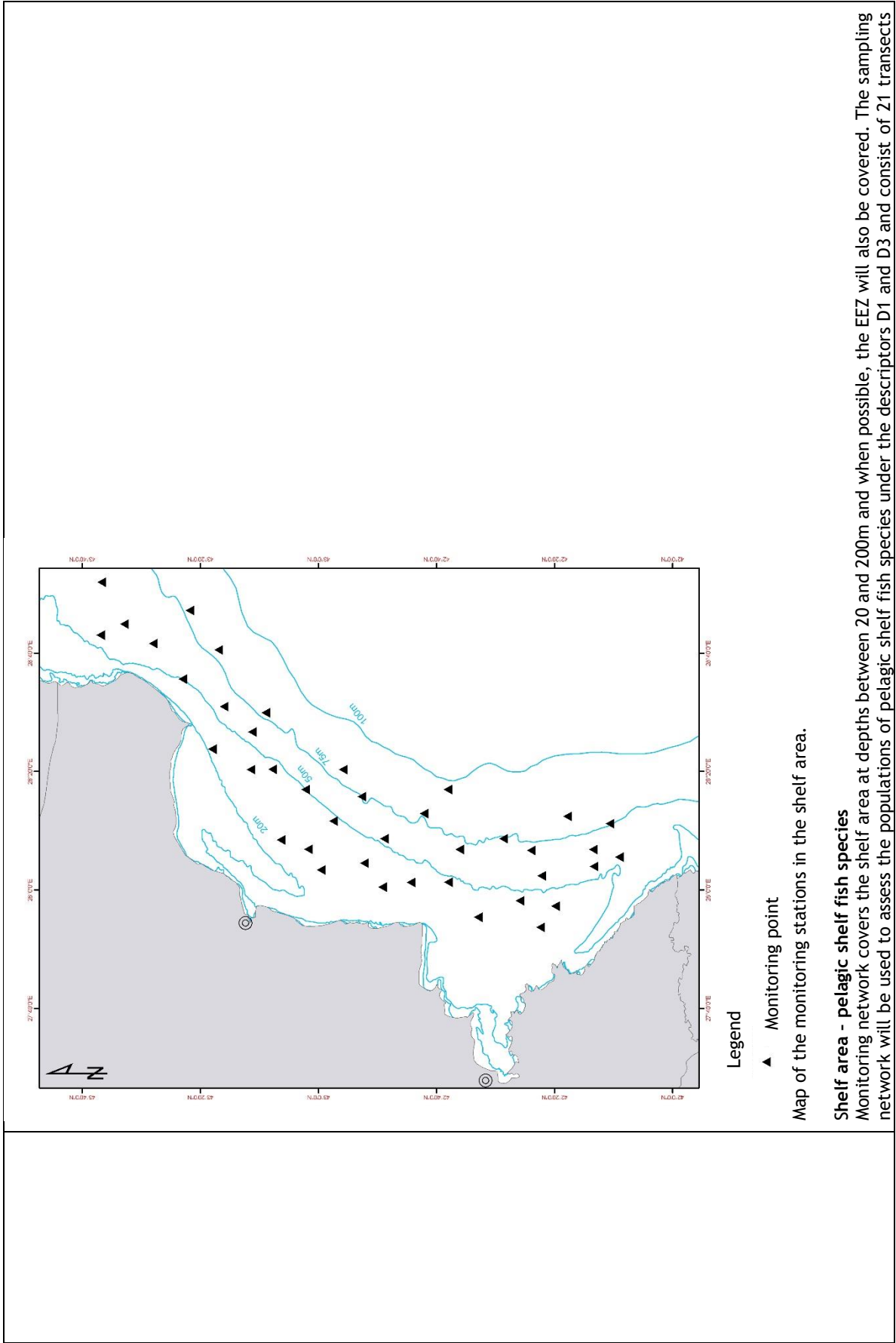
Classification scheme for assessment of the state of populations of non-commercially exploited fish in shelf area according to mean length (L_{mean} , cm) and 95-th percentile per species.

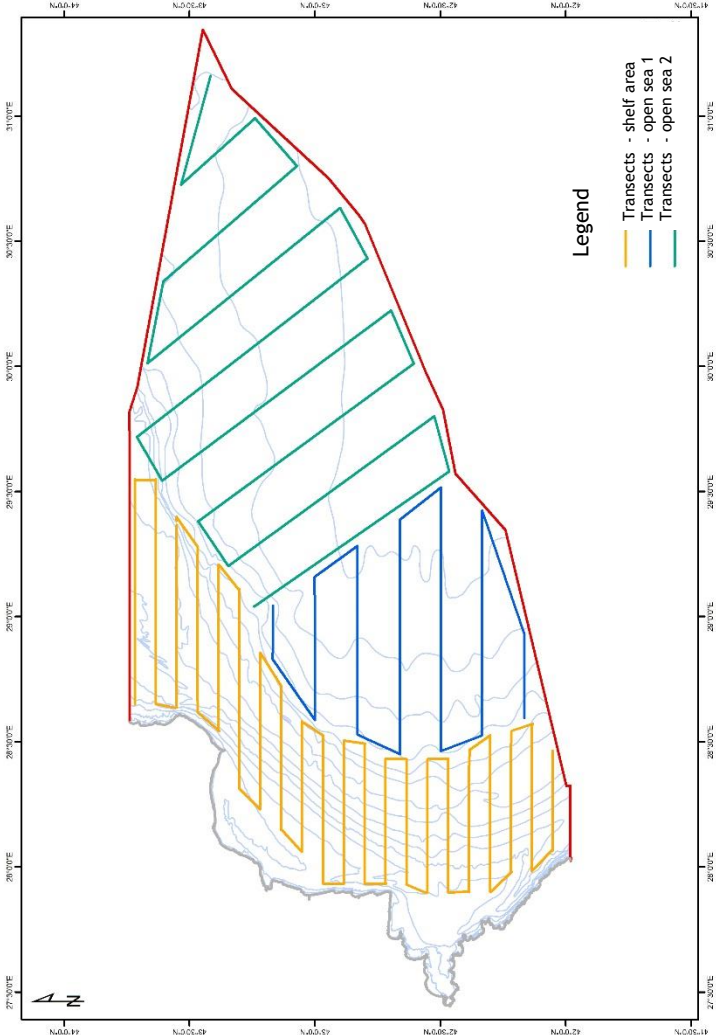
Species	Shelf area	
	Good	Not good
	20 - 40m	
<i>N. melanostomus</i>		
Mean value	10.45	<10.45
95th percentile	>13.60	<13.60
<i>G. niger</i>		
Mean value	8.51	<8.51
95th percentile	>9.90	<9.90
	41 - 100m	
<i>M. merlangus</i>		
Mean value	11.60	<11.60
95th percentile	>15.00	<15.00

	D1C4: Species distribution. Target: maintaining or increasing the distributional range (and distributional pattern within the scope) of representative fish species and groups of fish species in the assessment areas according to MSFD. List of representative species Coastal fish species: 1. <i>Syngnathus typhle</i> 2. <i>Syngnathus abaster</i> 3. <i>Syngnathus variegatus</i> 4. <i>Hippocampus guttulatus</i> 5. <i>Sciaena umbra</i> 6. <i>Symphodus roissali</i> 7. <i>Symphodus cinereus</i> 8. <i>Symphodus ocellatus</i> 9. <i>Trachinus draco</i> 10. <i>Uranoscopus scaber</i> 11. <i>Parablennius sanguinolentus</i> 12. <i>Ophidion rochei</i> 13. <i>Scorpaena porcus</i> 14. <i>Gobius cobitis</i> 15. <i>Gobius paganellus</i> 16. <i>Gobius niger</i> 17. <i>Ponticola cephalargoides</i> 18. <i>Neogobius melanostomus</i> 19. <i>Mesogobius batrachocephalus</i> 20. <i>Arnoglossus kessleri</i> 21. <i>Platichthys flesus</i> 22. <i>Pegusa lascaris</i> Pelagic shelf fish species 1. <i>Diplodus annularis</i> 2. <i>Oblada melanura</i> 3. <i>Spicara smaris</i> Demersal shelf fish species 1. <i>Dasyatis pastinaca</i> 2. <i>Acipenser gueldenstaedtii</i> 3. <i>Acipenser stellatus</i> 4. <i>Merlangius merlangus</i> 5. <i>Gaidropsarus mediterraneus</i> No targets and threshold values have been set for the distributional range of representative fish species and the indicator needs further development.
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	D1C5: Habitat of the species. Target: The habitat for the representative fish species has the necessary extent and condition to support the different stages in the life history of the species in the assessment areas according to MSFD. No targets and threshold values have been set and the indicator needs further development. Convention on the Protection of the Black Sea Against Pollution Strategic Action Plan for the Environmental Protection and Rehabilitation of the Black Sea (BS-SAP), 2009. (14) Consider the necessity of creation of new and/or expansion of existing protected areas, including transboundary areas in consultation with the relevant Black Sea countries with particular attention to marine protected areas. Establish or extend these areas where necessary. (21) Monitor and facilitate the progress in the implementation of nationally developed management plans of the protected areas. (25) Support coordinated scientific studies, increase resources to marine science and improve capacity particularly through targeted training programmes supporting scientific projects/programmes.
3 Monitoring concept	
3.2 Description of monitoring network	Monitoring program on Descriptor D1 will be integrated with monitoring programs on Descriptors D3 and D10. In order to take into account the different sources of pressures, sampling polygons will be located near the river estuaries, hot spots of pollution and areas with increased fishing pressure. Monitoring network will cover the following assessment areas: Coastal area - sampling by bottom-set gillnets/vinters for assessment of state of coastal fish populations. Shelf area - sampling by demersal trawl for assessment of state of demersal shelf fish populations. Shelf area and, if possible, Exclusive Economic Zone (EEZ) - hydroacoustic survey, combined by pelagic hauls for assessment of state of pelagic shelf fish populations. Coastal area Monitoring survey on the distribution and structure of coastal ichthyological communities covers two types of habitats - sandy and rocky bottoms, which are located in and outside the Natura 2000 sites. It is envisaged to deploy fishing nets / vinters in 52 stations, which are presented on Figure 1. The survey will be conducted annually.





	in the shelf zone and 16 transects in the offshore area, which will be surveyed by scientific echosounder EK 60 (Simrad, Norway), with working frequencies 38, 120, 200 KHz. The survey scheme includes parallel transects, perpendicular to the bathymetry of the area with inter-transect distance of 5 nautical miles. The speed of the ship during the acoustic sampling is fixed in the range between 7.5 and 8.5 knots. The surveys will be conducted annually in the shelf zone and once for every 2 years in the EEZ. The monitoring network is integrated also with sampling under national program for collection, management and data usage in fisheries sector in accordance with Reglament (EU) No. 199/2008 from 25.02.2008. 
6. Activities required to implement the concept 6.1 Changes to the current monitoring programme	Scheme of acoustic survey in the shelf and offshore areas. Necessary amendments and recommendations The main problems regarding the biodiversity of the ichthyofauna in front of the Bulgarian Black Sea coast are related to the lack of data on the abundance / biomass, population structure and spatial distribution of non-commercially exploited fish species. The lack of sufficiently up-to-date scientific information prevents the use of the indicators proposed to assess the progress in achieving good environmental status under Descriptor 1 as well as the baseline and threshold values for some of them. At this stage, some of the indicators are operational, but the indicators on criteria D1C1, D1C3 and D1C4 need further development.

	• Better co-ordination with other institutions / organizations, providing information on the state or impact on the marine environment. • Ensuring of sufficient capacity of competent authorities and organizations (such as human resources, expertise and equipment) to plan and conduct monitoring of the marine environment. • Development of indicators and criteria for assessing of the changes in the components of the marine environment in relation to the climate change and their differentiation from the effects of anthropogenic pressure. • Ensuring the necessary and timely financing of the implementation of the monitoring programs in accordance with the MSFD. • Improving the data management and information related to the state of the marine environment; improving the access to national and regional databases and data from projects funded by the EC and other financial instruments.
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MONITORING PROGRAMME FOR DESCRIPTOR 1 - BIODIVERSITY (MARINE MAMMALS)	
1. General	
1.1 Subject area	Programme name: D 1 - Biodiversity - Marine mammals Programme ID: BLKBG-D1-Marine_mammals
1.2 Definition / Description	The monitoring program for marine mammals will provide data on the distribution and state of the populations of cetaceans and accidental by-catch in the fishing gears. Mortality data can be provided by the detection of stranded animals during the monitoring activities and identification of the causes of death (natural, or as a result of human activities). When the causes of mortality are known and it is a result of human activity (for example, fishing, shipping, offshore activities), this would support the planning of specific measures for limiting the impact of these pressure sources on the population status of marine mammals. In Bulgaria, the Ministry of Environment and Waters (MOEW) has a network for monitoring of stranded cetaceans within the framework of the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS, http://accobams.org/). The goal of the network is gathering of basic data for the three cetacean species in Black Sea - stranded, entangled in fishing gears, or detected dead on the coast, and identifying the causes, in order to reduce their mortality. In the network are involved the Institute for Fishing Resources - Varna, NGO "Green Balkans", Regional Inspection of Environment and Waters in Varna and Burgas. The databases are officially accessible and reported in the framework of the MOEW system. The subject of current monitoring program are the three species of marine mammals observed in the Black Sea, identified as common species for monitoring between Bulgaria and Romania. Harbour porpoise (<i>Phocoena phocoena</i>); Bottlenose dolphin (<i>Tursiops truncatus</i>); Short-baked common dolphin (<i>Delphinus delphis</i>); Populations of marine mammals will be observed during visual and acoustic studies by: • Vessels and aircrafts; • stationary points on the coast and • autonomous systems for noise measurement. For assessment of the density and abundance of cetaceans during the visual and acoustic observations, the line transect method and Distance 7.0 software will be applied. The program can use different sources of information on pressures and impacts on the marine environment: • data on accidental by-catch, recorded during fishing activities; • established trends in abundance according to passive acoustic monitoring data; • occasional sightings of marine mammals during the monitoring activities on other descriptors; • analyzes of causes of mortality of found dead mammals.
2. Monitoring requirements and purpose	
2.2 GES criteria	D1C2 – Primary: The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured. Pressure indicator: • Accidental by-catch per species per fishing métier - abundance and biomass per species. D1C2 – Primary: The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured.

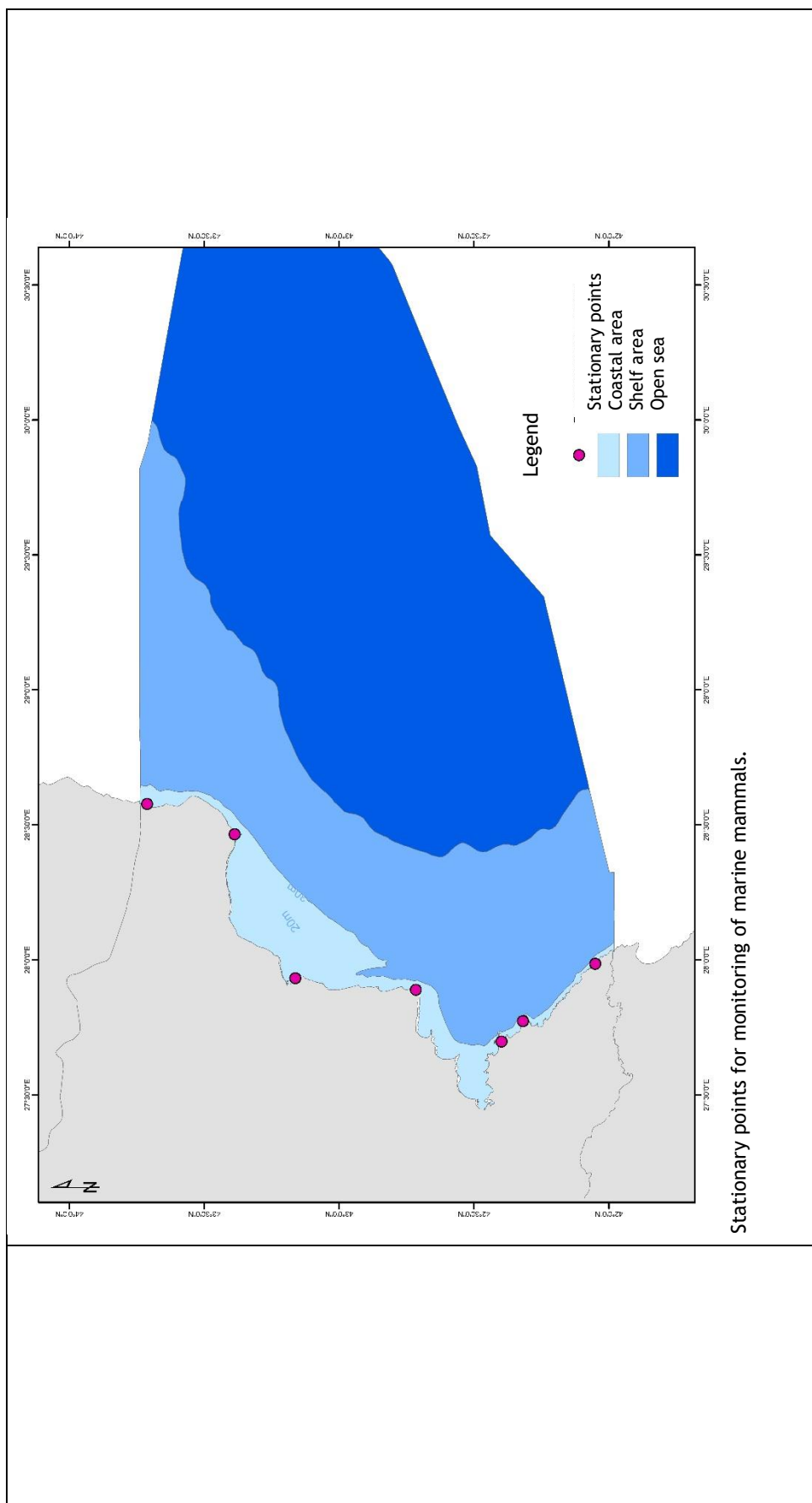
	State indicator: abundance (number of individuals) per species and MRU D1C3 – Primary for commercially- exploited fish and cephalopods and secondary for other species: The population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity, and survival rates) of the species are indicative of a healthy population which is not adversely affected due to anthropogenic pressures. D1C4 – Primary for species covered by Annexes II, IV or V to Directive 92/43/EEC and secondary for other species: The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions. State indicator: • distributional area by species (GIS layer); • density of distribution (ind/km²). D1C5 – Primary for species covered by Annexes II, IV and V to Directive 92/43/EEC and secondary for other species: The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species. Pressure indicator: • Assessment of area, negatively affected, expressed in square kilometers (km²) per habitat or as proportion (percent, %) from the total extent of the habitat. D2C3 – Secondary: Proportion of the species group or spatial extent of the broad habitat type which is adversely altered due to non-indigenous species, particularly invasive non-indigenous species. Pressure indicator: • the proportion of the species group (ratio of indigenous species to non-indigenous species, as number of species and/or their abundance within the group) or the spatial extent of the broad habitat type (in square kilometers (km²)) which is adversely altered. D8C2 – Secondary: The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergetic effects. Pressure indicator: • Abundance of affected individuals by species; spatial extent in km² per each affected broad habitat type. D8C4 – Secondary (to be used when a significant acute pollution event has occurred): The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated. Pressure indicator: • Abundance (number) of affected individuals per species; spatial extent in km² per each affected broad habitat type. D10C3 – Secondary: The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned. Pressure indicators: • Amount of litter > 2,5 cm in grams and in number of items per individual and species. Size (in grams or length) of the studied individual. • Amount of micro-litter (< 5mm) in grams and in number of items per individual and species Size (in grams or length) of the studied individual. D10C4 – Secondary: The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects. Pressure indicators: • number of individuals lethally affected per species.
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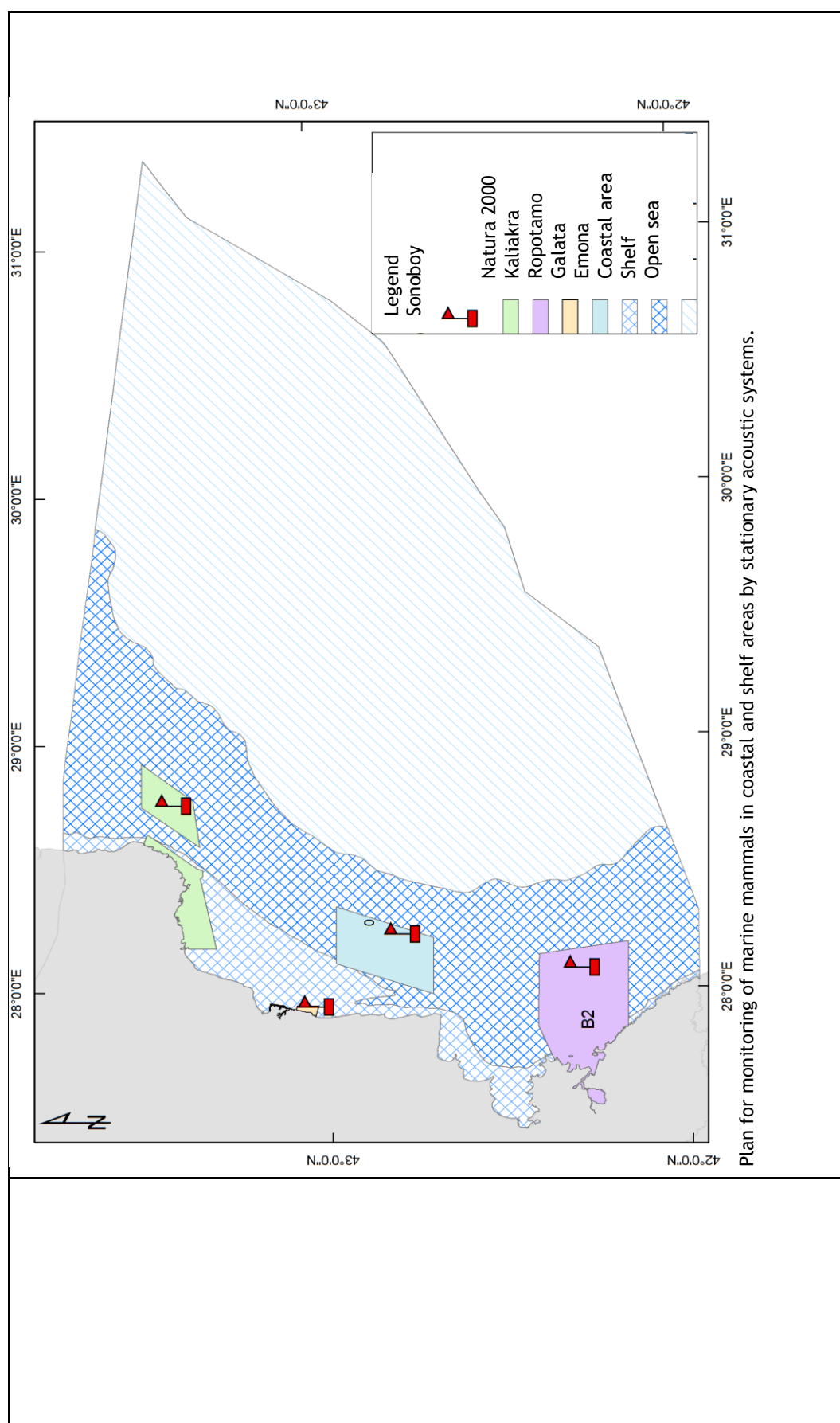
	- number of individuals sub-lethally affected per species due to entanglement, injury of other health effect. D11C1 – Primary: The spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals. Pressure indicator: - Number of days and their distribution within the calendar year over geographically defined areas and their spatial distribution where the anthropogenic sound sources exceed the levels that adversely affect marine animals measured as noise exposure level (dB re 1µPa² s) or as the peak sound pressure (dB re 1µPa m) over the frequency band 10 Hz to 10 kHz. D11C2 – Primary: The spatial distribution, temporal extent and levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals. Pressure indicator: - Trends in the ambient noise level in each of the two "1/3 octave bands" 63 Hz and 125 Hz (center frequency) (dB re 1 µPa RMS, average noise level in these terca-octave bands within one calendar year), measured directly from monitoring stations and / or derived from a model, if appropriate.																																																		
2.3 Features, pressures and impacts	Annex III, Table 2 - Anthropogenic pressures, uses and human activities in or affecting the marine environment <table><tr><th colspan="2">Table 2a. Anthropogenic pressures in the marine environment</th></tr><tr><th>Theme</th><th>Pressure</th></tr><tr><td rowspan="5">Biological</td><td>Input or spread of non-indigenous species</td></tr><tr><td>Input or spread of non-indigenous species</td></tr><tr><td>Disturbance of species (e.g. where they breed, rest and feed) due to human presence</td></tr><tr><td>Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)</td></tr><tr><td>Physical disturbance to seabed (temporary or reversible)</td></tr><tr><td>Physical</td><td>Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)</td></tr><tr><td>Substances, litter and energy</td><td>Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events</td></tr></table> <table><tr><th colspan="3">Table 2b. Uses and human activities in the marine environment</th></tr><tr><th>Theme</th><th>Activities</th><th></th></tr><tr><td>Transport</td><td>Transport (marine): - ballast waters from shipping</td><td></td></tr><tr><td>Cultivation of living resources</td><td>Aquaculture – marine, including infrastructure*</td><td></td></tr><tr><td>Cultivation of living resources</td><td>Aquaculture – marine, including infrastructure*</td><td></td></tr><tr><td>Transport</td><td>Transport (marine)</td><td></td></tr><tr><td>Extraction of non-living resources</td><td>Extraction of oil and gas, including infrastructure*</td><td></td></tr><tr><td>Tourism and leisure</td><td>Tourism and leisure infrastructure* Tourism and leisure activities*</td><td></td></tr><tr><td>Extraction of living resources</td><td>Fisheries</td><td></td></tr><tr><td>Extraction of living resources</td><td>Fish and shellfish harvesting</td><td></td></tr><tr><td>Use in cities and industrial use</td><td>Solid waste disposal</td><td></td></tr><tr><td>Use in cities and industrial use</td><td>Urban uses (sewage loads)</td><td></td></tr></table>	Table 2a. Anthropogenic pressures in the marine environment		Theme	Pressure	Biological	Input or spread of non-indigenous species	Input or spread of non-indigenous species	Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	Physical disturbance to seabed (temporary or reversible)	Physical	Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)	Substances, litter and energy	Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events	Table 2b. Uses and human activities in the marine environment			Theme	Activities		Transport	Transport (marine): - ballast waters from shipping		Cultivation of living resources	Aquaculture – marine, including infrastructure*		Cultivation of living resources	Aquaculture – marine, including infrastructure*		Transport	Transport (marine)		Extraction of non-living resources	Extraction of oil and gas, including infrastructure*		Tourism and leisure	Tourism and leisure infrastructure* Tourism and leisure activities*		Extraction of living resources	Fisheries		Extraction of living resources	Fish and shellfish harvesting		Use in cities and industrial use	Solid waste disposal		Use in cities and industrial use	Urban uses (sewage loads)	
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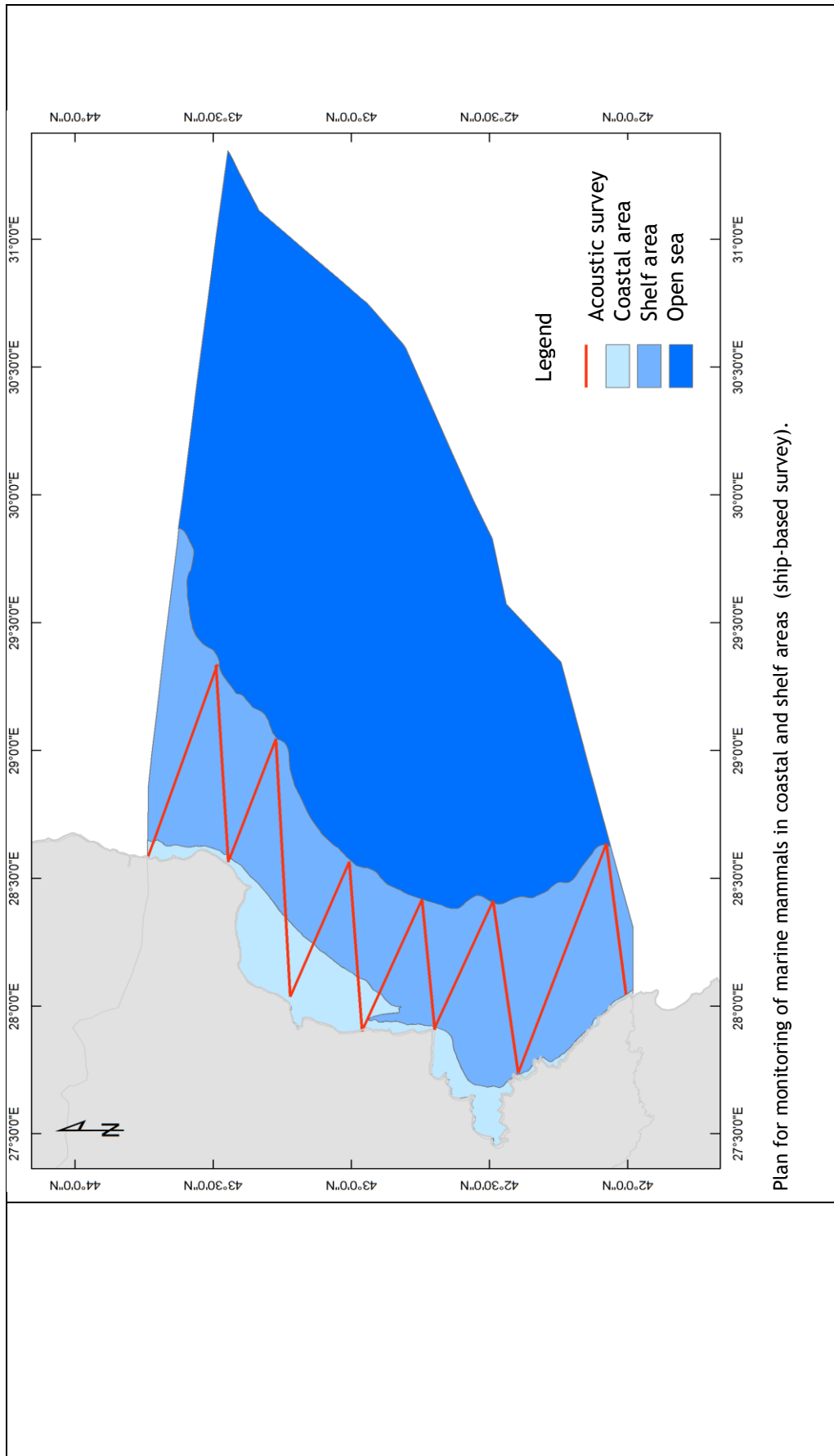
			Transport Extraction of non-living resources Extraction of living resources Cultivation of living resources Use in cities and industrial use Tourism and leisure	Transport (marine) Extraction of oil and gas, including infrastructure* Fish and shellfish harvesting (professional, recreational)* Aquaculture – marine, including infrastructure* Urban usage in cities Industrial usage Waste treatment and disposal* Tourism and leisure infrastructure* Tourism and leisure activities*
2.4 GES			Input of litter (solid waste matter, including micro-sized litter) Input of anthropogenic sound (impulsive, continuous) Input of other forms of energy (including electromagnetic fields, light and heat)	Transport (marine) Extraction of oil and gas, including infrastructure* Transmission of electricity and communications (cables)* Military operations (subject to Article 2(2)) Research, survey and educational activities*
2.5 Environmental targets MSFD HD BD WFD			Overall definition of GES: Good environmental status will be achieved when all three species of marine mammals do not change their distributional range, often occurring not only in remote areas but also close to the sources of pressure (coastal cities, seaside resorts and ports) and show signs of a stable or increasing abundance of populations. Cases of mammals killed by human activities (fishing and shipping) are extremely rare. D1C1. Accidental by-catch: mortality per species as a result from accidental by-catch does not exceed the levels that threaten the species and the cases are extremely rare. D1C2. Abundance of populations: Abundance of species is high and stable or increases. Each of the species must be in condition, corresponding to the individual targets. D1C3: Demographic characteristics of populations of marine mammals are not adversely affected by anthropogenic pressure. Each of the species must be in condition, corresponding to the individual targets. D1C4: Distribution of species: The distribution of marine mammals in assessment areas of MSFD is not adversely affected by the anthropogenic pressures and corresponds to the prevailing physico-geographic and climatic conditions. D1C5: State of species habitats: The habitat of the species has the necessary extent and condition to support the different stages in the life history of the species. Each of the habitats must be in the condition, corresponding to the individual needs of the species. Marine Strategy Framework Directive (Directive 2008/56/EC) Pressure targets D1C1. Accidental by-catch. Mortality by species as a result of accidental by-catch does not exceed the levels that threaten the species and ensure their long-term viability. No targets and threshold values have been set due to lack of information on the values of accidental by-catch by species and by fishing métiers.	

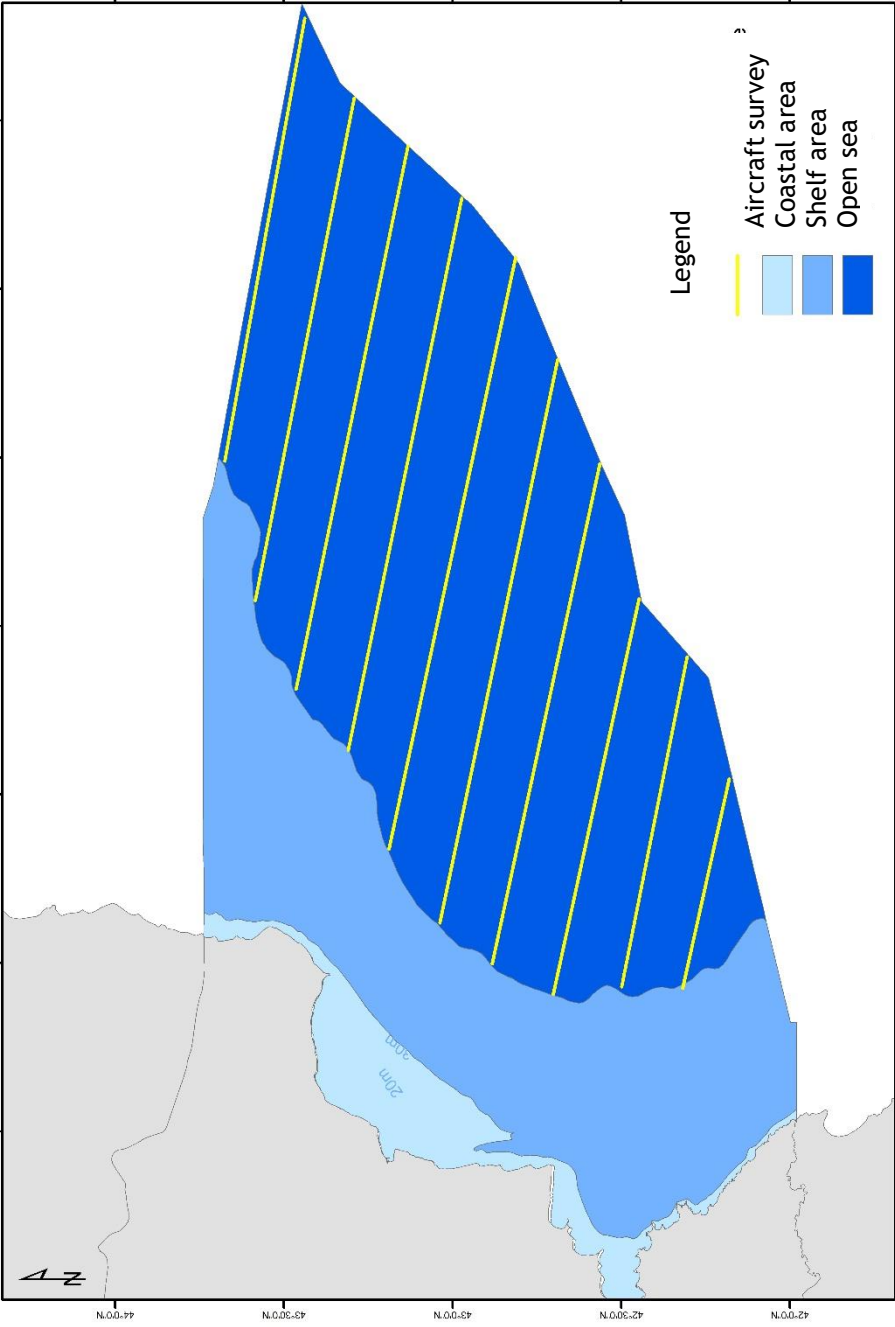
	State targets D1C2. Abundance of populations. Abundance per species is high and stable or increases. Each of the species must be in condition, corresponding to the individual targets. Threshold values for abundance (N) by species: • Short-baked common dolphin (<i>D.d. ponticus</i>) - coastal and shelf area - $N \geq 5\,019$ ind. (ship-based survey); offshore area - $N \geq 23\,580$ ind. (aerial survey). • Bottlenose dolphin (<i>T.t. ponticus</i>) - coastal and shelf area - $N \geq 4\,861$ ind., (ship-based survey); offshore area - $N \geq 10\,162$ ind. (aerial survey). • Harbour porpoise (<i>P.p. relicta</i>) - coastal and shelf area - $N \geq 1\,003$ ind. (ship-based survey); offshore area - $N \geq 9\,960$ ind. (aerial survey). D1C3. Demographic characteristics per species (age or size structure, sex ratio, fecundity, survival and mortality rates) are indicative of the native population that is not adversely affected by the anthropogenic pressure. No targets and threshold values have been set due to lack of information on the reference condition of the demographic characteristics of populations of cetaceans. D1C4. Species distribution. Target: maintaining or increasing the distributional range (and distributional pattern within the scope) of marine mammals in the assessment areas and increasing in density of distribution. Threshold values for density (D) by species: • Short-baked common dolphin (<i>D.d. ponticus</i>) - coastal and shelf area - $D \geq 0.718$ ind/km² (ship-based survey); offshore area - $D \geq 0.835$ ind/km² (aerial survey). • Bottlenose dolphin (<i>T.t. ponticus</i>) - coastal and shelf area - $D \geq 0.696$ ind/ km² (ship-based survey); offshore area - $D \geq 0.360$ ind/km² (aerial survey). • Harbour porpoise (<i>P.p. relicta</i>) - coastal and shelf area - $D \geq 0.144$ ind/ km² (ship-based survey); offshore area - $D \geq 0.353$ ind/km² (aerial survey). D1C5. The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species. No targets and threshold values have been set due to lack of information on the area coverage by habitat type, which is negatively affected. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora Art. 2 (1) The aim of this Directive shall be to contribute towards ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies. Strategic Action Plan for the Environmental Protection and Rehabilitation of the Black Sea (BS-SAP) http://www.blacksea-commission.org/_bssap2009.asp http://www3.moew.government.bg/files/file/POS/Strategic_documents/Strategy_Black_Sea.pdf Determined targets for achievement of GES in accordance with MSFD 2008/56/EO are integrated in Long-term Ecosystem Quality Objectives (EcoQOs), formulated in Strategic Action Plan for the Environmental Protection and Rehabilitation of the Black Sea: Long-term Ecosystem Quality Objectives (EcoQOs): EcoQO 2: Conservation of Black Sea Biodiversity and Habitats.
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	EcoQQ 2a: Reduce the risk of extinction of threatened species. EcoQQ 2b: Conserve coastal and marine habitats and landscapes. EcoQQ 2c: Reduce and manage human mediated species introductions
3 Monitoring concept 3.2 Description of monitoring network	Monitoring surveys cover the coastal, shelf and open sea areas (EEZ) of the Republic of Bulgaria by application of visual and acoustic methods on board of vessels or aircrafts and passive acoustic monitoring. The design of the surveys was done in accordance with the distance sampling principles and line transect method (Buckland et al. 1993; Thomas et al. 2010). In coastal and shelf areas (up to 100m depth), seasonal observations will be made from 7 landbased points on the coast, observations by stationary acoustic systems and visual and acoustic surveys by vessel. Open sea areas will be surveyed by aerial survey (Fig.4). Visual observation on board of the vessel will follow single or double platform methods depending on vessel type and condition. Double platform method includes observations by two teams of observers (two people), located on two independent platforms: Primary platform (Platform 1) and Tracker platform (Platform 2). Observers on Platform 1 (2.50 m height) perform observations on the transect near the ship (up to 500 m strip, from 90 ° to 10 ° across to the other side of the transect) with the naked eye and at a distance of 500 m to the horizon to detect the animals before have reacted to the presence of the ship, using binoculars with a high magnification. The observer on the port side searches the area from 90 ° on the port side to about 10 ° on starboard side. The observer on the starboard side scans the area from 90 ° on the starboard side to about 10 ° on the port side. Observers of Platform 2 conduct observations at a distance from 500 meters to the horizon to be able to detect the animals before responding to the presence of the ship using high magnification optical instruments (7 x 50 binoculars, 20-60x80, visual tube 1:10 viewpoints). For each observation, the following data is recorded: date, time, platform, distance, angle, observer, species, behavior, group size, age group, comment. Data on weather conditions (Beaufort's state of the sea, wave height, reflections and glare, wind direction and force, aggregate weather characteristic) are also recorded. Observations are not conducted at reduced visibility (below 1000 m) if precipitation or strong waves (> 4 at Beaufort). The data will be analyzed using the DISTANCE software package. Acoustic observations will be conducted at the same time as visual observations on board of the vessel by towed hydrophone system (Marine Ecological Research Ltd, UK), towed 200 m behind the ship's stern and at a depth of 2 to 5 m below sea surface. PAMguard software (Passive Acoustic Monitoring Guardianship, http://www.pamguard.org) will be used to adjust and manage the hydrophobic system and record real-time measured data. During the observations, a constant speed of about 6-10 knots is maintained. Observations take place during the daylight hours from 8:00 to 18:00, ie 10 hours a day. Frequency of observations - on vessel-based survey: once a year, aerial survey: once every 2 or 3 years.







	 Plan for monitoring of marine mammals' offshore areas (aerial survey)
6. Activities required to implement the concept	6.1 Changes to the current monitoring programme
	Monitoring program on D1 - Biodiversity (Marine mammals) is compliant with the criteria and methodological standards of the revised Decision 2010/477/EC and Annex III of MSFD. However, further action is still needed to provide quality data such as: Scientific:

	• due to the sporadic nature of the dedicated studies on assessment of the abundance and demographic characteristics of cetaceans in the Bulgarian Black Sea areay, there is a serious gap in available information. More extensive research is needed to fill the gaps in available information by conducting seasonal field studies on the distribution, species composition and abundance of marine mammals; • purchase of new equipment - 4 video cameras, two of which for underwater observation, having lens with high zoom. Administrative: • better co-ordination with other institutions / organizations, providing information on the state or impact on the marine environment; • ensuring the necessary and timely financing of the implementation of the monitoring programs in accordance with MSFD; • ensuring of sufficient capacity of competent authorities and organizations (such as human resources, expertise and equipment) to plan and conduct monitoring of the marine environment; • improving the data management and information related to the state of the marine environment; improving the access to national and regional databases and data from projects funded by the EC and other financial instruments.
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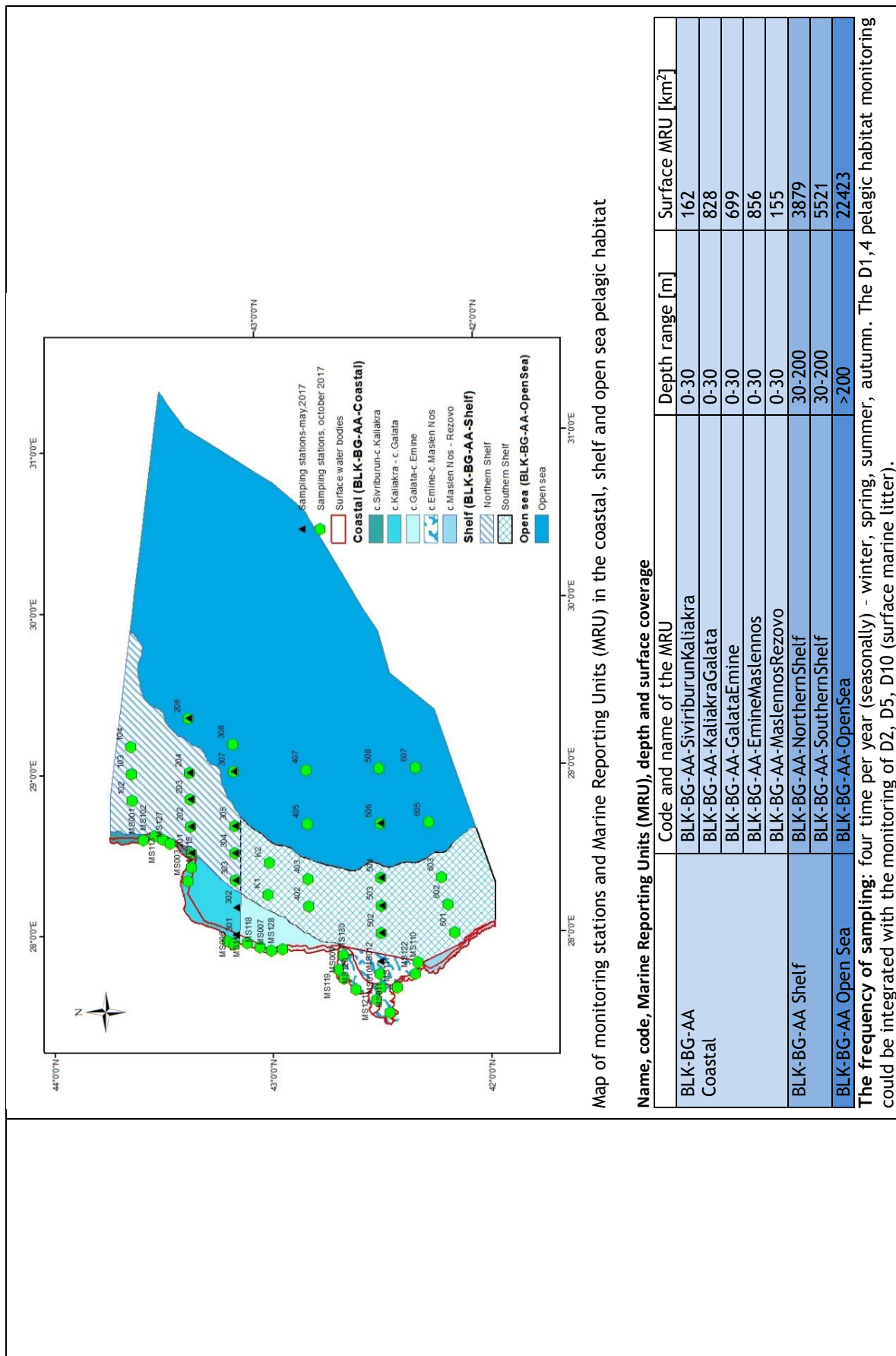
MONITORING PROGRAMME FOR DESCRIPTOR 1, 4 - BIODIVERSITY - PELAGIC HABITATS	
1. General	
1.1 Subject area	Programme name: Program of monitoring of Descriptor 1, 4 - Pelagic habitats Programme ID: BLKBG_D014_WaterColumnHabitats
1.2 Definition / Description	The monitoring program of Descriptor 1, 4 Pelagic Habitats addresses the biodiversity and food webs of pelagic communities in the water column. With regard to Descriptor 1 - the biodiversity is maintained, the quality of the habitats, the distribution and the size of the species are in line with the prevailing physical geographic, geographical and climatic conditions. This program covers the observation of the three main groups of pelagic habitats - coastal, shelf and open sea, according to the Bulgarian report under Art. 8 of the MSFD. The monitoring program focuses on the following pelagic communities: • Phytoplankton - species composition, abundance and biomass • Zooplankton - species composition, abundance and biomass The program addresses both the abiotic (physico-chemical and hydrographical) characteristics and associated biological communities. The recent program focuses not only on the state parameters, but it also provides information on the distribution, intensity and magnitude of the human driving forces impact on pelagic habitats such as tourism, urbanization, farming practices, etc. The program provides data for monitoring programs of: D2 - Non-indigenous species, D4 - Food webs, D5 - Eutrophication. In addition, physical, chemical and hydrographic data will be provided by the Monitoring Programs of D5 - Eutrophication, D7 - Hydrographical changes and D8 - Contaminants.
2. Monitoring requirements and purpose	
2.2 GES criteria and indicators	D1C6 – Primary: The condition of the habitat type, including its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), is not adversely affected due to anthropogenic pressures. Assessments of the adverse effects from pressures, including under D2C3, D5C2, D5C3, D5C4, D7C1, D8C2 and D8C4, shall be taken into account in the assessments of pelagic habitats under Descriptor 1. Using Criteria: The extent to which good environmental status has been achieved is expressed for each area of assessment as follows: (A) an assessment of the proportion of the range of each habitat assessed that has reached the limit values; (B) a list of broad habitat types in the assessment area that have not been evaluated Specifications and standardized methods for monitoring and evaluation Assessments of the adverse effects of the pressures, including under Descriptor 2 (non-indigenous species) - D2C3, Descriptor 5 (Eutrophication) - D5C2, D5C3, D5C4 Descriptor 7 (Hydrographic Changes) - D7C1, Descriptor 8 (Pollutants) - D8C2 and D8C4 shall be taken into account in the assessment of pelagic habitats under the Descriptor 1. <u>State indicators:</u> • "Biomass of phytoplankton" - indicator at coastal, shelf and open sea habitats by seasons, where it is applicable • "Phytoplankton abundance" indicator at the shelf habitat by seasons, where it is applicable • "Mesozooplankton biomass" indicator at the coastal, shelf and open sea habitats by seasons • "Mesozooplankton abundance" indicator at the coastal, shelf and open sea habitats by seasons • "Copepods biomass" - ratio of copepods to mesozooplankton biomass

	Descriptor 4 D4C1 – Primary: The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures. D4C2 – Primary: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures. D4C3 – Secondary (using to support D4C3, where it is necessary): The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures.
2.3 Features, pressures and impacts	Annex III, Table 1 - Structure, functions and processes of marine ecosystems With respect to an ecosystem element pelagic habitats: • species composition, abundance and / or biomass of phytoplankton and zooplankton assemblages • physical, hydrological and chemical characteristics • chlorophyll "a" • frequency of blooms of plankton and spatial distribution Annex III, Table 2 - Anthropogenic pressures, uses and human activities in or affecting the marine environment Anthropogenic pressure: • Input or spread of non-indigenous species • Changes to hydrological conditions • Input of nutrients - diffuse sources, point sources, atmospheric deposition • Input of organic matter - diffuse sources and point sources • Input of hazardous substances (synthetic substances, non-synthetic substances, radionuclides) - diffuse sources, point sources, atmospheric deposition, acute events • Uses and human activities in or affecting the marine environment • Aquaculture - marine, including infrastructure • Transport - shipping • Urban uses • Industrial uses • Waste treatment and disposal
2.4 GES	GES definition according to art.9 of MSFD Good environmental status in Descriptor 1 is achieved when biodiversity is maintained, the quality of the habitats, the distribution and the numbers of the species are in line with the prevailing physical geographical, geographic and climatic conditions. GES definition relating to criteria of D1C6 The condition of the habitat type, including its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size, structure of species), is not adversely affected due to anthropogenic pressures. Physical, hydrological and chemical conditions are appropriate for maintaining plankton communities at a level not affected by anthropogenic activities. GES definition relating to Descriptor 4. D4C1 - Primary: The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures. D4C2 - Primary: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures. D4C3 - Secondary: The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures.

	D4C4 - Secondary (to be used in support of criterion D4C2, where necessary): Productivity of the trophic guild is not adversely affected due to anthropogenic pressures. The program: • covers the needs for evaluation of descriptor 1 and targets. The monitoring program will provide data and an assessment system for species composition, biomass and abundance of the phytoplankton and zooplankton (criterion D1C6). • meets the needs of data / information requirements for the evaluation of the descriptor (or the specific biodiversity component of programs D1, D4, D6) - the monitoring program will provide data for assessment of the species composition, biomass and abundance of phytoplankton and zooplankton. Data for assessment of pressure on the pelagic habitats will be provided by the monitoring programs of Descriptor 2 - Non-indigenous species, Descriptor 5 - Eutrophication, Descriptor 7 - Hydrographical changes and Descriptor 8. Contaminants • will provide data that will allow further development of proposed indicators and refinement of proposed thresholds; on this basis, targets will be updated / set out to determine the extent of achievement of the GES for coastal, shelf and open sea habitats. At the same time, it will accumulate data on the development of indicators under D4, where gaps and uncertainties are the most significant • the information from the planned monitoring will show whether the GES and targets are being met and will allow to assess trends in the change in status of the monitored indicators. When recording sustainable negative trends, action will be taken to identify the sources of pressure and, if necessary, further mitigation measures.																																													
2.5 Environmental targets MSFD WFD Habitat Directive	Pressure targets The relevant targets of pressures are defined in the frames of Descriptor 2 - Non indigenous species, Descriptor 5 -Eutrophication, Descriptor 7 - Hydrographical changes, Descriptor 8 - Contaminants. State targets D1C6: within the 6 year monitoring cycle the 95 percentile of the monthly chl. a values during spring-summer (April-September) are not above the threshold in more than 10% of the samples in spring and in more than 5% in summer or the trend should be decreasing (BG Initial Assessment Report, art. 10 MSFD, http://www.bsbd.org/bg/page_1722859.html). Threshold values of indicator “Phytoplankton biomass” [mg·m⁻³] in coastal habitat. <table><tr><td>Indicator</td><td colspan="4">Coastal habitat</td></tr><tr><td></td><td>winter</td><td>spring</td><td>summer</td><td>autumn</td></tr><tr><td>Phytoplankton biomass [mg·m⁻³]</td><td></td><td>2200-3000</td><td>550-800</td><td></td></tr></table> Threshold values of indicator “Phytoplankton biomass” [mg·m⁻³] in shelf habitat. <table><tr><td>Indicator</td><td colspan="4">Shelf habitat</td></tr><tr><td></td><td>winter</td><td>spring</td><td>summer</td><td>autumn</td></tr><tr><td>Phytoplankton biomass [mg·m⁻³]</td><td></td><td>600-1000</td><td>460-600</td><td>900-1000</td></tr></table> Threshold values of indicator “Phytoplankton biomass” [mg·m⁻³] in open sea habitat (beyond shelf). <table><tr><td>Indicator</td><td colspan="4">Open sea habitat</td></tr><tr><td></td><td>winter</td><td>spring</td><td>summer</td><td>autumn</td></tr><tr><td>Phytoplankton biomass [mg·m⁻³]</td><td></td><td>150-220</td><td>100-150</td><td></td></tr></table>	Indicator	Coastal habitat					winter	spring	summer	autumn	Phytoplankton biomass [mg·m ⁻³]		2200-3000	550-800		Indicator	Shelf habitat					winter	spring	summer	autumn	Phytoplankton biomass [mg·m ⁻³]		600-1000	460-600	900-1000	Indicator	Open sea habitat					winter	spring	summer	autumn	Phytoplankton biomass [mg·m ⁻³]		150-220	100-150	
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Threshold values of indicator "Phytoplankton abundance" [cells/L] in shelf habitat.			
Indicator	Shelf habitat		
	winter	spring	summer
Phytoplankton abundance" [cells/L]	940 000	700 000	840 000
Target mesozooplankton: The mesozooplankton biomass and abundance within the 6-year period should be above the threshold values defined for GES in over 70% of cases. Threshold values of indicator "Zooplankton biomass" [mg·m⁻³] in coastal habitat.			
Indicator	Coastal habitat		
	winter	spring	summer
Zooplankton biomass [mg·m ⁻³]	15-16	45-50	230-250
Threshold values of indicator "Zooplankton biomass" [mg·m ⁻³] in shelf habitat.			
Indicator	Shelf habitat		
	winter	spring	summer
Zooplankton biomass [mg·m ⁻³]	20-25	30-35	50-70
Threshold values of indicator "Zooplankton biomass" [mg·m ⁻³] in open sea habitat (beyond shelf).			
Indicator	Open sea habitat		
	winter	spring	summer
Zooplankton biomass [mg·m ⁻³]	22-23	25-30	45
Threshold values of indicator "Zooplankton abundance" [ind·m ⁻³] in coastal habitat			
Indicator	Coastal habitat		
	winter	spring	summer
Zooplankton abundance [ind·m ⁻³]	850-900	5000-6000	10000-12000
Threshold values of indicator "Zooplankton abundance" [ind·m ⁻³] in shelf habitat			
Indicator	Shelf habitat		
	winter	spring	summer
Zooplankton abundance [ind·m ⁻³]	2200	2500	6000
Threshold values of indicator "Zooplankton abundance" [ind·m ⁻³] in open sea habitat (beyond shelf)			
Indicator	Open sea habitat		
	winter	spring	summer
Zooplankton abundance [ind·m ⁻³]	1000	1200	2400
Target: Within 6 years period maintenance of the ratio Copepods biomass / Mesozooplankton biomass over 42% (Reference: fig. 1.3.2.1, Initial Assessment Report related to art. 9 and 10 of MSFD)			

	Proposed Potential Indicators on Descriptor 4 regarding to the MSFD: • the ratio of the abundance of sprat - AS, ind·km⁻² and the number of copepods (Abundance of Copepoda - AC, ind·m⁻³); • the ratio between Mean Length Sprat (MLS, cm) and the mean size of zooplankton (Mean size zooplankton - MSZ, microns). • relationship between zooplankton biomass (mg·m⁻³) and biomass of phytoplankton (mg·m⁻³). • mean zooplankton size (zooplankton biomass ratio (mg·m⁻³) to the abundance (ind·m⁻³)) • jellyfish plankton biomass (g·m⁻³). Under Article 4 of the Water Framework Directive, Member States must implement the necessary measures to prevent the deterioration of the status of all surface water bodies, including coastal waters, by 2015 (15 years after the adoption of the Directive). The Art. 2 of the Habitat Directive aims to contribute to ensuring biodiversity by preserving natural habitats and wild fauna and flora on the European territories of the Member States.
3 Monitoring concept	
3.2 Description of monitoring network	The approach and methodology for identification of Marine Reporting Units is described in Moncheva et al., 2018 (Report, Contract between MOEW and IO-BAS, 2018). The coastal pelagic habitat is subdivided into 5 MRU, the shelf into 2 MRU and the open sea represents a single MRU. The coastal broad pelagic habitat covers the 37 stations located in the 16 water bodies from the national monitoring network under WFD (Directive 2000/60/EC) and additional 7 stations located at depth <30m, outside the 1nm zone. The selection of station was based on anthropogenic pressure sources and the specific hydrological features of the region. The key sources of anthropogenic pressure are the identified land-based point sources (WWTPs, river mouths), diffuse sources (agriculture, urbanization, industry, tourism) and atmospheric deposition. The anthropogenic pressures in the sea are mainly related to mariculture (mussels farms), fisheries, port activities and shipping.



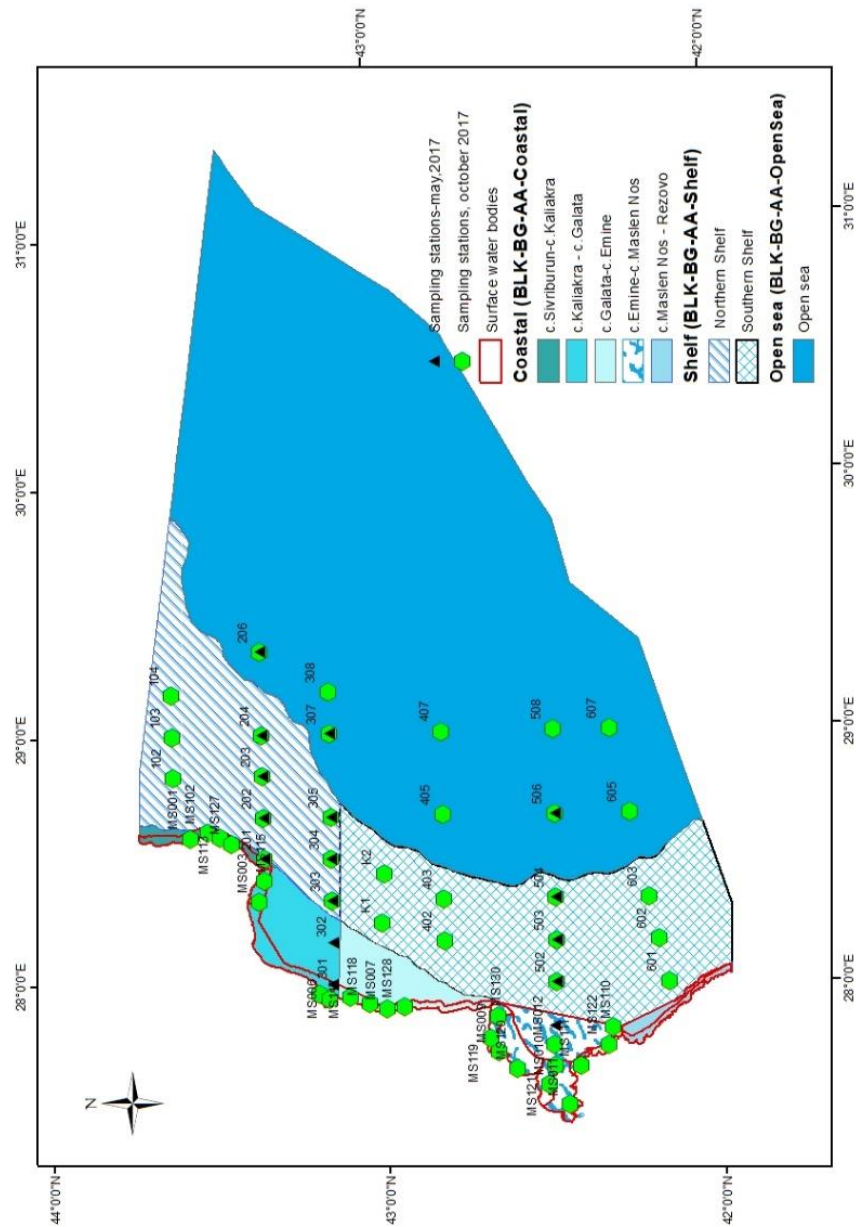
	Hydrophysical, hydrochemical parameters and chlorophyll "a" should be under the consideration. They are complementary for the D1, 4 pelagic habitats.
6. Activities required to implement the concept	
6.1 Changes to the current monitoring programme	The following types of actions are needed to improve the monitoring program: Scientific-and technological: • Validation of the proposed threshold values of the "phytoplankton abundance" indicator at the shelf habitat by seasons after new data accumulation • Validation of the proposed threshold values of the "Mesozooplankton abundance" indicator at three pelagic habitats after new data accumulation • Specification of ecological targets for GES of marine environment • Collection and accumulation of new data in winter and autumn seasons for identification of threshold values of indicators "Phytoplankton abundance" and "Phytoplankton biomass" at open sea habitat • Applying of new and inovative technological monitoring approaches - Full-Featured Flow Cytometer; Plankton Recorder; hydroacoustic methods; buoy stations equipped with chemical and biological sensors and etc.) • Establishment of database center on the state of the marine environment; Criation of a policy regulation on the access and use of databases and data collected during EU projects funded by the EC and other financial instruments. • Development and validation of indicators for the food webs assessment. Administrative: • Providing funding for the implementation of the monitoring programs in accordance with the MSFD; • Good coordination with other institutions / organizations providing information on the state or impact on the marine environment; • Providing sufficient capacity to competent authorities and organizations (such as human resources, expertise and equipment) to plan and conduct monitoring of the marine environment.

MONITORING PROGRAMME FOR DESCRIPTOR 2 - NON-INDIGENOUS SPECIES	
1. General	
1.1 Subject area	Programme name: Program for monitoring D 2 - Non-indigenous species Programme ID: BLKBG_D2_NIS
1.2 Definition / Description	Descriptor 2 - Non indigenous species reflects pressure of human activities with introduction of non indigenous species. Non indigenous species (synonyms: exotic, introduced, alohtone, non native) is a species, subspecies or other taxonomic level, introduced intentionally or accidentally via by different vectors and human activity as a mediator in areas beyond its natural distribution range (Occhipinti-Ambrogi, Galil, 2004; Olenin et al., 2010). Cryptogenic species is a species that can not reliably demonstrate its introduced or local origin (Carlton, 1996). Biological migrants can influence the new environment, changing communities, habitats and the functioning of the ecosystem as a whole. The extent to which alien species change the environment depends on the degree of their invasiveness. "Biological pollution" (biopollution) is defined as the effect of introduction of non-native species sufficient to disrupt the environment of the individual, community or ecosystem, including the causal link of adverse economic consequences (Elliott, 2003). However, quantitative assessment of the negative impact of non-indigenous species is difficult and requires comprehensive research and efforts in collecting data to establish world-wide databases (Molnar et al., 2008). The control or removal of alien species is difficult to implement. The risk of biological invasions could be reduced most effectively through appropriate management measures (for example, by ballast water treatment and increasing of public awareness about the risk of invasions). The program will provide data on pressures, status and impacts of marine communities from the introduction of non indigenous species in the Black Sea and their development in the marine waters of the Republic of Bulgaria. The monitoring program is focused to the following communities: • Pelagic communities - phytoplankton and zooplankton • Benthic communities - macrozoobenthos The program will provide information for human activities (driving forces) related to the introduction of alien species (shipping). The program provides data for D1 Biodiversity Monitoring Program and D4 - Food webs. Additionally, data for physical, chemical and hydrographical changes will be provided by the D5 Eutrophication Monitoring Program, D7 - Hydrographical changes Monitoring Program.
2. Monitoring requirements and purpose	
2.2 GES criteria and indicators	D2C1. Primary. The number of non-indigenous species which are newly introduces via human activity into the wild, per assessment period (6 years), measured from the reference year as reported for the initial assessment under Article 8(1) of Directive 2008/56/EC, is minimised and where possible reduced to zero. Indicator: Number of non-indigenous species, introduced via human activity for the 6 year assessment period, measured from the reference year (Initial Assessment Report). D2C2. Secondary Abundance and spatial distribution of established non-indigenous species, particularly of invasive species, contributing significantly to adverse effects on particular species groups or broad habitat types. Criteria elements are established non-indigenous species, particularly invasive non-indigenous species, which include relevant species on the list of invasive alien species of Union concern adopted in accordance with Article 4(1) of Regulation (EU) № 1143/2014 and species which are relevant for use under criterion D2C3 Use of criteria: Criterion D2C2 (quantification of non-indigenous species) shall be expressed per species assessed and shall contribute to the assessment of criterion D2C3 (adverse effects of non-indigenous species) Indicator: Biomass of <i>Mnemiopsis leidyi</i> [g·m⁻³].

	Indicator: Biopollution level index - BPI Indicator: Biomass and distribution of <i>Rapana venosa</i> D2C3. Secondary Proportion of the species group or spatial extent of the broad habitat type, which is adversely altered due to non-indigenous species, particularly invasive non-indigenous species. Criterion D2C3 shall provide the proportion per species group and extent per broad habitat type assessed which are adversely altered, and thus contribute to their assessment under Descriptor 1 and 6. Indicator: Ratio of non-indigenous/invasive species to native species (phytoplankton and zooplankton). Indicator: The site specific biocontamination index - SBCI. Indicator: Biomass ration of bivalve prey/invasive predator <i>Rapana venosa</i> (Todorova, this document) Assessment results: distribution (GIS layer), area (km²) and proportion (%) of each habitat type adversely altered due to invasive non-indigenous species.
2.3 Features, pressures and impacts	Annex III, Table 2a concerned Indicative lists of ecosystem elements, anthropogenic pressures and human activities relevant to the marine waters. The monitoring program of D2 reflects: • ecosystem elements (relevant to Annex III Table 1) • broad habitat types of the water column (pelagic) and seabed (benthic) • possible parameters and characteristics • species composition, abundance and/or biomass (spatial and temporal variation) • size and age structure of species (if appropriate) • pelagic-benthic community shifts • productivity Annex III Table 2 - Anthropogenic pressures, uses and human activities in or affecting the marine environment Table 2a Anthropogenic pressures on the marine environment • Input or spread of non-indigenous species • Input of microbial pathogens • Input of genetically-modified species and translocation of native species Table 2b Uses and human activities in or affecting the marine environment • Aquaculture - marine, including infrastructure • Transport - shipping
2.4 GES	Good environmental status is achieved when Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems D2C1. GES is achieved when newly introduced species are not registered in the 6-year assessment period after Initial Assessment reporting. D2C2. GES is achieved in cases when abundance and spatial distribution of established non-indigenous species, especially of invasive species, do not adversely affect particular groups of species or broad habitat types. D2C3. GES is achieved when proportion of the species group or spatial extent of the broad habitat type do not adversely alter due to non-indigenous species, particularly invasive non-indigenous species. The program:

	• will use and integrate data and assessments elaborated during the monitoring programs of Descriptors 1 and 5. In addition, it will provide new data for pressure assessment of non-indigenous introduction at relevant broad habitat types - coastal, shelf and open sea (see below: Criteria D2C2, D2C3). Consider planning of surveillance in areas such as "hot spots" - the main ports on the Bulgarian coastal areas, aquaculture areas and NATURA 2000 as reference areas. • provide data / information to evaluate the descriptor or specified Biodiversity component in Descriptor 1. The current monitoring program provides data on monitoring programs under Descriptor 1 - Biodiversity, Descriptor 4 - Food webs and provides information about human activities (driving forces) related to the introduction of alien species. • contributes to determining the distance from the GES and trends in the state - the monitoring program will allow determination of the distance to the GES through defined targets, based on the indicator thresholds in criteria D2C1, D2C2, D2C3 for coastal, shelf and offshore waters. • respond to the risk to not achieve the GES - the information from the monitoring will show whether targets are achieved and will allow to assess trends or status based on the observed indicators. When persistent negative trends or failure to meet the threshold values will be register, action will be taken to identify the specific sources of pressure and, if necessary, additional measures to reduce the negative impacts.
2.5 Environmental targets MSFD HD BD WFD	The identified indicators for GES (D2) in accordance with Art. 10 of the MSFD need further development. Because of the limited knowledge of the impact of alien species on the environment, the defined targets and set up threshold values at this stage need validation. Target under criteria D2C1. No new species introduced per 6 years period (from the period of Initial Assessment reporting) in the assessment area - 0 newly introduced alien species. Reducing the risk of introducing and spreading alien species by improving the management of high-risk roads and vectors. Indicator: Number of non-indigenous species introduced via human activity per assessment period (6 years), as compared to those indicated in the initial assessment of the marine environmental state. Targets under criteria D2C2 and D2C3. • Communities dominated by native species - the proportion of the non-indigenous species group s or spatial distribution of the broad habitat type adversely affected in the relevant assessment area are low or minimized. • Abundance, biomass or spatial distribution of non-indigenous/invasive species is below thresholds. Indicator: Biomass of <i>Mnemiopsis leidyi</i> - $< 4 \text{ g} \cdot \text{m}^{-3}$ or $120 \text{ g} \cdot \text{m}^{-2}$ Indicator: Ratio of biomass of non-indigenous/invasive species to native species (phytoplankton, zooplankton) with threshold values $\leq 10\%$. Indicator: The site-specific biocontamination index - SBCI. The threshold for the lowest quality is based on the assumption that the alien species represent more than half of the established taxa or their number exceeds 50%. Therefore, the community is influenced and developed as a result of the impact of the non-indigenous species. Threshold value for good status is SBCI ≤ 1. Indicator: Biopollution level index - BPI. The index is based on a classification of the abundance and extent of non-indigenous / invasive species distribution and the impact on the native communities, habitats and the ecosystem functioning. The index ranges from 0 (no impact) to 4 (mass impact). Threshold for GES with low or insignificant impact on the ecosystem is BPI ≤ 1. Indicator: Biomass ratio bivalves/<i>Rapana venosa</i> ≥ 10. The threshold value is proposed based on the 10% trophic efficiency law in the food chain (Slobodkin, 1962). It is necessary to verify this value with in-situ and experimental data.
3 Monitoring concept	
3.2 Description of monitoring network	The D2 monitoring program uses the data and results of the monitoring programs under Descriptors 1,4, 5 and 6. The approach and methodology for identification of Marine Reporting Units is described in Moncheva et al., 2018 (Report, Contract between MOEW and IO-BAS, 2018). The coastal pelagic habitat is subdivided into 5 MRU, the shelf into 2 MRU and the open sea

represents a single MRU. The coastal broad pelagic habitat covers the 37 stations located in the 16 water bodies from the national monitoring network under WFD (Directive 2000/60/EC) and additional 7 stations located at depth <30m, outside the 1nm zone. The selection of station was based on anthropogenic pressure sources and the specific hydrological features of the region. The key sources of anthropogenic pressure are the identified land-based point sources (WWTPs, river mouths), diffuse sources (agriculture, urbanization, industry, tourism) and atmospheric deposition. The anthropogenic pressures in the sea are mainly related to mariculture (mussels farms), fisheries, port activities and shipping.

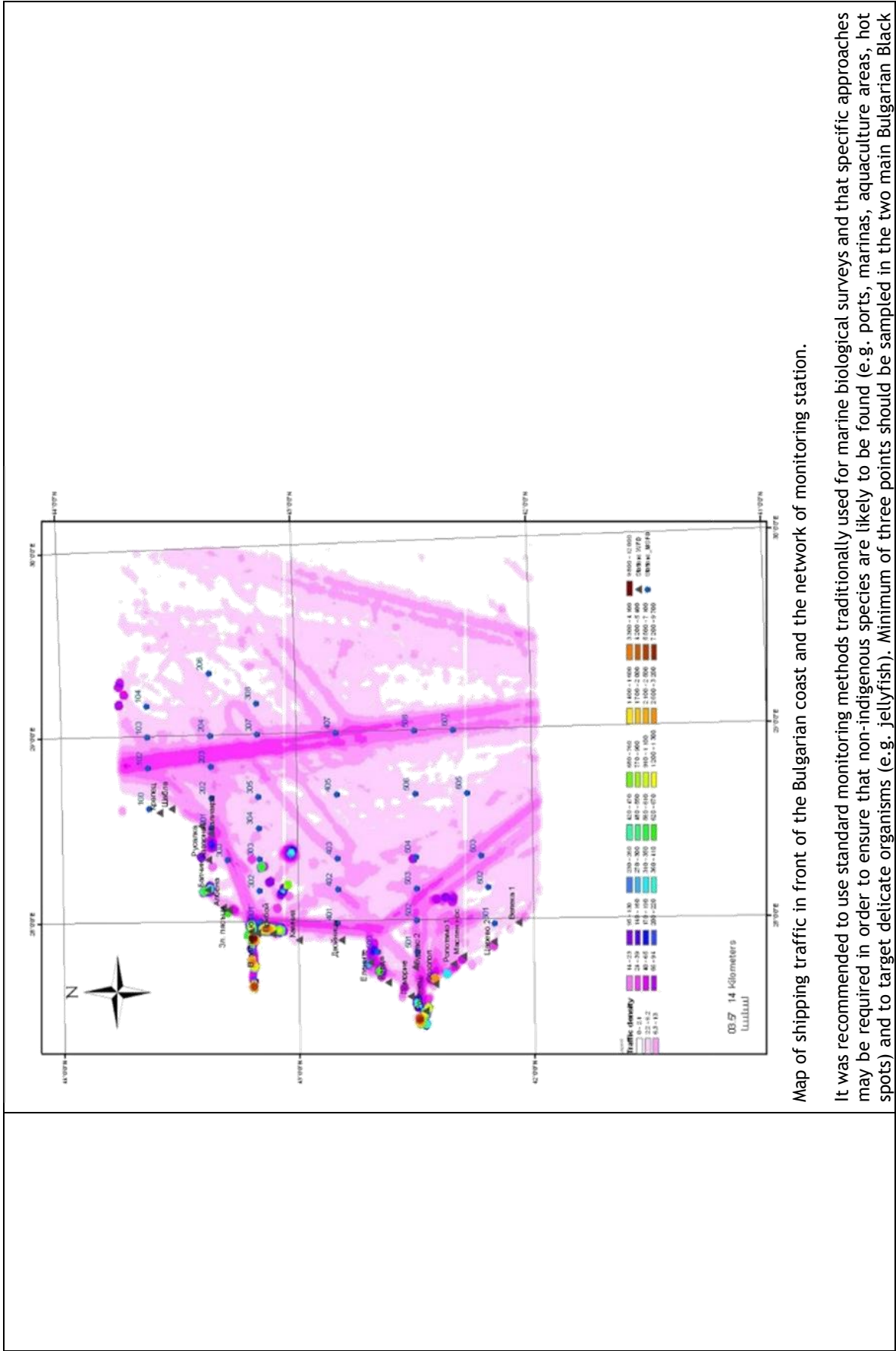


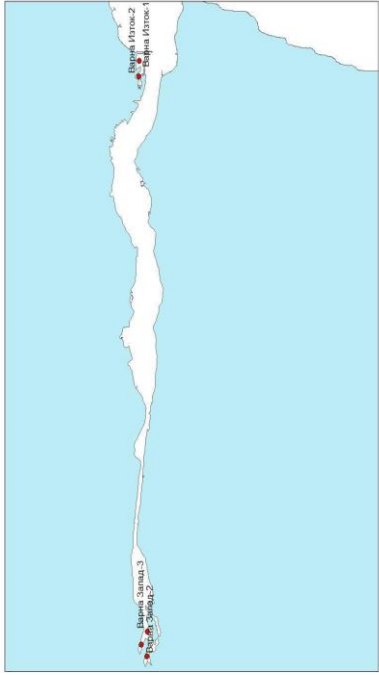
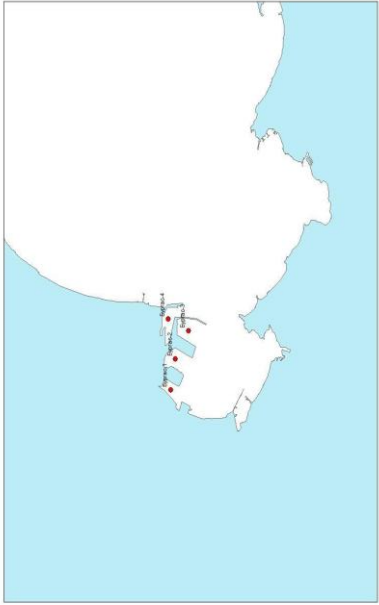
Map of monitoring stations and Marine Reporting Units (MRU) in the coastal, shelf and open sea pelagic habitat

Name, code, Marine Reporting Units (MRU), depth and surface coverage				
	Code and name of the MRU	Depth range [m]	Surface MRU [km ²]	
BLK-BG-AA Coastal	BLK-BG-AA-Siviriburun Kaliakra	0-30	162	
	BLK-BG-AA-Kaliakra Galata	0-30	828	
	BLK-BG-AA-Galata Emine	0-30	699	
	BLK-BG-AA-Emine Maslennos	0-30	856	
BLK-BG-AA Shelf	BLK-BG-AA-Maslennos Rezovo	0-30	155	
	BLK-BG-AA-Northern Shelf	30-200	3879	
	BLK-BG-AA-Southern Shelf	30-200	5521	
BLK-BG-AA Open Sea	BLK-BG-AA-Open Sea	>200	22423	

The frequency of sampling: four time per year (seasonally) - winter, spring, summer, autumn. Additionally, the D2 monitoring program includes the sampling in the main vectors and risk areas of introducing new alien species such as ports. Monitoring should take place at the appropriate time of the year, at the same time as the main vectors (pathways) and the characteristics of the communities.

Figure below presents a map of shipping traffic in front of the Bulgarian coast and the network of stations and their location in the space according to the monitoring programs under D1,4, D2 and D5. It also reflects the coverage of the pressures - transport and eutrophication.



	Sea ports - Varna and Burgas. For an adequate analysis, more numbers of stations may be required. Two surveys per year (in spring and in the end of summer) should be conducted with an aim to catch life stages that may only occur in certain seasons and to include all taxonomic groups (e.g. non-indigenous disease agents, bacteria and viruses). Phyto -, zooplankton and benthos (from all type substrates - hard and soft, epifauna, fouling organisms) should be sampled.   a) b) Map of station location at main Bulgarian Black Sea ports a) Varna, b) Burgas.
6. Activities required to implement the concept 6.1 Changes to the current monitoring programme	Recommendations for filling in gaps in knowledge and information: Scientific: • Validation of the site-specific biocontamination index. • Validation of the Biopollution level index. • Development of new specific indicators regarding to important invasive species as <i>Rapana venosa</i>, <i>Beroe ovata</i>. • Development of a coherent methodology between the Black Sea states for setting up threshold values- coherent definitions of the GES and targets. • Creation of non-indigenous species database on regional or EU level. Establishment of the access and usage regulation of databases provided by projects funded by the EC and other financial instruments. • Application of molecular technologies (barcoding / DNA analysis) to compare conventional with the innovative assessment methods. Administrative: • Providing funding for the implementation of the monitoring programs in accordance with the MSFD. • Good coordination with other institutions / organizations providing information on the state or impact on the marine environment. • Providing sufficient capacity to competent authorities and organizations (such as human resources, expertise and equipment) to plan and conduct monitoring of the marine environment. • The Member States (Bulgaria and Romania) are obliged to set up thresholds at regional level for the assessment of the GES under Descriptor 2.

MONITORING PROGRAMME FOR DESCRIPTOR 3 - COMMERCIALY-EXPLOITED FISH AND SHELLFISH	
1. General	
1.1 Subject area	Programme name: D3 - Commercially-exploited fish and shellfish. Programme ID: BLKBG-D3-Commercial_Fish
1.2 Definition/ Description	Monitoring program is aimed at assessing the current status of commercially exploited fish and shellfish populations, managed on the basis of the Common Fisheries Policy. Fish stock assessments of the of commercially exploited species should be carried out at regional level and, if does not exist - at national level. The program is aimed to assess the adverse impact on species as a result of anthropogenic activity (fishing, spatial coverage and distribution of physical disturbance on the seabed, spatial coverage of the habitats that are adversely affected by physical disturbance). The scope of the assessment for the Bulgarian area covers the following species: european sprat (<i>S. sprattus</i>), turbot (<i>S. maximus</i>), whiting (<i>M. merlangus</i>), red mullet (<i>M. barbatus</i>), Mediterranean horse mackerel (<i>T. mediterraneus</i>), picked dogfish (<i>S. acanthias</i>), anchovy (<i>E. encrasicolus</i>), thornback ray (<i>R. clavata</i>), had (<i>A. immaculata</i>). Monitoring approach At national level, the data and results from research surveys under the National Program for Data Collection from fisheries could be used to calculate some of the primary and secondary indicators. The rest of the primary indicators could be calculated only after analytical stock assessments carried out at the regional Black Sea level. For species for which regional assessments do not exist, secondary indicators will be applied. The monitoring program will provide data for the monitoring programs on Descriptors: D3 - Commercially-exploited fish and shellfish and D6 - Seabed integrity. Monitoring program will include demersal trawl survey in shelf area (for demersal shelf fish species) and hydroacoustic survey in the Bulgarian EEZ (for pelagic shelf fish species). At national level, the monitoring program under MSFD will use the research data from the National Program for the collection, management and use of data in the Fisheries sector in accordance with Regulation (EC) No 199/2008 of 25.02.2008 and as well as data from the NAFA fishing statistics for incidental by-catches of non-target species.
2. Monitoring requirements and purpose	
2.2 GES criteria and indicators	D3C1. Primary: The Fishing mortality rate of populations of commercially-exploited species is at or below levels which can produce the maximum sustainable yield (MSY). Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013. <u>Pressure indicator</u> - Fishing mortality (F), consistent with Maximum Sustainable Yield (F_{MSY}) by species or proxy ($F0.1$). - Catch/biomass ratio. D3C2. Primary: The Spawning Stock Biomass of populations of commercially-exploited species are above biomass levels capable of producing maximum sustainable yield. Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013. <u>State indicators:</u> - Spawning Stock Biomass (SSB) by species; - Precautionary reference point for spawning stock biomass (Bpa) by species; - Survey abundance indices. D3C3. Primary: The age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population. This shall include a high proportion of old/large individuals and limited adverse effects of exploitation on genetic diversity. <u>State indicators:</u>

	- the proportion of fish larger than mean size of first sexual maturation - Lm. - the 95th percentile of the fish-length distribution of each population, as observed in research vessel or other surveys (L95). - mean length of fish of each population, as observed in research vessel or other surveys (Lmean).																												
2.3 Features, pressures and impacts	ANNEX III, Table 2a. Anthropogenic pressures, uses and human activities in or affecting the marine environment <table><tr><th>Theme</th><th>Pressure</th><th>Activity</th></tr><tr><td rowspan="4">Biological</td><td>Input or spread of non-indigenous species</td><td>Transport – shipping (ballast waters)</td></tr><tr><td>Input of genetically modified species and translocation of native species</td><td>Aquaculture – marine, including infrastructure</td></tr><tr><td>Loss of, or change to, natural biological communities due to cultivation of animal or plant species</td><td>Aquaculture – marine, including infrastructure</td></tr><tr><td>Disturbance of species (e.g. where they breed, rest and feed) due to human presence</td><td>Tourism, Transport – shipping</td></tr><tr><td rowspan="3">Physical</td><td>Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)</td><td>Fish and shellfish harvesting</td></tr><tr><td>Physical disturbance to seabed (temporary or reversible)</td><td>Fish and shellfish harvesting</td></tr><tr><td>Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)</td><td>Solid waste disposal, incl. dredging masses</td></tr><tr><td rowspan="4">Substances, litter and energy</td><td>Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events</td><td>Industry (loads, emissions)</td></tr><tr><td>Input of litter (solid waste matter, including micro-sized litter)</td><td>Agriculture and Forestry (оток, эмисии) Urban uses (sewage loads)</td></tr><tr><td>Input of anthropogenic sound (impulsive, continuous)</td><td>Shipping (underwater noise and pollutants)</td></tr><tr><td>Input of other forms of energy (including electromagnetic fields, light and heat)</td><td></td></tr></table>	Theme	Pressure	Activity	Biological	Input or spread of non-indigenous species	Transport – shipping (ballast waters)	Input of genetically modified species and translocation of native species	Aquaculture – marine, including infrastructure	Loss of, or change to, natural biological communities due to cultivation of animal or plant species	Aquaculture – marine, including infrastructure	Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Tourism, Transport – shipping	Physical	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	Fish and shellfish harvesting	Physical disturbance to seabed (temporary or reversible)	Fish and shellfish harvesting	Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)	Solid waste disposal, incl. dredging masses	Substances, litter and energy	Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events	Industry (loads, emissions)	Input of litter (solid waste matter, including micro-sized litter)	Agriculture and Forestry (оток, эмисии) Urban uses (sewage loads)	Input of anthropogenic sound (impulsive, continuous)	Shipping (underwater noise and pollutants)	Input of other forms of energy (including electromagnetic fields, light and heat)	
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	Input of other forms of energy (including electromagnetic fields, light and heat)																												
2.4 GES	Definition of GES for Descriptor D 3 - populations of commercially-exploited fish and shellfish Populations of all commercially-exploited fish and shellfish are within safe biological limits, spawning stock biomasses (SSB) are at level or above biomass levels capable of producing maximum sustainable yield (MSY) and each population has exhibiting a population age and size distribution that is indicative of a healthy stock. Fishing activities are carried out in a manner and extent that does not exceed maximum sustainable yield, do not systematically reduce the exploited populations and their reproductive capacity, do not harm their habitats (particularly damage of bottom habitats due to trawling activities) and do not reduce the opportunities for use of fish and shellfish stocks by future generations. D3C1. The Fishing mortality rate of populations of commercially-exploited species is at or below the levels which can produce the maximum sustainable yield (MSY), established according to scientific advice. D3C2: The Spawning Stock Biomass (SSB) of populations of commercially-exploited species show stable trend to be above the biomass levels capable of producing maximum sustainable yield. D3C3: The age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population (stock). The age and size structure shall include a high proportion of old/large individuals and limited adverse effects of exploitation on genetic diversity.																												
2.5 Environmental targets	Pressure targets																												

MSFD HD BD WFD	D3C1 Fishing mortality (F). Target: maintaining the fishing mortality rates of populations of commercially-exploited species at or below the levels which can produce the maximum sustainable yield (msy) by reducing the fishing effort as follows: <u>Regional level</u> <i>S. sprattus</i> $f \leq f_{msy}$, $f_{msy} = 0.64$ <i>S. maximus</i> $f \leq f_{msy}$, $f_{msy} = 0.26$ <i>M. barbatus</i> $f \leq f_{msy}$, $f_{msy} = 0.64$ <i>E. encrasicolus</i> $f \leq f_{msy}$, $f_{msy} = 0.49$ <i>T. mediterraneus</i> $f \leq f_{msy}$, $f_{msy} = 0.27$ <i>S. acanthias</i> $f \leq f_{msy}$, $f_{msy} = 0.08$ <i>M. merlangus</i> $f \leq f_{msy}$, $f_{msy} = 0.79$ <i>R. clavata</i> $f \leq f_{msy}$, $f_{msy} = 0.16$ D3C1. Catch/biomass ratio. Target: maintaining the value of the catch / biomass ratio below the threshold value: <u>National level</u> <i>S. sprattus</i> ≤ 0.082 (sprat) <i>S. maximus</i> ≤ 0.033 (turbot) <u>State targets</u> D3C2: Spawning stock biomass (SSB). Target: the spawning stock biomass of populations of commercially-exploited species are above the biomass levels capable of producing maximum sustainable yield or biomass levels at precautionary approach ($b \geq bpa$), as follows: <u>Regional level</u> <i>S. maximus</i> , $B \geq BPA$, $BPA=4949$ t D3C2. Target: maintain a trend towards an increase in the biomass indices per species above the reference level. <u>National level</u> <i>S. sprattus</i> - biomass index $\geq 55\,000$ t <i>S. maximus</i> - biomass index $\geq 1\,700$ t D3C3. Target: the age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population (stock). The age and size structure shall include a high proportion of old/large individuals, as follows: <u>National level</u> <u>Proportion of fish larger than mean size of first sexual maturation - L_m.</u> Classification scheme for state of populations of commercially exploited fish in the shelf area according to the proportion of fish larger than mean size of first sexual maturation - L_m .																				
	<table><tr><th>Species</th><th>L_m (cm)</th><th>% of fish larger than L_m</th><th>State</th></tr><tr><td colspan="4">Pelagic fish species</td></tr><tr><td><i>S. sprattus</i></td><td>7.1</td><td>68%</td><td>> 68%</td></tr><tr><td><i>E. encrasicolus</i></td><td>-</td><td>-</td><td>-</td></tr><tr><td><i>T. mediterraneus</i></td><td>12.25</td><td>30%</td><td>> 30%</td></tr></table>	Species	L_m (cm)	% of fish larger than L_m	State	Pelagic fish species				<i>S. sprattus</i>	7.1	68%	> 68%	<i>E. encrasicolus</i>	-	-	-	<i>T. mediterraneus</i>	12.25	30%	> 30%
	Species	L_m (cm)	% of fish larger than L_m	State																	
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	<i>E. encrasicolus</i>	-	-	-																	
	<i>T. mediterraneus</i>	12.25	30%	> 30%																	

<i>P. saltatrix</i>	-	-	-	-
<i>A. immaculata</i>	-	-	-	-
Demersal fish species				
<i>M. barbatus</i>	10.73	53%	> 53%	< 53%
<i>M. merlangus</i>	14.9	16%	> 16%	< 16%
<i>S. maximus</i>	45	74%	> 74%	< 74%
<i>S. acanthias</i>	-	-	-	-

The 95th percentile of the fish length distribution of each population, as observed in research vessel or other surveys (L95).

Classification scheme for state of populations of commercially exploited fish in the shelf area according to the 95th percentile of the fish length distribution of each population, as observed in research vessel or other surveys (L95).

Species	L95 (cm)	State
		Good
Pelagic fish species		
<i>S. sprattus</i>	10.17	> 10.17
<i>E. encrasicolus</i>	-	-
<i>T. mediterraneus</i>	13	> 13
<i>P. saltatrix</i>	-	-
<i>A. immaculata</i>	-	-
Demersal fish species		
<i>M. barbatus</i>	13.43	> 13.43
<i>M. merlangus</i>	15.3	> 15.3
<i>S. maximus</i>	62	> 62
<i>S. acanthias</i>	-	-

95th percentile of size structure by height and length of commercially exploited bivalves' species *Donax trunculus*, *Chamelea gallina*
 Thresholds for good status of the population of *Chamelea gallina*.

	H95 (mm)	L95 (mm)
Percentile 0.95	≥ 22.22	≥ 23.92

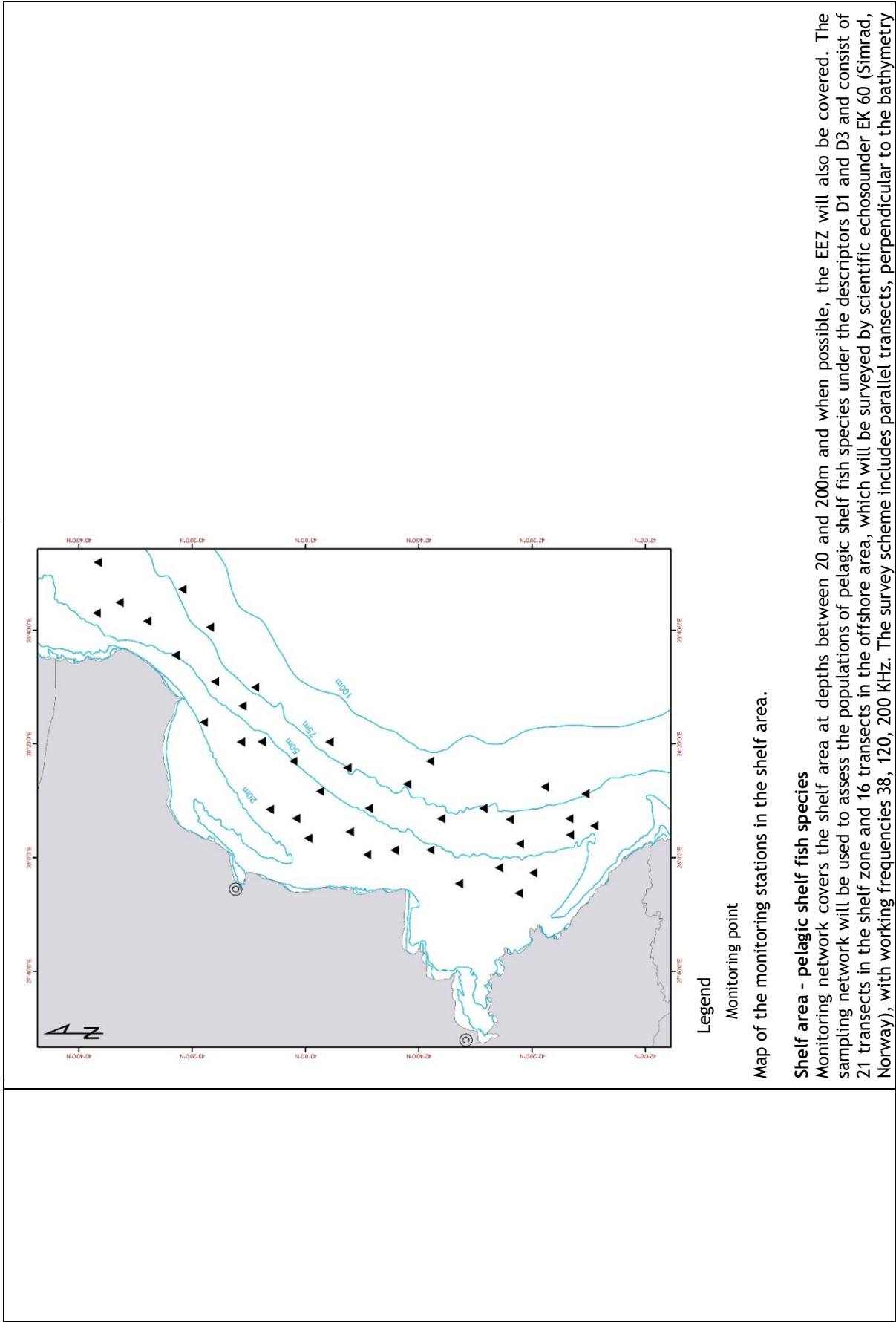
Thresholds for good status of the population of *Donax trunculus*

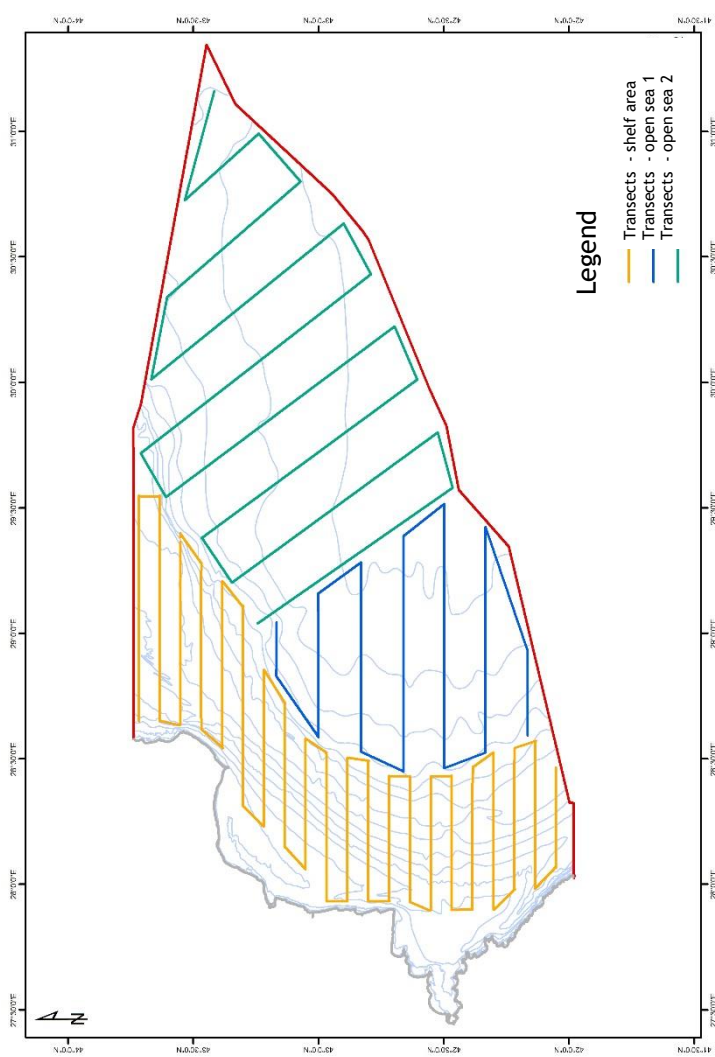
	H95 (mm)	L95 (mm)
Percentile 0.95	≥ 20.91	≥ 33.78

Mean length of fish of each population, as observed in research vessel or other surveys (L_{mean}).

Classification scheme for state of populations of commercially exploited fish in the shelf area according to the mean length of fish, observed in research vessel surveys (L_{mean}, cm).

	Species	L _{mean} (cm)	State	
			Good	Not good
	Pelagic fish species			
	<i>S. sprattus</i>	8	> 7.2	< 7.2
	<i>E. encrasicolus</i>	10	9	11
	<i>T. mediterraneus</i>	11.6	> 10.44	< 10.44
	<i>P. saltatrix</i>	-	-	-
	<i>A. immaculata</i>	-	-	-
	Demersal fish species			
	<i>M. barbatus</i>	15.6	> 14.04	< 14.04
	<i>M. merlangus</i>	17.8	> 16.02	< 16.02
	<i>S. maximus</i>	56	> 50.4	< 50.4
	<i>S. acanthias</i>	-	-	-
3 Monitoring concept				
3.2 Description of monitoring network	Monitoring program on Descriptor D3 will be integrated with monitoring programs on Descriptors D1 and D10 and will complement the National Data Collection Program of Bulgaria in line with the Common Fisheries Policy. Monitoring network will cover the following assessment areas: • Shelf area - sampling by demersal trawl for assessment of state of demersal shelf fish populations. • Shelf area and, if possible, Exclusive Economic Zone (EEZ) - hydroacoustic survey, combined by pelagic hauls for assessment of state of pelagic shelf fish populations. Shelf area - demersal shelf fish species Monitoring network covers the shelf area at depths between 20 and 100m and the survey is combined with the assessment of demersal shelf fish species under Descriptors D1 and D3. The monitoring network is integrated also with sampling under national program for collection, management and data usage in fisheries sector in accordance with Regulation (EU) № 199/2008 from 25.02.2008. The control hauls by demersal trawl gear will be carried out in 40 fields in the Bulgarian Black Sea area, selected at random, depending on the relief of the bottom. For the aims of the survey, the area is divided into four depth strata -Stratum 1 (20 - 35 m), Stratum 2 (35 - 50 m), Stratum 3 (50 - 75 m) and Stratum 4 m). The plan of monitoring stations is presented on figure below. The survey will be conducted annually during the spring - autumn seasons.			



	of the area with inter-transect distance of 5 nautical miles. The speed of the ship during the acoustic sampling is fixed in the range between 7.5 and 8.5 knots. The surveys will be conducted annually in the shelf zone and once for every 2 years in the EEZ. The monitoring network is integrated also with sampling under national program for collection, management and data usage in fisheries sector in accordance with Reglament (EU) No. 199/2008 from 25.02.2008. 
6. Activities required to implement the concept 6.1 Changes to the current monitoring programme	Scheme of acoustic survey in the shelf and offshore areas. Necessary amendments and recommendations • The main problems regarding the commercially exploited fish and shelfish in front of the Bulgarian Black Sea coast are related to the lack of data on demographic characteristics of species, as well as assessment of their stock abundance and biomass. The lack of sufficiently up-to-date scientific information prevents the use of the indicators proposed to assess the progress in achieving good environmental status for all commercial species as well as the baseline and threshold values for some of them. Some of the indicators need further development. • Better co-ordination with other institutions / organizations, providing information on the state or impact on the marine environment.

	• Ensuring of sufficient capacity of competent authorities and organizations (such as human resources, expertise and equipment) to plan and conduct monitoring of the marine environment. • Development of indicators and criteria for assessing of the changes in the components of the marine environment in relation to the climate change and their differentiation from the effects of anthropogenic pressure. • Ensuring the necessary and timely financing of the implementation of the monitoring programs in accordance with the MSFD. • Improving the data management and information related to the state of the marine environment; improving the access to national and regional databases and data from projects funded by the EC and other financial instruments.
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MONITORING PROGRAMME FOR DESCRIPTOR 5 - EUTROPHICATION	
1. General	
1.1 Subject area	Programme name: Program for monitoring D5- Eutrophication Programme ID: BLKBG-D5-Eutrophication
1.2 Definition / Description	Eutrophication is a process driven by the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, leading to: increased growth, primary production and biomass of algae; changes in the balance of organisms; and water quality degradation. The consequences of eutrophication are undesirable if they appreciably degrade ecosystem health and biodiversity and/or the sustainable provision of goods and services. Nitrogen and phosphorus occur naturally in marine waters, transferred from land via streams, rivers and runoff of rainwater and also from degradation of organic material within the water. However, human inputs of nutrients to the environment has increased the load of nitrogen and phosphorus to the oceans which are in need of management measures. The Black Sea is extremely vulnerable to anthropogenic eutrophication due to its natural specific features: semi-enclosed basin with strong vertical stratification, high residence time and low water -exchange rate, large catchment area (exceeding 5 time its surface area) and H₂S accumulated at depths below 150-200m. All these preconditioned its categorisation among the "highly sensitive marine basins". In the context of the DPSIR model (Driving forces/ Pressure/ State/ Impact/ Response) the Programm addresses the pressure from nutrient (inorganic and organic) loads originating from multiple sources: • land-based inputs as a result of various anthropogenic activities, • inputs from the marine environment, including transboundary sources and • atmospheric deposition aimed to provide relevant information for pressure spatial distribution, intensity and scale (direct and indirect effects) over the pelagic and benthic habitats and their biological communities. Program criteria elements and criteria are: • Nutrients in the water column: Dissolved Inorganic Nitrogen (DIN), Total Nitrogen (TN), Dissolved Inorganic Phosphorus (DIP), Total Phosphorus (TP) and Si (µmol/l) and TOC (µg/l) in the water (pressure criteria) <u>Direct effects (criteria elements):</u> • Chl <i>a</i> concentration in the water column (µg/l); • Harmful algal blooms (HABs) (e.g. cyanobacteria) in the water column; • Opportunistic macroalgae of benthic habitats; • Photic limit (transparency) of the water column; <u>Indirect effects (Criteria elements):</u> • Dissolved O₂ concentration in the bottom of the water column and O₂ saturation at the surface waters; • Macrophyte communities (perennial seaweeds and seagrasses such as fucoids, eelgrass) of benthic habitat; • Macrofaunal communities of benthic habitats. The program supply data/information to the Monitoring Programs for Descriptor 1-6, 1-4 and it could be integrated with the Monitoring program for Descriptor 8 (pollutants in the water column) based on the general notion that nutrients and pollutants originate from a common source of pressure. It is obligatory that the Monitoring Program should also take into consideration additional monitoring of physical, hydrological and chemical variables of the environment (COMMISSION DECISION (EU) 2017/848, repealing Decision 2010/477/EU, AnnexIII, Table 1). In the coastal waters where the cases of increased eutrophication and the related negative consequences are more frequent, member states should use the current control and operational monitoring of the coastal marine waters, developed for the Black Sea basin region in compliance with the requirements of WFD 2000/60/EC.

	Anthropogenic activities including land -based sources of pressure and the corresponding measures for their reduction have been already included in the current Monitoring Program developed for the Black Sea basin region in compliance with the requirements of WFD 2000/60/EC. The monitoring of the land-based point sources of pollution is part of the current information system for wastewaters (regulated by section 4 of Ordinance No. 1/11.04.2011 for water monitoring). The present monitoring program is aimed to upgrade the existing monitoring program by increasing assessment of the spatial scale of distribution of land-based pollutants and those originating in the sea (e.g. shipping) spanning from BG coastal area over the territorial waters and EEZ.
2. Monitoring requirements and purpose	
2.2 GES criteria and indicators	List of Criteria elements and criteria according to COMMISSION DECISION (EU) 2017/848, repealing Decision 2010/477/EU and specifications and standardised methods for monitoring and assessment. D5C1. Primary: Nutrient concentrations are not at levels that indicate adverse eutrophication effects. State indicator: Nutrients in the water column (µmol/l): Dissolved Inorganic Nitrogen (DIN = NH₄+NO₃+NO₂), Total Nitrogen (TN), Dissolved Inorganic Phosphorus (DIP), Total Phosphorus (TP), additional parameters- Si and Total Organic Carbon (TOC) during spring-summer (April-September) are below the levels that indicate adverse eutrophication effects. The threshold values are as follows: • in coastal waters, the values set in accordance with Directive 2000/60/EC; • beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. Scale of assessment: – within coastal waters, as used under Directive 2000/60/EC, – beyond coastal waters, subdivisions of the region or subregion, divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: • the values achieved for each criterion used, and an estimate of the extent of the assessment area over which the threshold values set have been achieved; • in coastal waters, the criteria shall be used in accordance with the requirements of Directive 2000/60/EC to conclude on whether the water body is subject to eutrophication; • beyond coastal waters, an estimate of the extent of the area (as a proportion (%)) that is not subject to eutrophication (as indicated by the results of all criteria used, integrated in a manner agreed where possible at Union level, but at least at regional or subregional level). D5C2. Primary: Chlorophyll <i>a</i> concentration (µg/l) in the water column are not at levels that indicate adverse effects of nutrient enrichment. State indicator: Chlorophyll <i>a</i> concentration (µg/l) in the water column during spring-summer (April-September) are not at levels that indicate adverse effects of nutrient enrichment. The threshold values are as follows: • in coastal waters, the values set in accordance with Directive 2000/60/EC; • beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. Scale of assessment: – within coastal waters, as used under Directive 2000/60/EC, – beyond coastal waters, subdivisions of the region or subregion, divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows:

	- the values achieved for each criterion used, and an estimate of the extent of the assessment area over which the threshold values set have been achieved; - in coastal waters, the criteria shall be used in accordance with the requirements of Directive 2000/60/EC to conclude on whether the water body is subject to eutrophication; - beyond coastal waters, an estimate of the extent of the area (as a proportion (percentage)) that is not subject to eutrophication (as indicated by the results of all criteria used, integrated in a manner agreed where possible at Union level, but at least at regional or subregional level). D5C3. Secondary: The number, spatial extent and duration of harmful algal bloom events are not at levels that indicate adverse effects of nutrient enrichment. State indicator: Harmful algal blooms (e.g. cyanobacteria) in the water column: - abundance of a single phytoplankton species (monoalgal bloom) or 2-3 species exceeding values 1×10^6 cells/L during spring-summer (April-September) that indicate adverse effects of nutrient enrichment (data from D1, additional parameter in compliance to point 2 “For D5C2 and D5C3, Member States may in addition use phytoplankton species composition and abundance” as well as to reflect the presence of potentially toxic species initiating blooms (Dzhembekova, Moncheva, 2015); - Chl.a concentrations above the defined bloom threshold due to the proliferation of a single phytoplankton species (monoalgal bloom) or 2-3 species during spring- summer (April-September) that indicate adverse effects of nutrient enrichment (data from D1); - abundance of potentially toxic species exceeding the species-specific threshold for toxicity that indicate adverse effects of nutrient enrichment (additional parameter due to the presence of potentially toxic species initiating blooms- Dzhembekova, Moncheva, 2015); - area of pelagic habitats in the shelf and open sea with chl <i>a</i> concentration in the surface waters (remote-sensing) exceeding the defined bloom threshold (April-September); - number of days with chl <i>a</i> concentration in the surface waters (remote-sensing) exceeding the defined bloom threshold (April-September) in the pelagic habitats in the shelf and open sea ; - proportion of <i>Noctiluca scintillans</i> (B %) from the total mesozooplankton biomass in spring (additional parameter) - a typical for the Black Sea blooming species in spring with direct and indirect adverse effects The threshold values are as follows: - in coastal waters, the values set in accordance with Directive 2000/60/EC; - beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. Scale of assessment: – within coastal waters, as used under Directive 2000/60/EC, – beyond coastal waters, subdivisions of the region or subregion, divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: - the values achieved for each criterion used, and an estimate of the extent of the assessment area over which the threshold values set have been achieved; - in coastal waters, the criteria shall be used in accordance with the requirements of Directive 2000/60/EC to conclude on whether the water body is subject to eutrophication; - beyond coastal waters, an estimate of the extent of the area (as a proportion (percentage)) that is not subject to eutrophication (as indicated by the results of all criteria used, integrated in a manner agreed where possible at Union level, but at least at regional or subregional level).
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	D5C4. Secondary: The photic limit (transparency) of the water column during spring-summer (April-September) is not reduced, due to increases in suspended algae, to a level that indicates adverse effects of nutrient enrichment. State indicator: Photic limit (transparency) of the water column The threshold values are as follows: • in coastal waters, the values set in accordance with Directive 2000/60/EC; • beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. Scale of assessment: – within coastal waters, as used under Directive 2000/60/EC, – beyond coastal waters, subdivisions of the region or subregion, divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: • the values achieved for each criterion used, and an estimate of the extent of the assessment area over which the threshold values set have been achieved; • in coastal waters, the criteria shall be used in accordance with the requirements of Directive 2000/60/EC to conclude on whether the water body is subject to eutrophication; • beyond coastal waters, an estimate of the extent of the area (as a proportion (percentage)) that is not subject to eutrophication (as indicated by the results of all criteria used, integrated in a manner agreed where possible at Union level, but at least at regional or subregional level). D5C5. Primary (may be substituted by D5C8): The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse effects on benthic habitats (including on associated biota and mobile species) or other eutrophication effects. State indicator: Dissolved oxygen (DO, mg/l)/Oxygen saturation (OS, %) in the bottom of the water column. Additional parameter Dissolved oxygen (DO, mg/l)/Oxygen saturation (OS, %) at the surface waters of the water column- an important feature of marine environment directly related to the phytoplankton blooms (D5C2) and (D5C4). Phytoplankton blooms could be associated with surface waters O₂ oversaturation or deficit depending on the ecophysiological features of the species causing adverse effects not necessarily followed by an O₂ deficit in the bottom waters. The threshold values are as follows: • in coastal waters, the values set in accordance with Directive 2000/60/EC; • beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. Scale of assessment: – within coastal waters, as used under Directive 2000/60/EC, – beyond coastal waters, subdivisions of the region or subregion, divided where needed by national boundaries. Use of criteria: The extent to which good environmental status has been achieved shall be expressed for each area assessed as follows: • the values achieved for each criterion used, and an estimate of the extent of the assessment area over which the threshold values set have been achieved; • in coastal waters, the criteria shall be used in accordance with the requirements of Directive 2000/60/EC to conclude on whether the water body is subject to eutrophication; • beyond coastal waters, an estimate of the extent of the area (as a proportion (percentage)) that is not subject to eutrophication (as indicated by the results of all criteria used, integrated in a manner agreed where possible at Union level, but at least at regional or subregional level).
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	D5C6. Secondary: The abundance of opportunistic macroalgae is not at levels that indicate adverse effects of nutrient enrichment. The abundance /biomass of opportunistic macrophyte species in the coastal waters do not exceed the WFD thresholds. State indicator: Opportunistic macroalgae of benthic habitats • % of the wet biomass of tolerant species (ESGI) from the total wet biomass; • Ecological index EI (Dencheva K., Doncheva V., 2014; Berov D., 2015), applicable for infralitoral rocky habitat down to 3 m depth. • Epithytes on the seagrass leaves (additional parameter) The threshold values are as follows: • in coastal waters, the values set in accordance with Directive 2000/60/EC; • should this criterion be relevant for waters beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. D5C7. Secondary: The species composition and relative abundance or depth distribution of macrophyte communities achieve values that indicate there is no adverse effect due to nutrient enrichment including via a decrease in water transparency. State indicator: Macrophyte communities (perennial seaweeds and seagrasses such as fucoids, eelgrass) of benthic habitats • % of the wet biomass of macroalgal species from the first ecological group (ESGI) normalized for the infralitoral rocky habitat down to 3 m depth. • Ecological index EI, (Dencheva K., Doncheva V.; 2014, Berov D., 2015), normalized for the infralitoral rocky habitat down to 3 m depth. • Proactive coverage of <i>Cystoseira</i> spp and other macrophytes from the first ecological category (ESGI), normalized for the infralitoral rocky habitat down to 3 m depth. • Depth distribution of <i>Cystoseira barbata</i> and <i>C. bosporica</i> (in case a suitable substrate id available). • Depth distribution of seagrass meadows. • Depth distribution of <i>Phyllophora crispa</i> and other perannual sciophilic macrophytes (in case a suitable substrate is available). Other indicators for lower infralitoral: benthic proactive coverage by species <i>Phyllophora crispa</i>, <i>Apoglossium ruscifolium</i>, <i>Zanardinia typus</i>, <i>Gelidium spinosum</i> as well as other species from the second ecological group (ESGI). Underground biomass of <i>Zostera noltii</i>, ratio below ground/aboveground biomass of <i>Zostera noltii</i>, density of <i>Zostera noltii</i> shoots, length of <i>Zostera noltii</i> shoots. The threshold values are as follows: • in coastal waters, the values set in accordance with Directive 2000/60/EC; • should this criterion be relevant for waters beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. D5C8. Secondary (except when used as a substitute for D5C5): The species composition and relative abundance of macrofaunal communities, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment. State indicator: Macrofaunal communities of benthic habitats • Number of species S • Index of biodiversity Shannon H' • Biotic index AMBI, • M-AMBI*n (composite index integrating S, H' and AMBI) The threshold values are as follows: • in coastal waters, the values for benthic biological quality elements set in accordance with Directive 2000/60/EC;
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	beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.																					
2.3 Features, pressures and impacts	List of ecosystem elements, characteristics and pressures targeted by the monitoring program in order to assess the spatial extent of the habitat adversely affected/not affected by eutrophication. Ecosystem elements listed in Annex III, Table 1: - Broad pelagic and benthic habitat types and their associated biological communities in the coastal shelf and open sea ecological zones of the marine region Characteristics of all habitat types (listed in Annex III, Table 1): - habitat distribution and extent (and volume, if appropriate) - species composition, abundance and/ or biomass (spatial and temporal variation) - physical, hydrological and chemical characteristics - chlorophyll <i>a</i> concentration (for pelagic habitats) - plankton bloom frequencies and spatial extent (for pelagic habitats) - physical characteristics (temperature, turbidity, transparency, sediment loads) - hydrological characteristics (wave and current regimes; upwelling, mixing, residence time, freshwater input; sea level) - chemical characteristics - dissolved gases (pCO₂, O₂), nutrients, TOC, pH. Anthropogenic pressures on the marine environment (listed in Annex III, Table 2a). - Input of nutrients – diffuse sources, point sources, atmospheric deposition. - Inputs of fertilizers and other substances containing N and P (diffuse sources, point sources, including agriculture, aquaculture, atmospheric deposition); - Inputs of organic matter (e.g. sewage system, mariculture, riverine inputs). Uses and human activities affecting the marine environment by eutrophication pressure (BG marine environment) <table><tr><th colspan="2">Uses and human activities affecting the marine environment by eutrophication pressure</th><th>Activities in the BG Black Sea environment related to D5</th></tr><tr><th>Theme</th><th>Activity</th><th></th></tr><tr><td>Extraction of living resources</td><td>Fish and shellfish harvesting (professional)</td><td>Bottom trawling, beam-trawl, dredging (secondary nutrients input in the water column); fishing ship (emission)</td></tr><tr><td>Cultivation of living resources</td><td>Muscelculture, Agriculture</td><td>Mussels culture farm (secondary sources of nutrients enrichment); Agriculture (fertilizer)</td></tr><tr><td>Transport</td><td>Shipping</td><td>Port activities (dredging-nutrients enrichment from the bottom) Shipping (emission)</td></tr><tr><td>Urban and industrial uses</td><td>Urban and industrial uses</td><td>Inputs from coastal WWTP; sewage systems of combined type (diffuse source of nutrients)</td></tr><tr><td>Tourism and leisure</td><td>Tourism and leisure infrastructure, activities related to leisure and recreation</td><td>Yachts ports, artificial islands, WWTPs, maritime tourism (recreation)</td></tr></table>	Uses and human activities affecting the marine environment by eutrophication pressure		Activities in the BG Black Sea environment related to D5	Theme	Activity		Extraction of living resources	Fish and shellfish harvesting (professional)	Bottom trawling, beam-trawl, dredging (secondary nutrients input in the water column); fishing ship (emission)	Cultivation of living resources	Muscelculture, Agriculture	Mussels culture farm (secondary sources of nutrients enrichment); Agriculture (fertilizer)	Transport	Shipping	Port activities (dredging-nutrients enrichment from the bottom) Shipping (emission)	Urban and industrial uses	Urban and industrial uses	Inputs from coastal WWTP; sewage systems of combined type (diffuse source of nutrients)	Tourism and leisure	Tourism and leisure infrastructure, activities related to leisure and recreation	Yachts ports, artificial islands, WWTPs, maritime tourism (recreation)
Uses and human activities affecting the marine environment by eutrophication pressure		Activities in the BG Black Sea environment related to D5																				
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Transport	Shipping	Port activities (dredging-nutrients enrichment from the bottom) Shipping (emission)																				
Urban and industrial uses	Urban and industrial uses	Inputs from coastal WWTP; sewage systems of combined type (diffuse source of nutrients)																				
Tourism and leisure	Tourism and leisure infrastructure, activities related to leisure and recreation	Yachts ports, artificial islands, WWTPs, maritime tourism (recreation)																				

2.4 GES	GES definition for D5: Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters. D5C1. Nutrient's concentrations vary within the identified GES thresholds and do not cause adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters. D5C2, D5C3, D5C4, D5C6. Direct effects of nutrient enrichments are within the identified GES thresholds or targets. D5C5, D5C7, D5C8. Indirect effects of nutrient enrichments are within the identified GES thresholds or targets.																																																																																																				
2.5 Environmental targets MSFD HD BD WFD	Marine strategy Framework Directive (MSFD) State targets: D5C1. Coastal, shelf and open sea marine regions for assessment (MRUs): the identified thresholds (refer to the surface homogenous layer) are given in tables below. Nutrients threshold for spring and summer (BG Initial assessment Report, art. 9 and 10, MSFD) <table><tr><th rowspan="2">Concentration (µM/L)</th><th colspan="2">Spring</th><th colspan="2">Open sea</th><th colspan="2">Summer</th></tr><tr><th>coastal</th><th>shelf</th><th></th><th></th><th>coastal</th><th>shelf</th></tr><tr><td>N-NH₄</td><td>1.5</td><td>1</td><td></td><td>1</td><td>1.5</td><td>1</td></tr><tr><td>N-NO₃</td><td>2.5</td><td>1.5</td><td></td><td>1</td><td>1.5</td><td>1</td></tr><tr><td>P-PO₄</td><td>0.3</td><td>0.2</td><td></td><td>0.2</td><td>0.25</td><td>0.2</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>0.1</td></tr></table> Nutrients threshold for spring, summer and autumn (based on last 10 years statistical data) <table><tr><th rowspan="2">Concentration (µM/L)</th><th colspan="3">Spring</th><th colspan="3">Summer</th><th colspan="3">Autumn</th></tr><tr><th>Coastal</th><th>Shelf</th><th>Open sea</th><th>Coastal</th><th>Shelf</th><th>Open sea</th><th>Coastal</th><th>Shelf</th><th>Open sea</th></tr><tr><td>N-NH₄</td><td>0.9</td><td>0.50</td><td>0.5</td><td>0.7</td><td>0.6</td><td>0.5</td><td>0.6</td><td>0.4</td><td>0.4</td></tr><tr><td>N-NO₂</td><td>0.3</td><td>0.08</td><td>0.06</td><td>0.12</td><td>0.08</td><td>0.06</td><td>0.1</td><td>0.08</td><td>0.05</td></tr><tr><td>N-NO₃</td><td>1.0</td><td>0.5</td><td>0.3</td><td>0.3</td><td>0.25</td><td>0.2</td><td>0.5</td><td>0.45</td><td>0.3</td></tr><tr><td>P-PO₄</td><td>0.15</td><td>0.1</td><td>0.1</td><td>0.15</td><td>0.08</td><td>0.08</td><td>0.14</td><td>0.1</td><td>0.07</td></tr></table> The thresholds need to be validated. For total N and total P there are no thresholds identified. Additional parameters: • Si concentration in the surface homogenous layer. No thresholds identified. • TOC, µg/l - no thresholds identified. D5C2. Coastal, shelf and open sea marine regions for assessment (MRUs): within the 6 year monitoring cycle the 95 percentile of the monthly chl. <i>a</i> values during spring-summer (April-September) are not above the threshold in more than 10% of the samples in spring and in more than 5% in summer or the trend should be decreasing (BG Initial Assessment Report) as revised during ISMEIM Project.	Concentration (µM/L)	Spring		Open sea		Summer		coastal	shelf			coastal	shelf	N-NH ₄	1.5	1		1	1.5	1	N-NO ₃	2.5	1.5		1	1.5	1	P-PO ₄	0.3	0.2		0.2	0.25	0.2							0.1	Concentration (µM/L)	Spring			Summer			Autumn			Coastal	Shelf	Open sea	Coastal	Shelf	Open sea	Coastal	Shelf	Open sea	N-NH ₄	0.9	0.50	0.5	0.7	0.6	0.5	0.6	0.4	0.4	N-NO ₂	0.3	0.08	0.06	0.12	0.08	0.06	0.1	0.08	0.05	N-NO ₃	1.0	0.5	0.3	0.3	0.25	0.2	0.5	0.45	0.3	P-PO ₄	0.15	0.1	0.1	0.15	0.08	0.08	0.14	0.1	0.07
Concentration (µM/L)	Spring		Open sea		Summer																																																																																																
	coastal	shelf			coastal	shelf																																																																																															
N-NH ₄	1.5	1		1	1.5	1																																																																																															
N-NO ₃	2.5	1.5		1	1.5	1																																																																																															
P-PO ₄	0.3	0.2		0.2	0.25	0.2																																																																																															
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Concentration (µM/L)	Spring			Summer			Autumn																																																																																														
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P-PO ₄	0.15	0.1	0.1	0.15	0.08	0.08	0.14	0.1	0.07																																																																																												

Revised thresholds for chl <i>a</i> for spring and summer						
Concentration (µg/L)	Spring			Summer		
	1 nm	coastal	shelf	Open sea	1 nm	coastal shelf Open sea
Chl <i>a</i>	3.3	3.3	1.4	0.4	1.5	1.4 1.2 0.36

D5C3. Bloom intensity:
Maintaining the current decreasing trend of spring and summer bloom intensity in compliance to the revised chl *a* threshold (based on remote sensing data - Project Devotes) for shelf and open sea.

Thresholds for primary and secondary bloom intensity in the BG shelf and open sea based on the application of the biooptical algorithm (Kopelevich et al, 2012) and remote-sensing data from MODIS Aqua/Terra, for the period 1999- 2013.

Pelagic habitat	Season	Bloom type	Threshold
Shelf	spring	Primary	3.8
Shelf	Spring	Secondary	2.9
Shelf	Summer	Primary	2.7
Shelf	Summer	Secondary	2.0
Open sea	Spring	Primary	1.5
Open sea	Spring	Secondary	1.1
Open sea	Summer	Primary	13
Open sea	summer	Secondary	1.0

The proportion of *Noctiluca scintillans* biomass (B %) of the total mesozooplankton biomass do not exceed 30% in spring.

Additional parameters:

- abundance of a single phytoplankton species (monoalgal bloom) or 2-3 species exceeding values 1×10^6 cells/L during spring-summer (April-September) that indicate adverse effects of nutrient enrichment (data from D1), do not exceed the identified thresholds in more than 10% of the spring and 5% of the summer seasonal measurements.
- Chl. *a* concentrations above the defined bloom threshold due to the proliferation of a single phytoplankton species (monoalgal bloom) or 2-3 species during spring - summer (April-September) that indicate adverse effects of nutrient enrichment (data from D1) do not exceed the identified thresholds in more than 10% of the spring and 5% of the summer seasonal measurements.
- abundance of potentially toxic species exceeding the species-specific threshold for toxicity that indicate adverse effects of nutrient enrichment (the concentrations are species specific and should be revised for the Black Sea after long-term data will be available). Thresholds should be identified.

The diatoms: dinoflagellates biomass ratio (Bac: Din) in spring is within the GES thresholds, reported in the BG Initial Assessment report, art.10 MSFD, but the thresholds need revision for which more data are needed.

Spatial bloom extent: the proportion of the surface area of the shelf and open sea habitat with concentration of chl *a* (remote sensing data) above the bloom threshold is less than 5 % of the corresponding MRU.

Bloom duration: number of days with chl *a* concentration in the surface waters (remote-sensing) of shelf and open sea pelagic habitat exceeding the defined bloom threshold – threshold should be identified (by 2020).

D5C4. (coastal, shelf and open sea marine regions for assessment, MRUs). Within the 6 year monitoring cycle 95 percentile of the monthly transparency values during spring-summer (April-September) are not above the threshold in more than 10% of the cases in spring and in more than 5% in summer or the trend should be decreasing (BG Initial Assessment Report) as revised during ISMEIM Project. Revised thresholds for photic limit for spring and summer <table><tr><th rowspan="2">Photic limit, m</th><th colspan="3">Spring</th><th colspan="3">Summer</th></tr><tr><th>1 nm</th><th>coastal</th><th>shelf</th><th>Open sea</th><th>1 nm</th><th>Open sea</th></tr><tr><td>Secchi depth</td><td>5.2</td><td>4.5-7.0</td><td>5.8-6.5</td><td>9-10</td><td>4.7</td><td>11-13</td></tr></table> D5C5. The thresholds reported in the BG Initial assessment Report refer to OS %. Initially the classical value of Dissolved oxygen at the bottom ≥ 2 mg/l is accepted as a threshold for hypoxia. There are no specific thresholds for the different habitats identified yet. Additional parameter: Dissolved O₂ at the surface of the water column (as OS%) related directly to phytoplankton blooms (D5C2 and D5C4). Oxygen saturation (OS%) thresholds <table><tr><th>OS%</th><th>Season</th><th>Coastal</th><th>Shelf</th><th>Open Sea</th></tr><tr><td rowspan="2">Surface homogenous layer</td><td>Spring</td><td>100-120</td><td>100-120</td><td>100-120</td></tr><tr><td>Summer</td><td>95-120</td><td>100-115</td><td>100-115</td></tr><tr><td>Botoom layer (depth <40 M)</td><td>Summer</td><td>>75</td><td></td><td></td></tr></table> D5C6. Thresholds for the related indicators: - the % of the wet biomass of tolerant macroalgae species (ESGI) is < 40 % from the total wet biomass normalized for the infralitoral rocky habitat down to 3 m depth; - Ecological index EI > 6 normalized for infralitoral rocky habitat down to 3 m depth; - Epiphytes on the seagrass leaves (additional parameter) - no threshold set yet. The threshold for D5C4 to assess the adverse effect of nutrient enrichment related to Criteria D5C6 is specified as follows: The annual average transparency (Secchi disk, m) in the seagrass meadows should be ≥ 6 m, not exceeding this threshold in more than 10% of the monthly values in spring and 5 % in summer (April-September). D5C7. Thresholds for the related indicators: % of the wet biomass of macroalgal species from the first ecological group (ESGI) > 60 % normalized for the infralitoral rocky habitat down to 3 m depth. - Ecological index EI > 6 normalized for the infralitoral rocky habitat down to 3 m depth. - Proactive coverage of <i>Cystoseira</i> spp and other macrophytes from the first ecological category (ESGI), $\geq 40\%$ (measured by the method of Orfanidis et al. 2011, as modified by Berov, 2013 in the upper infralitoral, depth between 2, 3 m). - Depth distribution of <i>Cystoseira barbata</i> ≥ 10 m and <i>C. bosporica</i> ≥ 4m in case a suitable substrate is available. - Depth distribution of seagrass meadows ≥ 6. - Depth distribution of <i>Phyllophora crispa</i> and other perannual sciophilic macrophytes ≥ 17 m (in case a suitable substrate is available).	Photic limit, m	Spring			Summer			1 nm	coastal	shelf	Open sea	1 nm	Open sea	Secchi depth	5.2	4.5-7.0	5.8-6.5	9-10	4.7	11-13	OS%	Season	Coastal	Shelf	Open Sea	Surface homogenous layer	Spring	100-120	100-120	100-120	Summer	95-120	100-115	100-115	Botoom layer (depth <40 M)	Summer	>75		
Photic limit, m		Spring			Summer																																		
	1 nm	coastal	shelf	Open sea	1 nm	Open sea																																	
Secchi depth	5.2	4.5-7.0	5.8-6.5	9-10	4.7	11-13																																	
OS%	Season	Coastal	Shelf	Open Sea																																			
Surface homogenous layer	Spring	100-120	100-120	100-120																																			
	Summer	95-120	100-115	100-115																																			
Botoom layer (depth <40 M)	Summer	>75																																					

	Total benthal proactive coverage by species <i>Phyllophora crispa</i>, <i>Apoglossium ruscolium</i>, <i>Zanardinia typus</i>, <i>Gelidium spinosum</i> $\geq 35\%$ benthal proactive coverage by species from the second ecological group (ESGII) (<i>Cladophora albida</i>, <i>Cladophora coelothrix</i>, <i>Chaetomorpha linum</i>, <i>Ulva rigida</i>) $\leq 15\%$ (measurements by the method of Berov, 2013; Berov et al., in prep.) Bellow ground biomass of <i>Zostera noltii</i>, ratio above ground/bellow ground biomass of, density of <i>Zostera noltii</i> shoots, length of <i>Zostera noltii</i> shoots. Thresholds for <i>Zostera noltii</i> indicators* <table><tr><td>Zostera noltii parameters</td><td>Bellow ground biomass, bg [b·m⁻²]</td><td>Ratio above/bellow the ground biomass (ag·bg ratio)</td><td>Leaf length [mm]</td><td>Shoots [shoots·m⁻²]</td><td>density</td></tr><tr><td>GES tresh</td><td>>105.2</td><td><2.4</td><td>≥ 151.5 - ≤ 270.5</td><td>≥ 500.6 - ≤ 1696.6</td><td></td></tr></table> *Based on the methodology of Karamfilov et al. (in review) for seagrass meadows located at depthn between 2-3m	Zostera noltii parameters	Bellow ground biomass, bg [b·m ⁻²]	Ratio above/bellow the ground biomass (ag·bg ratio)	Leaf length [mm]	Shoots [shoots·m ⁻²]	density	GES tresh	>105.2	<2.4	≥ 151.5 - ≤ 270.5	≥ 500.6 - ≤ 1696.6	
Zostera noltii parameters	Bellow ground biomass, bg [b·m ⁻²]	Ratio above/bellow the ground biomass (ag·bg ratio)	Leaf length [mm]	Shoots [shoots·m ⁻²]	density								
GES tresh	>105.2	<2.4	≥ 151.5 - ≤ 270.5	≥ 500.6 - ≤ 1696.6									
3 Monitoring concepts													
3.2 Description of monitoring network	The monitoring program is based on the following sources of data: - Field surveys by ship - Real time data from Argo profilers in the shelf and open sea - Remote sensing data (shelf and open sea) - The Real time Argo data provide information for the following parameters: temperature (0-1000 m), Salinity (0-1000m), Chlorophyll a (0-150 m) - vertical profile, O₂ (0-150 m) - vertical profile Frequency: - Depending on program cycle: 5 or 10 days - The data for chl. a are relevant for Criteria D5C2 and Criteria D5C3- bloom intensity and duration - The Remote sensing data is relevant for Criteria D5C3: - bloom intensity, duration and spatial scale Monitoring field network The approach and methodology for identification of Marine Reporting Units is described in detail in Moncheva et al., 2019 (Report, Contract between MOEW and IO-BAS, 2018). The coastal pelagic habitat is subdivided into 5 MRU, the shelf into 2 MRU and the open sea represents a single MRU. The coastal broad pelagic habitat covers the 37 stations located in the 16 WBs from the national monitoring network under WFD (Directive 2000/60/EC) and additional 7 stations located at depth <30m, outside the 1nm zone. The selection of station was based on anthropogenic pressure sources and the specific hydrological features of the region. The key sources of anthropogenic pressure are the identified land-based point sources (WWTPs, river mouths), diffuse sources (agriculture, urbanization, industry, tourism) and atmospheric deposition. The anthropogenic pressures in the sea are mainly related to mariculture (mussels farms) and shipping (port activities, emissions of NO₃).												

Name, code, boundaries and surface area of the Marine Reporting Units (MRU)				
	Code and name of the MRU	Depth range [m]	Surface MRU [km ²]	
BLK-BG-AA Coastal	BLK-BG-AA-Siviriburun Kaliakra	0-30	162	
	BLK-BG-AA-Kaliakra Galata	0-30	828	
	BLK-BG-AA-Galata Emine	0-30	699	
	BLK-BG-AA-Emine Maslennos	0-30	856	
	BLK-BG-AA-Maslennos Rezovo	0-30	155	
BLK-BG-AA Shelf	BLK-BG-AA-Northern Shelf	30-200	3879	
	BLK-BG-AA-Southern Shelf	30-200	5521	
BLK-BG-AA Open Sea	BLK-BG-AA-Open Sea	>200	22423	
MRU code and name, WFD WBs and surface area				
MRU code and name	WB code WFD	MRU code MSFD	Surface area [km ²]	
BLK-BG-AA-Siviriburun Kaliakra	BG2BS000C001	BLK-BG2000-CW	58	
	BG2BS000C002	BLK-BG2000-CW	22	
	BG2BS000C1003	BLK-BG2000-CW	33	
BLK-BG-AA-Kaliakra Galata	BG2BS000C1004	BLK-BG2000-CW	48	
	BG2BS000C1013	BLK-BG2000-CW	148	
	BG2BS000C005	BLK-BG2000-CW	16	
	BG2BS000C1113	BLK-BG2000-CW	46	
BLK-BG-AA-Galata Emine	BG2BS000C1006	BLK-BG2000-CW	21	
	BG2BS000C1007	BLK-BG2000-CW	62	
BLK-BG-AA-Emine Maslennos	BG2BS000C1008	BLK-BG2000-CW	52	
	BG2BS000C1010	BLK-BG2000-CW	402	
	BG2BS000C1011	BLK-BG2000-CW	51	
	BG2BS000C1108	BLK-BG2000-CW	159	
	BG2BS000C1208	BLK-BG2000-CW	62	
	BG2BS000C1308	BLK-BG2000-CW	139	
BLK-BG-AA-Maslennos Rezovo	BG2BS000C1012	BLK-BG2000-CW	76	
	BG2BS000C1112	BLK-BG2000-CW	76	
Frequency of sampling Due to the very high heterogeneity and dynamics of the pelagic habitats, it is recommended monthly monitoring during spring - summer (April-September) for Criteria/indicators D5C1, D5C2, D5C3 (field sampling), D5C4 and D5C5. For Criteria D5C6, D5C7 and D5C8 it is foreseen at least once per year (in Summer) complementary to WFD sampling (details provided in D1,6).				
6. Activities required to implement the concept				
6.1 Changes to the current monitoring programme	The following types of actions are needed to improve/upgrade the monitoring program:			
	A. Validation and revision (determination where lacking) GES thresholds for D5 criteria/indicators Validation and revision of the identified thresholds for MSFD N species and P-PO₄ for Spring-Summer (CriteriaD5C1)			

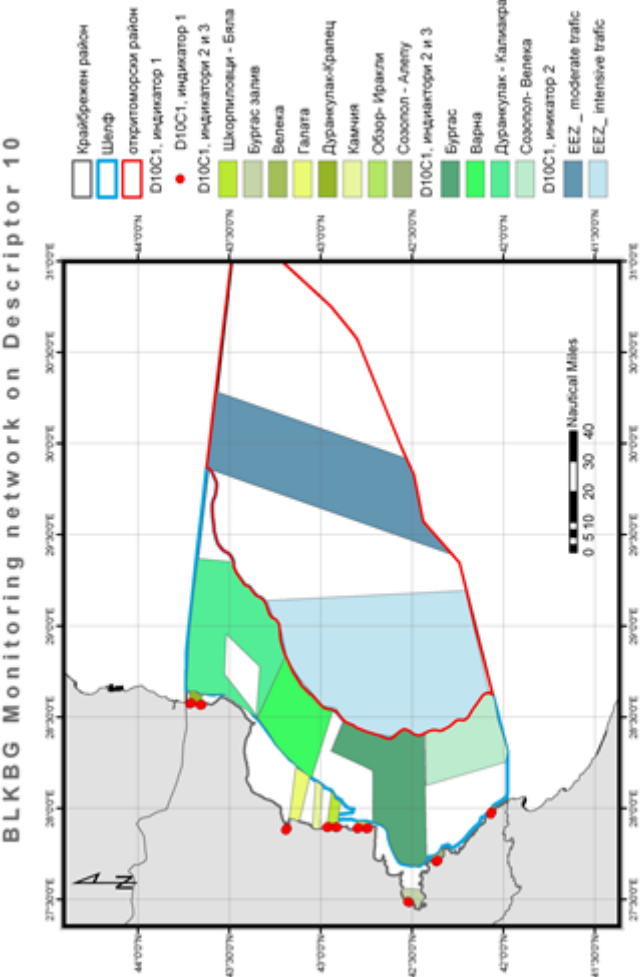
	• Validation and revision of the identified thresholds for WFD N species and P-PO₄ for Spring-Summer (CriteriaD5C1). • Determination of thresholds for the parameters Total N and P for the surface homogeneous layer for spring and summer (WFD and MSFD) (Criteria D5C1) • Validation and revision of the identified thresholds for O₂ (surface and bottom) -WFD and MSFD for spring and summer (Criteria D5C5) • Validation and revision of the identified thresholds for chlorophyll a, transparency, intensity and spatial scale of phytoplankton blooms (CriteriaD5C2, D5C3, D5C4) • Determination of thresholds the parameter "bloom duration" (based on satellite data) - Criteria D5C3 • Revision of the threshold for BAC: DIN biomass ratio in spring (additional for Criteria D5C3) • Definition of threshold for epiphytes on sea grass • Definition of thresholds for the indicators S, H', AMBI, M-AMBI* of macrozoobenthic communities of mud benthic habitats (details in D1-4). B. Need of additional indicators/parameters: • Development of thresholds for the additional parameter Si (D5C1) - it is important for the assessment of shifts between diatoms and dinoflagellates related to eutrophication • Development of thresholds for the additional parameter Total organic carbon (TOC) as a measure of organic loads(D5C1) • Development of classification system for: wet biomass of macroalgae from the first and second ecological group (ESGI и ESGII), ecological index EI, proactive coverage of <i>Cystoseira spp.</i> And other macroalgae from ESGI & ESGII for macroalgae communities at depths >3m • For a lot of the monitored parameters and indicators there is a need of enough data of relevant spatio-temporal resolution to reflect the natural variability of the parameter (e.g. phytoplankton, macrophytes etc) and differentiate the natural from anthropogenic impacts • Supporting (min monthly) measurements (data) for pressure (nutrients) of all possible sources (point, diffuse, land-based, sea-based, atmospheric deposition) • Supporting information (data) for nutrients loads from the Danube and the BG rivers • Supporting information (data) for physical, hydrodynamic and chemical parameters of the marine environment. C. Application of up-to-date technological and methodological approaches for monitoring: • Making use of the biogeochemical ARGO profilers real time data for the broad pelagic habitats shelf and open sea • Operational application of the unmanned airborne system model Spy Owl 200 (Project MARLEN) for monitoring and assessment of bloom events in the coastal and shelf pelagic habitats as well as for assessment of the spatial extent of sea grass meadows in the close coastal zone • Operational application of the BEAST program as a tool for integrated assessment of eutrophication • Pilot application of the NEAT tool (developed under Project Devotes, 7FP) for integrated assessment of eutrophication. D. Need of experimental investigations to fill in the knowledge gaps: • Development of thresholds and targets for an additional indicator for seagrass degradation: C%, N%, P% and their ratios in the leaves of genus <i>Zostera</i> • Quantification of the bottom emissions of nutrients during various activities (e.g. dredging, aquaculture) and different specific processes in the water environment (e.g. stagnation, O₂ deficiency etc.).
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	• Introduction in the monitoring programs of molecular methods for taxonomy of phytoplankton especially related to potentially toxic species. E. Organizational improvements • Better coordination between the various organizations providing data and information related to the status/pressures/impacts on the marine environment • Providing relevant funding for monitoring in full compliance to the requirements of MSFD • Improvement of data management related to the marine environment • Improvement of accessibility to regional and national data bases and outputs of Project funded by public funds.
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MONITORING PROGRAMME FOR DESCRIPTOR 10 - MARINE LITTER	
1. General	
1.1 Subject area	Programme name: Descriptor 10- Marine litter Programme ID: BLKBG-D10-Marine litter
1.2 Definition / Description	Monitoring concept within the Drivers-Pressure-State-Impact-Response (DPSIR) conceptual framework Marine litter (also called marine debris) is waste created by humans that has been discharged into coastal or marine environments, resulting from human activities on land or at sea. The threat from plastic litter is one of the most dangerous ones since it is insoluble and non-degradable in the marine environment. Persistent plastics, with an estimated lifetime for degradation of hundreds of years in marine conditions, can break up into micro and nanoplastics over shorter timescales, thus facilitating their uptake by marine biota throughout the food chain. The Marine Strategy Framework Directive (MSFD2008/56/EU) establishes the basis of integrated marine management taking into account the pressures, in this case marine litter and its impact on marine environment. Monitoring programme of Descriptor 10 will monitor the composition (individual categories and subcategories of marine litter) and amount (weight/ number of items per categories: artificial polymer materials, rubber, cloth/textile, paper/cardboard, processed/worked wood, metal, glass/ceramic, unidentified and total weight and / or number of items per each MRU) of marine macro and micro litter along the Bulgarian Black Sea coast, in the surface layer of water column, on seabed and biota (fish, mammals and birds). According to the source of marine litter the monitoring programme will cover the urban and rural areas, transboundary regions and coasts close to the river's estuary. The D10 monitoring could be carried out jointly with monitoring programmes: D1-Biodiversity, D3-Commercial fish and shellfish, D5-Euthrofication, D8-Contaminants and D9-Contaminants in biota. Floating litter monitoring surveys will cover coastal (0-30m), shelf (30-100m) and open sea (>200m) regions. Campaigns for monitoring of seabed litter will cover coastal (0-30m) and shelf (30-100m) regions.
2. Monitoring requirements and purpose	
2.2 GES criteria and Indicators	D10C1. Primary: The composition, amount and special distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment. Indicators: • The amount of beach litter >2.5 cm per category in number of items and weight per 100 meters (m) on coastline; • The amount of floating litter >2.5 cm in the surface layer of the water column per category in number of items per km² • The amount of litter >2.5 cm on the seabed per category in number of items per km². Result of assessment: • GIS layers and maps of marine litter special distribution on the coastline, in the surface layer of the water column and on seabed per categories and subcategories • integrated assessment approach (number of items per 100 m coastline and per km² in the surface layer of the water column and on the seabed exceeding the defined threshold values and percentage ratio). D10C2. Primary: The composition, amount and spatial distribution of micro-litter on the coastline, in the surface layer of the water column, and in seabed sediment, are levels that do not cause harm to the coastal and marine environment Indicators: • The amount of beach litter <5mm per category in number of items and weight in gram (g) per kg (dry weight) of sediment; • The amount of litter <5mm in the surface layer of the water column per category in number of items and weight in gram per 100 m²; • The amount of litter <5mm on the seabed per category in number of items and weight in gram (g) per kg (dry weight) of sediment. Result of assessment: • GIS layers and maps of micro-litter special distribution on the coastline, in the surface layer of the water column and on seabed per different categories and subcategories

	- integrated assessment approach (number of items exceeding the defined threshold values and percentage ratio) D10C3. Secondary: The amount of litter and micro litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned. Indicators: - The amount of litter > 2.5 cm ingested by fish in grams (g) and number of items per individual for each species in relation to size (weight or length) of individual sampled. Fishes that will be monitored: <i>Sprattus sprattus</i>, <i>Scophthalmus maximus</i>, <i>Merlangius merlangus</i>, <i>Mullus barbatus ponticus</i>, <i>Trachurus mediterraneus</i>, <i>Squalus acanthias</i>, <i>Engraulis encrasicolus</i>, <i>Alosa immaculate</i>. - The amount of litter > 2.5 cm ingested by marine mammals in grams (g) and number of items per individual for each species in relation to size (weight or length) of individual sampled. Marine mammals that will be monitored: <i>Phocoena phocoena</i>, <i>Tursiops truncatus</i>, <i>Delphinus delphis</i>. - The amount of litter > 2.5 cm ingested by birds in grams (g) and number of items per individual for each species in relation to size (weight or length) of individual sampled. Birds that will be monitored: medium (hooded) cormorant and <i>Puffinus yelkouan</i>. - The amount of micro litter ingested by fishes in grams (g) and number of items per individual for each species in relation to size (weight or length) of individual sampled. Fishes that will be monitored: <i>Sprattus sprattus</i>, <i>Scophthalmus maximus</i>, <i>Merlangius merlangus</i>, <i>Mullus barbatus ponticus</i>, <i>Trachurus mediterraneus</i>, <i>Squalus acanthias</i>, <i>Engraulis encrasicolus</i>, <i>Alosa immaculate</i>. - The amount of micro litter ingested by marine mammals in grams (g) and number of items per individual for each species in relation to size (weight or length) of individual sampled. Marine mammals that will be monitored: <i>Phocoena phocoena</i>, <i>Tursiops truncatus</i>, <i>Delphinus delphis</i>. - The amount of microlitter ingested by birds in grams (g) and number of items per individual for each species in relation to size (weight or length) of individual sampled. Birds that will be monitored: medium (hooded) cormorant and <i>Puffinus yelkouan</i>. Result of assessment: - integrated assessment approach (number of items and weight per each marine litter category and subcategory) per species group and per individual for each species per each MRU. D10C4. Secondary: The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects. Indicator: - number of individuals affected lethal per species - number of individuals affected sub-lethal per species																		
2.3 Features, pressures and impacts	Table 2a Anthropogenic pressures on the marine environment. Substances, litter and energy, input of litter (solid waste matter, including micro sized litter). 2b Uses and human activities in or affecting the marine environment <table> <tr> <th>Theme</th><th>Activity</th></tr> <tr> <td>Physical restructuring of coastline or seabed (water management)</td><td>Restructuring of seabed morphology, including dumping of materials</td></tr> <tr> <td>Extraction of living resources</td><td>Fish and shellfish harvesting</td></tr> <tr> <td>Transport</td><td>Fish and shellfish processing</td></tr> <tr> <td></td><td>Transport infrastructure</td></tr> <tr> <td></td><td>Transport - shipping</td></tr> <tr> <td>Urban and industrial uses</td><td>Urban and industrial uses</td></tr> <tr> <td></td><td>Waste treatment and disposal</td></tr> <tr> <td></td><td>Industrial uses</td></tr> </table>	Theme	Activity	Physical restructuring of coastline or seabed (water management)	Restructuring of seabed morphology, including dumping of materials	Extraction of living resources	Fish and shellfish harvesting	Transport	Fish and shellfish processing		Transport infrastructure		Transport - shipping	Urban and industrial uses	Urban and industrial uses		Waste treatment and disposal		Industrial uses
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	Waste treatment and disposal																		
	Industrial uses																		

	Tourism and leisure		Tourism and leisure infrastructure
	Cultivation of living resources		Tourism and leisure activities
			Aquaculture - marine, including infrastructure
2.4 GES	GES definition for D10. The amount of marine litter washed ashore is negligible and does not spoil the visual aesthetics of the beach. There is no marine litter in the sea surface and on the seabed in the hotspots - recreational beaches, river estuaries, near the major coastal cities, in the seaports and open sea. Consequently, there are no instances of marine litter in the stomach of seabirds and fish species and no case of dead or injured marine mammals, birds and fish. D10C1. The amount of macro litter on the coastline, in the surface layer of the water column, and on the seabed is negligible and does not cause harm to the coastal and marine environment. D10C2. The amount of micro litter on the coastline, in the surface layer of the water column, and on the seabed is negligible and does not cause harm to the coastal and marine environment D10C3. There is a decreasing trend of instances of marine species found death from ingesting marine litter. D10C4. There is a steady decreasing trend of instances of injured or dead species as result of entanglement in marine litter. The programme: Recognizes the need to assess the descriptor and its objectives - the D10 monitoring programme will provide information about the trends of the amount and composition of marine macro and micro litter on the coastline, in the surface layer of the water column, and on the seabed that will be used for assessment of the marine environment in respect to D10. Data from monitoring surveys will be recorded on standardized monitoring protocols to ensure consistency and compatibility of marine litter assessments in the Black Sea region. Takes into account the data need/information to support the marine litter assessment - the programme will provide data and information about the trends in the amount an composition by beach surveys, bottom trawling and scuba diving, visual observation and remote sensing of sea surface as well as laboratory analysis (selected fish species, marine mammals and birds, subject under D1- Biodiversity). Help to identify the progress towards achievement of GES - the programme will provide data and information about the mid and long term trends of marine litter abundance on coastline, in the surface layer of the water column, on the seabed and ingested by marine animals (micro plastic). Addresses the natural and climatic variability and distinguishes them from the effects caused by the anthropogenic pressure - The programme does not address natural and climatic variability. It will only provide information of pressures from human activities and their impact on the marine environment. Marine Strategy Framework Directive (Directive 2008/56/EC) D10C1. • Reduction of marine macro litter amount by 30% over 6 year period, against the baseline values defined in 2017. • No baseline and threshold values have been set due to lack of information. D10C2. • A non - increasing amount of marine microliter (<5 mm) on the coastline in the surface layer of the water column and on the seabed after establishing its baseline values. • A decreasing trend of marine microliter (<5 mm) amount over 6-year period, against the baseline values defined in 2017. • No baseline and threshold values have been set due to lack of information. D10C3. No targets and baseline/threshold values have been set due to lack of information. D10C4. No targets and baseline/threshold values have been set due to lack of information. Convention on the Protection of the Black Sea Against Pollution Strategic Action Plan for the Environmental Protection and Rehabilitation of the Black Sea (BS-SAP), 2009 .		
2.5 Environmental targets MSFD			

	http://www.blacksea-commission.org/_bssap2009.asp http://www3.moew.government.bg/files/file/POS/Strategic_documents/Strategy_Black_Sea.pdf (4a) Reduction of pollutants from land-based sources, including atmospheric emissions; (4b) Reduction of pollutants from vessels and land-based facilities. HD Ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies. Bathing Waters Directive 2006/7/EC The purpose of this Directive is to preserve, protect and improve the quality of the environment and to protect human health by complementing Directive 2000/60/EC.
3 Monitoring concept 3.2 Description of monitoring network	Monitoring network will cover the following assessment areas: • Coastal area (coastal, floating and seafloor litter) • Shelf area (floating and seafloor litter) • Exclusive Economic Zone (EEZ) (floating litter). 

D10C1. Indicator beach/shoreline litter >2.5 cm): Monitoring of the marine macro litter on the coastline covers 10 unprotected beaches/shorelines along the Bulgarian Black Sea coast. The monitoring includes classification of the litter items according to the official "master list categories and subcategories" and counting of the individual items. All data and metadata are filled in standardized protocols, according to Guidance on monitoring of Marine Litter in the European Seas (MSFD Technical Sub Group, 2013). Monitoring areas:		<table> <tr> <th>No.</th><th>Name of beach/shorelines</th><th>Coordinates</th></tr> <tr> <td>1</td><td>Durankulak - north 1</td><td>43° 43'0.01" / 28° 34'24.72"</td></tr> <tr> <td>2</td><td>Krapetz</td><td>43° 39'4.00" / 28° 34'10.00"</td></tr> <tr> <td>3</td><td>Varna lake- Black Sea (canal)</td><td>43° 11'31.57" / 27° 52'51.97"</td></tr> <tr> <td>4</td><td>Shkorpilovci -North</td><td>42° 57'25.66" / 27° 53'54.25"</td></tr> <tr> <td>5</td><td>Byala - Karadere</td><td>42° 55'12.06" / 27° 53'48.06"</td></tr> <tr> <td>6</td><td>Obzor</td><td>42° 48'1.38" / 27° 53'25.64"</td></tr> <tr> <td>7</td><td>Irakli</td><td>42° 44'59.29" / 27° 53'20.69"</td></tr> <tr> <td>8</td><td>Chernomorski solnici- Burgas</td><td>42° 30'57.16" / 27° 29'9.19"</td></tr> <tr> <td>9</td><td>Alepu</td><td>42° 22'7" / 27° 42'33"</td></tr> <tr> <td>10</td><td>Veleka</td><td>42° 3'54.664" / 27° 58'44.568"</td></tr> </table> Additionally, the monitoring of marine macro litter on the coastline will include 2 not easily accessible beaches/shorelines along the Bulgarian Black Sea coast. The monitoring will be carried out using UAV observations. <table> <tr> <th>No.</th><th>Name of beach/shorelines</th><th>Coordinates</th></tr> <tr> <td>1</td><td>Yailata</td><td>43.453050 / 28.558197</td></tr> <tr> <td>2</td><td>Silistar</td><td>42.024457 / 28.010349</td></tr> </table>	No.	Name of beach/shorelines	Coordinates	1	Durankulak - north 1	43° 43'0.01" / 28° 34'24.72"	2	Krapetz	43° 39'4.00" / 28° 34'10.00"	3	Varna lake- Black Sea (canal)	43° 11'31.57" / 27° 52'51.97"	4	Shkorpilovci -North	42° 57'25.66" / 27° 53'54.25"	5	Byala - Karadere	42° 55'12.06" / 27° 53'48.06"	6	Obzor	42° 48'1.38" / 27° 53'25.64"	7	Irakli	42° 44'59.29" / 27° 53'20.69"	8	Chernomorski solnici- Burgas	42° 30'57.16" / 27° 29'9.19"	9	Alepu	42° 22'7" / 27° 42'33"	10	Veleka	42° 3'54.664" / 27° 58'44.568"	No.	Name of beach/shorelines	Coordinates	1	Yailata	43.453050 / 28.558197	2	Silistar	42.024457 / 28.010349
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Monitoring methodology: The methodology of marine litter monitoring along the Bulgarian Black Sea coast fully follows the recommendations given in the Guidance on monitoring of Marine Litter in the European Seas (2013). MSFD Technical Subgroup. On each reference beach (1 km in length) three sampling units are chosen, covering the whole area between the water edge to the back of the beach with dimensions - 100 m length/100 m width if possible. All Marine litter found, from the water's edge up to the vegetation or dune area are collected, categorized, counted and entered on a survey forms. On the survey forms each item has an unique identification number. Items are sorted in 8 categories according to the type of material including: artificial polymer materials; rubber; cloth/textile; paper/cardboard; processed wood; metal; glass/ceramics and unidentified. The assessment of the of beach litter is carried out based on the amount of litter per category and subcategories in number of items and weight per 100 m on coastline. The frequency of beach macro litter monitoring will be four surveys per year in spring, summer, autumn and winter. Survey periods: 1) Winter: Mid-December-mid-January 2) Spring: April 3) Summer: Mid-June-mid-July 4) Autumn: Mid-September-mid-October Preferably, the surveys for all participating beaches in a given region should be carried out within the shortest timeframe possible within a survey period.																																												

D10C1. Indicator floating litter >2.5 cm).

The programme covers coastal, shelf and open sea areas. Based on the type of the pressure and impact as well as origin of the marine litter 8 monitoring polygons is determined in the coastal area, 4 in the shelf region and 2 in the open sea.

Coastal area consists of 8 polygons which are consistent with the monitoring network of D10C1, indicator 1 (beach/shoreline litter>2.5 cm), D10C1 (seabed litter>2.5 cm), D10C2 indicator 1 (beach litter<5mm) and D10C2 indicator 3 seabed litter<5 mm).

No.	Polygon name	Area (km ²)	Method	Number of transects
1	Durankulak -Krapetz	42	Visual observations	4 transects in front of Durankulak beach 4 transects in front of Krapetz beach
2	Galata	17	Visual observations	4 transects in front of Galata beach
3	Kamchia	92	Visual observations	4 transects in front of Kamchia beach
4	Shkorpilovci- Byala	79	Visual observations	4 transects in front of Shkorpilovci beach 4 transects in front of Yala North beach
5	Obzor - Irakli	19	Visual observations	3transects in front of Obzor South beach 3 transects in front of Irakli beach
6	Burgas bay	77	Visual observations	2 transects in front of Chernomorski solnici Burgas
7	Sozopol- Alepu	21	Visual observations	4 transects in front of Duni
8	Veleka	6	Visual observations	4 transects in front of river Veleka
Total number of transects				40

Shelf area consist of 4 polygons which are consistent with the monitoring network of D10C1 indicator 1 (beach/shoreline litter>2.5 cm), D10C1 (seabed litter>2.5 cm), D10C2 indicator 1 (beach litter<5mm) and D10C2 indicator 3 (seabed litter<5 mm).

No.	Polygon name	Area (km ²)	Method	Number of transects
1	Durankulak -Krapetz	2477	Visual observations	12
2	Varna	1233	Visual observations	6
3	Burgas	2020	Visual observations	12
4	Sozopol- Veleka	1235	Visual observations	6
Total number of observations				36

Open sea area consists of 2 polygons which are consistent with the monitoring network of D10C1, indicator 1 (beach/shoreline litter>2.5 cm), D10C1 (seabed litter>2.5 cm), D10C2, indicator 1 (beach litter<5mm) and D10C2, indicator 3 (seabed litter<5 mm).

No.	Polygon name	Area (km ²)	Method	Number of transect
1	EEZ intensive traffic	6537	Visual observations	18
2	EEZ moderate traffic	4630	Visual observations	18
Total number of observations				36

Methodology

The visual observations from boats/vessels should ensure the detection of litter items in the size range of 2.5cm to > 50cm, therefore along with the observation transect the speed of the boat/vessel should not be higher than 6knots. The survey area is defined by the transect width and length. The transect width depending on the observation level of the surveyor for the predefined ship speed of 6knots. The observation, quantification and identification of floating litter items must be made by a dedicated observer who does not have other duties at the same time. The transect length should correspond approximately to 30min of observation for each survey. The ideal location for observation is on the bow area of the boat. The observation direction must be perpendicular to the boat track. The surveyor should conduct the survey from the glare-free side of the vessel and to avoid the hours of the day when the sun is low on the horizon (sunrise and sunset), since visibility is not good enough due to glare and/or reflection. The transect length will be determined from latitude and longitude of transect start and end points obtained by GPS.

Frequency and timing of surveys:

The frequency of floating macro litter monitoring should be at least one per year. The optimal option is 2 times per year.

Survey periods:

1) Spring: April-May

2) Autumn: September-October

Preferably, the surveys in a given marine reporting unit should be carried out within the shortest timeframe possible within a survey period. D10C1, indicator 1 (seafloor litter >2.5 cm):

The programme covers coastal and shelf areas. Based on the type of the pressure and impact as well as origin of the marine litter 8 monitoring polygons is determined in the coastal area and 4 in the shelf region.

Monitoring polygons (coastal area):

No.	Polygon name	Area (km ²)	Number of transects
1	Durankulak -Krapetz	42	4 (5, 10, 20, 30 m) transects in front of Durankulak beach 4 (5, 10, 20, 30 m) transects in front of Krapetz beach
2	Galata	17	4 (5,10,20,30 m) transects in front of Galata beach
3	Kamchia	92	4 (5,10,20,30 m) transects in front of Kamchia beach
4	Shkorpilovci- Byala	79	4 (5,10,20,30m) transects in front of Shkorpilovci beach 4 (5,10,20,30m) transects in front of Byala North beach
5	Obzor - Irakli	19	3 (5,10,20,30 m) transects in front of Obzor South beach 3 (5,10,20,30 m) transects in front of Irakli beach
6	Burgas bay	77	2 (5,10,20,30 m) transects in front of Chernomorski solnici Burgas
7	Sozopol- Alepu	21	4 (5,10,20,30m) transects in front of Duni
8	Veleka	6	4 (5,10,20,30 m) transects in front of river Veleka
Total		353	40

Methodology

Monitoring of the seafloor litter in the coastal area will be carried out using line transect sampling method as follows:

- underwater visual surveys with scuba diving (0-15m);
- underwater visual surveys with ROV (15-30m).

For the aims of the survey, the area of each polygon is divided into two depth strata-Stratum 1 (0-15m) and Stratum 2 (15-30 m). The total number of monitoring transect in the coastal area is 40.

	Frequency and timing of surveys																										
	The frequency of seafloor litter monitoring should be at least one per year. The optimal option is 2 times per year.																										
	Survey periods:																										
	1) Spring-April-May 2) Autumn-September-October																										
	Monitoring polygons (shelf area):																										
	<table><tr><th>No.</th><th>Polygon name</th><th>Area (km²)</th><th>Number of transects</th></tr><tr><td>1</td><td>Durankulak-Krapetz</td><td>2477</td><td>12</td></tr><tr><td>2</td><td>Varna</td><td>1233</td><td>6</td></tr><tr><td>3</td><td>Burgas</td><td>2020</td><td>12</td></tr><tr><td>4</td><td>Sozopol-Veleka</td><td>1235</td><td>6</td></tr><tr><td>Total</td><td></td><td>6965</td><td>36</td></tr></table>				No.	Polygon name	Area (km ²)	Number of transects	1	Durankulak-Krapetz	2477	12	2	Varna	1233	6	3	Burgas	2020	12	4	Sozopol-Veleka	1235	6	Total		6965
No.	Polygon name	Area (km ²)	Number of transects																								
1	Durankulak-Krapetz	2477	12																								
2	Varna	1233	6																								
3	Burgas	2020	12																								
4	Sozopol-Veleka	1235	6																								
Total		6965	36																								
	Methodology																										
	Monitoring of seafloor litter in the shelf area covers depths between 30 and 100m. Sampling of seafloor litter will be carried with a beam trawl. For the aims of the survey, the area of each polygon is divided into 3 depths strata Stratum 1(30-50m), Stratum 2(50-75m) and Stratum 3 (75-100m). The hauls will be positioned following a depth stratum of each polygon with random drawing of the positions within each stratum. The number of positions in each stratum is proportional to the surface of these strata and the hauls are made in the same position from year to year. The haul duration is fixed at 30 minutes at 3 knots (Cheshire, 2009). Frequency and timing of surveys The frequency of seafloor litter monitoring should be at least one per year. The optimal option is 2 times per year. Survey periods: 1) Spring-April-May 2) Autumn-September-October D10C2. Indicator 1 (beach/shoreline litter <5 mm): The monitoring of the marine micro litter on the coastline covers 10 unprotected beaches/shorelines along the Bulgarian Black Sea coast. The monitoring includes classification of the litter items according to the official "master list categories and subcategories" and counting of the individual items. All data and meta are filled in standardized protocols, according to Guidance on monitoring of Marine Litter in the European Seas (2013). MSFD Technical Sub Group. The monitoring of beach litter < 5mm will be carried out jointly with D10C1, indicator 1. Methodology: On each 100 m coastline five replicate samples are collected. Each replicate is separated by at least 5m. Replicates can be distributed in a stratified random manner so as to be representative of an entire beach or a specific section of beach. Microplastics 1 - 5mm: The sediment is sampled by collecting with a metal spoon or trowel the top 5 cm of sand from the area contained within a metal 50 cm x 50 cm quadrat and passing through a 1 mm metal sieve and then will be stored in metal or glass containers. Microplastics 20 µm - 1mm: The sediment is collected from the top 5 cm of sand using a metal spoon with volume 15ml. Microplastics are subsequently extracted in the laboratory by density separation. Sediment is stored in metal or glass containers. Survey periods: 1) Winter: Mid-December-mid-January 2) Spring: April 3) Summer: Mid-June-mid-July 4) Autumn: Mid-September-mid-October D10C2. Indicator 2 (floating litter <5 mm):																										

	Monitoring of the floating micro litter in the surface layer of the water column will be carried out jointly with D10C1, indicator 2. The total number of monitoring polygons is 14, of which 8 are in the coastal area, 4 in the shelf and 2 in the open sea. Methodology: Seawater samples will be taken by nets. During trawls it should be maintain a steady linear course for 30 minutes at a constant speed. The estimated water volume should be recorded. Microparticles will be recorded as the total quantity of such captured by the net during the period it is deployed. The sample is transferred to a metal or glass container for subsequent density separation/ FT-IR spectroscopy. Survey periods: 1) Spring- April-May 2) Autumn- September- October D10C2. Indicator 3 (seafloor litter <5 mm): Monitoring of the seafloor micro litter will be carried out jointly with D10C1, indicator 3. The total number of monitoring polygons is 12, of which 8 are in the coastal area and 4 in the shelf. Methodology: Material can be collected using any approach that recovers a sample of relatively undisturbed surface sediment from the sea bed (e.g. Van veen grab, multi corer, box core etc.). Once recovered onto the vessel a small sample of sediment around 250 ml is recovered to represent the location of the original 5 cm surface to sub surface of the seabed. The sample is transferred to a metal or glass container for subsequent density separation/ FT-IR spectroscopy. Survey periods: 1) Spring-April-May 2) Autumn-September-October
6. Activities required to implement the concept	
6.1 Changes to the current monitoring programme	Monitoring program on D10 -Marine litter is compliant with the criteria and methodological standards of the revised Decision2010/477/EC and Annex III of MSFD. However, further action is still needed to provide quality data such as: • Currently available data for amount, composition and special distribution of marine macro and micro litter are extremely insufficient. • More data is need in order to define the baseline and thresholds values of individual criteria and indicators. • Purchase of new equipment: ROV, scuba equipment, Manta net, binocular microscope. • Better co-ordination with other institutions / organizations, providing information on the state or impact on the marine environment. • Ensuring of sufficient capacity of competent authorities and organizations (such as human resources, expertise and equipment) to plan and conduct monitoring of the marine environment. • Improving the data management and information related to the state of the marine environment; improving the access to national and regional databases and data from projects funded by the EC and other financial instrument.

ANNEX B Fact sheets of selected monitoring programmes under MSFD in Romania

MONITORING PROGRAMME FOR DESCRIPTOR 1, 6 - BENTHIC HABITATS	
1. General	Programme name: BIODIVERSITY - SEABED HABITATS - D1, D6 Programme ID: BLKRO-D1, D4, D6 - SBH
1.1 Subject area	Definition of the elements and general approach
1.2 Definition/Description	The Programmes addresses the following aspects of the Drivers-Pressures-State-Impact-Response (DPSIR) model: Drivers. The human activities that lead to physical pressures on the seabed are addressed by the Programme. Pressures. The Programme implementation will assist in gathering and analyses of data on physical pressure (loss and disturbance) on the seabed. State and Impact. The present programme addresses not only the state/impact parameters, but also the pressures and relevant human activities with impact on the seabed habitats. Not all pressures are considered by the present programme, only those related to physical loss and physical disturbance (bottom trawling, dredging, etc.). Other pressures affecting benthic habitats are subject to other monitoring programmes in the Romanian waters (Non-indigenous species (D2), Commercial fish and shellfish (D3), Eutrophication (D5), Hydrographical changes (D7), Contaminants (D8 and D9), and Litter (D10)). Ecosystem elements, observed in the Programme are defined according to Table 2, Part II of COMMISSION DECISION (EU) 2017/848 and the amended ANNEX III of MSFD by COMMISSION DIRECTIVE (EU) 2017/845. These include: Benthic broad habitat types and their associated biological communities The natural habitat types of Community interest under Directive 92/43/EEC
2. Monitoring requirements and purpose	
2.2 GES criteria and indicators	D6C1. Primary: Spatial extent and distribution of physical loss (permanent change) of the natural seabed. <u>Relevant pressures</u>: Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate) <u>Indicators for pressure</u>: - extent of physical loss resulted from coastal defence works (km²) - extent of physical loss resulted from substrate extraction (km²) <u>Assessment results</u>: distribution (GIS layer) and area (km²) of physical loss (permanent changes) of seabed. D6C2. Primary: Spatial extent and distribution of physical disturbance pressures on the seabed. <u>Relevant pressures</u>: physical disturbance to seabed (temporary or reversible). <u>Indicator for pressure</u>: - extent of physical disturbance resulted from fishing activities (bottom trawling)(km²) - extent of physical disturbance resulted from hydro-morphological processes (erosion-accretion) in coastal waters (km²) <u>Assessment results</u>: distribution (GIS layer) and area (km²) of seabed under physical disturbance. D6C3. Primary: Spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its functions (e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance. <u>Relevant pressures</u>: physical disturbance to seabed (temporary or reversible). <u>Indicators of state</u>: Macrozoobenthic community: - Number of species S, Shannon-Wiener community diversity H', Biotic index AMBI (Borja <i>et al.</i> 2000, 2003), multimetric index M-AMBI*n (average of the normalized S, H' and AMBI) (Sigovini <i>et al.</i> 2013, Todorova <i>et al.</i>, 2015)

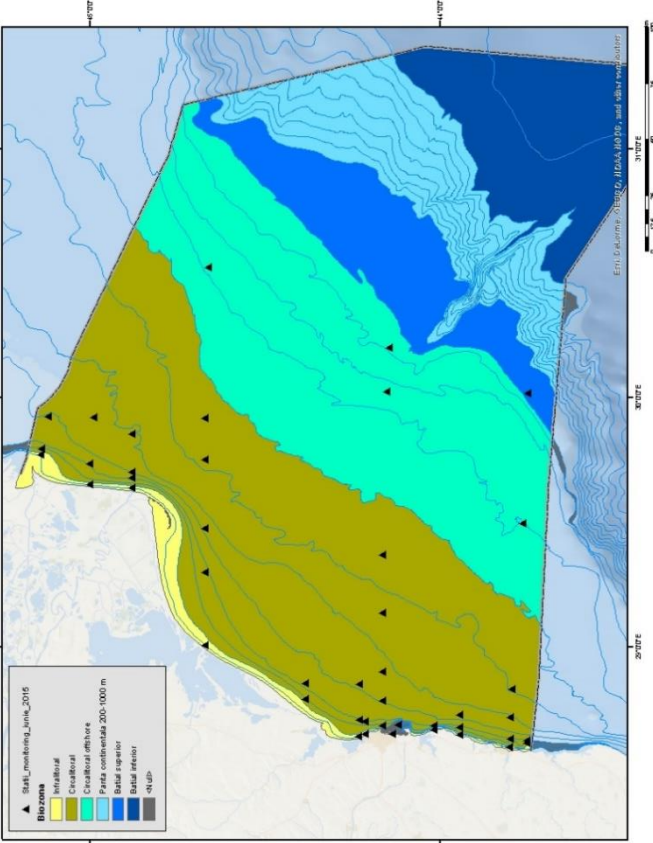
	• These and other habitat condition indicators need to be validated for physical disturbance sensitivity. • % cover of mussel beds of <i>Mytilus galloprovincialis</i> on circalittoral sediment • Average height of <i>Mytilus galloprovincialis</i> (in mussel beds on sediment) • Biomass of key species (<i>Mytilus galloprovincialis</i>, <i>Lentidium mediterraneum</i>, <i>Modiolula phaseolina</i>) • Abundance of <i>Lentidium mediterraneum</i> on infralittoral sands Assessment results: distribution (GIS layer), area (km²) and proportion (%) of each habitat type adversely affected by physical disturbance based on achieving the thresholds of the indicators under criterion D6C3. D6C4. Primary: The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area. Member States shall establish the maximum allowable extent of habitat loss as a proportion of the total natural extent of the habitat type, through cooperation at Union level, taking into account regional or subregional specificities. Relevant pressures: Physical loss. Indicator of state: distribution (GIS layer), area (km²) and proportion (%) of loss of each habitat type. D6C5. Primary: The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), does not exceed a specified proportion of the natural extent of the habitat type in the assessment area. Member States shall establish threshold values for adverse effects on the condition of each habitat type, ensuring compatibility with related values set under Descriptors 2, 5, 6, 7 and 8, through cooperation at Union level, taking into account regional or subregional specificities. Member States shall establish the maximum allowable extent of those adverse effects as a proportion of the total natural extent of the habitat type, through cooperation at Union level, taking into account regional or subregional specificities. Assessment results: distribution (GIS layer), area (km²) and proportion (%) of cumulative adverse effects from different pressures addressed under Descriptors 2, 5, 6, 7 and 8, including habitat loss of each habitat type, and assessment of the spatial threshold for maximum allowable extent of the habitat type adversely affected, including habitat loss. The assessment under D6C5 should combine the assessments of the adverse effects from pressures, including under criteria D2C3, D5C4, D5C5, D5C6, D5C8, D6C3, D7C2, D8C2 and D8C4 as follows: D2C3. Secondary: Proportion of the spatial extent of the broad habitat type which is adversely altered due to non-indigenous species, particularly invasive non-indigenous species. Member States shall establish the threshold values for the adverse alteration to species groups and broad habitat types due to non-indigenous species, through regional or subregional cooperation. Relevant pressure: Input or spread of non-indigenous species. Indicator of state: Biomass ration of bivalve prey/invasive predator <i>Rapana venosa</i> Assessment results: distribution (GIS layer), area (km²) and proportion (%) of each habitat type adversely altered due to invasive non-indigenous species. D5C4. Secondary: The photic limit (transparency) of the water column is not reduced, due to increases in suspended algae, to a level that indicates adverse effects of nutrient enrichment (see D5 revised template). Relevant pressures: Input of nutrients; Input of organic matter Indicator of state: water transparency depth (m) D5C5. Primary: The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse effects on benthic habitats (including on associated biota and mobile species) or other eutrophication effects (see D5 revised template). Indicator of state: concentration (mg/l) of dissolved oxygen in the bottom of the water column
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	D5C6. Secondary: The abundance of opportunistic macroalgae is not at levels that indicate adverse effects of nutrient enrichment. Indicators of state: Ecological index EI Ratio between opportunistic and sensitive macroalgae species D5C8. Secondary (except when used as a substitute for D5C5): The species composition and relative abundance of macrofaunal communities, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment. Indicators for state: Number of species S, Shannon-Wiener community diversity H', Biotic index AMBI (Borja <i>et al.</i> 2000, 2003), multimetric index M-AMBI*n (average of the normalized S, H' and AMBI) (Sigovini <i>et al.</i> 2013, Todorova <i>et al.</i>, 2015) with thresholds standardised for each habitat type and subtype as necessary. D7C2. Secondary: Spatial extent of each benthic habitat type adversely affected (physical and hydrographical characteristics and associated biological communities) due to permanent alteration of hydrographical conditions. Relevant pressures: Physical loss (due to permanent change of seabed substrate or morphology or to extraction of seabed substrate); Changes to hydrological conditions Indicators for state: Indicators for the adverse effects on the physical and hydrological characteristics not developed yet. Macrozoobenthic communities: • Number of species S, Shannon-Wiener community diversity H', Biotic index AMBI (Borja <i>et al.</i> 2000, 2003), multimetric index M-AMBI*n (average of the normalized S, H' and AMBI) (Sigovini <i>et al.</i> 2013, Todorova <i>et al.</i>, 2015) with thresholds standardised for each habitat type and subtype as necessary; • Abundance, biomass and size structure of <i>Donacilla cornea</i> Macrophytobenthic communities: • Ecological index EI. Additional indices to be further developed Assessment results: distribution (GIS layer), area (km²) and proportion (%) of each benthic habitat type adversely affected due to changes in the hydrological conditions base on achieving the indicators. D8C2. Secondary: The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergetic effects. Relevant pressures: Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) Indicators of state: Macrozoobenthic communities: • Number of species S, Shannon-Wiener community diversity H', Biotic index AMBI (Borja <i>et al.</i> 2000, 2003), multimetric index M-AMBI*n (average of the normalized S, H' and AMBI) (Sigovini <i>et al.</i> 2013, Todorova <i>et al.</i>, 2015) with thresholds standardised for each habitat type and subtype as necessary.; • The indicators need to be validated against the pressure from contaminants. Macrophytobenthic communities: Indicators are not developed yet. Assessment results: distribution (GIS layer), area (km²) and proportion (%) of each benthic habitat type adversely affected due to chronic contamination with hazardous substances based on achieving the indicators thresholds.
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	D8C4. Secondary (to be used when a significant acute pollution event has occurred): The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated. Macrozoobenthic communities: Number of species S, Shannon-Wiener community diversity H', Biotic index AMBI (Borja <i>et al.</i> 2000, 2003), multimetric index M-AMBI*ⁿ (average of the normalized S, H' and AMBI) (Sigovini <i>et al.</i> 2013, Todorova <i>et al.</i>, 2015) with thresholds standardised for each habitat type and subtype as necessary.; The indicators need to be validated against the pressure from contaminants. Macrophytobenthic communities: Indicators are not developed yet. <u>Assessment results:</u> distribution (GIS layer), area (km²) and proportion (%) of each benthic habitat type adversely affected due to acute contamination with hazardous substances based on achieving the indicators thresholds. Monitoring is carried out in cases of acute pollution events.				
2.3 Features, pressures and impacts	Ecosystem elements (according to Table 2, Part II of COMMISSION DECISION (EU) 2017/848 and Annex III, Tabl. 1 of COMMISSION DIRECTIVE (EU) 2017/845): Broad habitat types and their associate biological communities The natural habitat types of Community interest under Directive 92/43/EEC. The representative national broad habitat types include: • Mediollittoral sediments (Annex I HD: 1140) • Infralittoral rock (Annex I HD: 1170) • Infralittoral coarse sediments • Infralittoral mixed sediments • Infralittoral sand (Annex I HD: 1110) • Infralittoral mud • Circalittoral rock and biogenic reef (Annex I HD: 1170) • Circalittoral sand and coarse sediments (Annex I HD: 1110) • Circalittoral mud • Offshore circalittoral mud • Offshore circalittoral mixed sediments Habitat characteristics: • distribution and area • species composition, abundance and/or biomass (spatial and temporal variability) • size structure of the species • physical characteristics (sediment grain size, depth, transparency) • chemical characteristics (dissolved oxygen, nutrients, organic carbon in sediments) Pressures • Physical loss • Physical disturbance • Other relevant pressures as described under Descriptors 2, 3, 5, 7 and 8. Uses and human activities: <table border="1"> <tr> <td>Uses and human activities</td><td>Activities in the Romanian Black Sea relevant to D6</td></tr> <tr> <td>Theme</td><td>Activity</td></tr> </table>	Uses and human activities	Activities in the Romanian Black Sea relevant to D6	Theme	Activity
Uses and human activities	Activities in the Romanian Black Sea relevant to D6				
Theme	Activity				

	Physical restructuring of coastline or seabed (water management)	Land claim	dikes, beach nourishing
	Extraction of non-living resources	Coastal defence and flood protection	groins, dikes, wave-breakers, incl. floating and underwater
	Production of energy	Extraction of oil and gas, including infrastructure	Oil/gas platforms and pipelines
	Extraction of living resources	Extraction of minerals (sand, shell)	Dredging
		Transmission of electricity and communications (cables)	Underwater cables
		Fish and shellfish harvesting	Bottom trawling, near-bottom pelagic trawling, beam-trawling, dredging, hydraulic dredging
	Transport	Transport infrastructure	Ports and marinas
	Urban and industrial uses	Urban and industrial uses	Water treatment plants discharges
	Tourism and leisure	Tourism and leisure infrastructure	Piers, yacht marinas
2.4 GES	Definition of GES under Descriptors 1, 6 - The extent, area and condition of the benthic habitat types, including their biotic structure (the typical species composition of the associated biological communities and the relative abundance of the species, the size structure of the typical species) and abiotic characteristics correspond to the physical geographic and climatic conditions, taking into consideration the sustainable use of the marine environment and climate change. - The natural extent and area of the benthic broad habitat types do not decrease significantly and there is no likelihood to decrease in the future. The physical loss of habitats is minimized. - The human activities do not exert significant physical disturbance of the seabed substrate and biological structures leading to adverse alteration of the associated biological communities' status. - The associated biological communities (species composition and relative abundance, size structure of the typical species) are not adversely affected due to human activities. - The specific ecological conditions necessary for the long-term maintenance of the typical species and biological communities exist and will continue to exist in the future. - The extent, area and condition of the benthic habitat types are sufficient for the natural ecological functions and processes to occur, that ensure the ecosystem goods and services such as food production, water quality regulation, recreation and tourism conditions. - The habitats of conservation importance categorized as threatened or vulnerable at the national level or listed by the European regulations (e.g. Directive 92/43/EEC) are effectively protected through suitable national and regional mechanisms.		
2.5 Environmental targets MSFD HD WFD	Target under D6C4: The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed 5 % of the natural extent of the habitat type in the assessment area. The natural habitat types of Community interest under Directive 92/43/EEC have stable or increasing spatial extent, which is not smaller than the favourable habitat range, do not have smaller area than the area at the year of enforcement of the Habitats Directive and the distribution within the range is not alternated significantly. D6C5. The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), does not exceed 20 % of the natural extent of the habitat type in the assessment area, including the proportion lost. Thresholds of GES indicators D5C6. % wet biomass of macroalgae from ESGII is ≤ 40 %		

EI ≥ 6									
D5C8.									
Macrozoobenthic communities									
Infralittoral sand and mud in waters with variable salinity									
Ecological status		EQR	AMBI	H'	S	M-AMBI*n			
Reference conditions		1	1.8	2.9	15	0.90			
Good status		0.68	3.21	1.9	10	0.61			
Circalittoral sand/mud in waters with variable salinity									
Reference conditions		1	1.8	2.9	15	0.90			
Good status		0.68	3.21	1.9	10	0.61			
Circalittoral mud with <i>Mytilus galloprovincialis</i> biogenic reef and diverse fauna									
Reference conditions		1	1.4	3.5	24	1.00			
Good status		0.68	2.8	2.38	16	0.68			
Offshore circalittoral mud with <i>Modiolula phaseolina</i>									
Reference conditions		1	0.2	3.7	21	1.00			
Good status		0.68	2.06	2.52	14	0.61			
D6C3.									
Macrozoobenthic communities:									
% cover of living <i>Mytilus galloprovincialis</i> inside biogenic reefs on circalittoral mud > 50%									
Indicator Species	Average abundance ((ind/m²)		Average biomass (g/m²)		Average length (mm)				
<i>Mytilus galloprovincialis</i>	≥ 500		≥ 5000		≥ 50				
<i>Lentidium mediterraneum</i>	≥ 9000		≥ 100		n.a.				
<i>Modiolula phaseolina</i>	≥ 200		≥ 16		n.a.				
For the sandy and muddy habitats, the thresholds for S, H', AMBI and M-AMBI*n under D5C8 are applicable. Validation needed against physical disturbance.									
Seagrass communities:									
Thresholds as for D5C6 are applicable.									
D7C2.									
Macrozoobenthic communities:									
Thresholds for S, H', AMBI and M-AMBI*n under D5C8 are applicable.									
Thresholds for good status of <i>Donacilla cornea</i> population									
Indicator Species	Average abundance (ind/m²)				Maximum length (mm)				
<i>Donacilla cornea</i>	≥ 3300				≥ 22-24				
Macrophyte communities:									
Thresholds for the indicators under D5C6 are applicable									
D8C2 and D8C4									
Macrozoobenthos communities:									
Thresholds for S, H', AMBI and M-AMBI*n under D5C8 are applicable. The indicators need validation against chronic and acute contamination.									

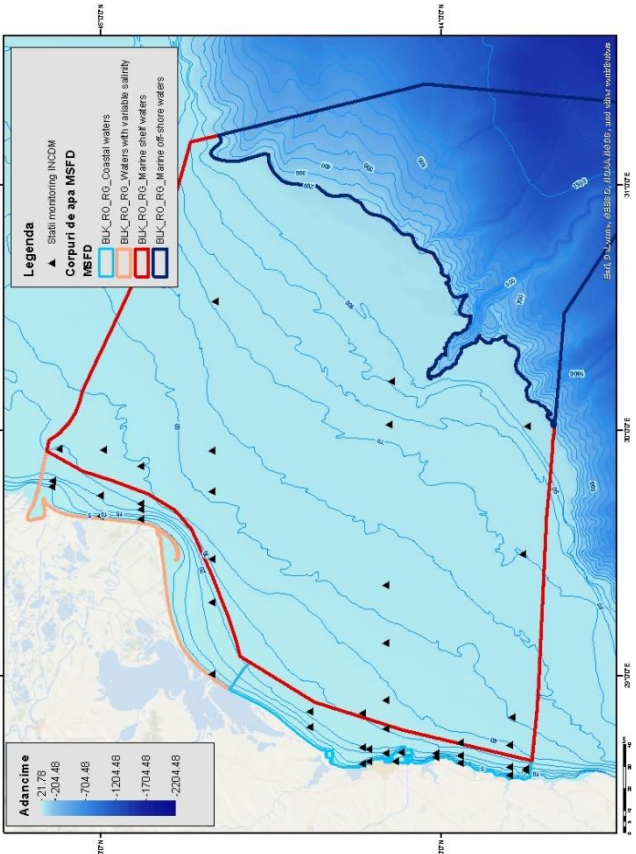
3 Monitoring concept	3.2 Description of monitoring network Sedimentary habitats dominated by macrozoobenthic communities: Sampling with Van Veen grab (0.1 m²) Van Veen grab sampling is used to collect point data for the species composition and abundance of the macroinvertebrate fauna in the sediments needed for the calculation of the indices. The sampling network includes 45 stations distributed among the broad habitat types and MRUs at depths between 5 and 100m, which is superimposed with the existing monitoring network under the WFD. Shallow waters (0-5m) mediolittoral and infralittoral are monitored separately whenever needed.  Map of the sampling network for D1,6 - benthic habitats: macrozoobenthos Additional samples shall be collected in areas with anthropogenic structures that cause hydrographic changes that might lead to adverse effects under D7C2. Additional samples shall be collected in areas for which information for chronic contamination or events of acute contamination with hazardous substances is available in order to assess the status under criteria D8C2 and D8C4. Sampling and laboratory processing of macrozoobenthos with Van Veen grab follow the procedures according to Todorova, Konsulova (2005). The sampling frequency shall be once a year. Sampling with beam trawl and dredge
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Beam trawl sampling is necessary to collect data for the biomass and size structure of <i>Mytilus galloprovincialis</i> (D2C3, D6C3) <i>Rapana venosa</i> (D2C3). Dredge samples are required to assess the size structure of <i>Donax trunculus</i> and <i>Chamelea gallina</i> and <i>Donacilla cornea</i>. Habitats with seagrass and <i>Cystoseira</i> beds: The monitoring network complements the existing network for monitoring of seagrasses under the WFD. The sampling locations cover the natural extent of the known seagrass and <i>Cystoseira</i> beds. Sampling shall be done during the warm season.	Map of the sampling network for D1,6 - benthic habitats sedimentary beds with seagrass and infralittoral rock macroalgae
	6. Activities required to implement the concept

6.1 Changes to the current monitoring programme	Recommendations for filling in gaps in knowledge and information: Habitats of the seabed sediments • Development of indicators and thresholds based on functional groups of macrozoobenthos (e.g longevity) for assessment of the adverse effects from physical disturbance (D6C3), especially by fisheries. • Definition of thresholds for S, H⁺, AMBI and M-AMBIⁿ in specific infralittoral communities and revision of the thresholds for circalittoral muds and offshore circalittoral sediments communities. • Development of indicators based on epiphytic growth on seagrass leaves. • Development and validation of indicators sensitive to chronic and acute contamination with hazardous substances. • Habitats of the hard bottom (reefs) • Development of indicators and thresholds for infralittoral and circalittoral rock broad habitat types. • Adaptation and validation of indicators for chronic and acute contamination with hazardous substances. Further actions needed: • Increasing financial assistance and securing sustainable financing at national level; • Development of projects and studies on habitats, identification, mapping, and analysis of their structure and functioning; • Better integration the MSFD monitoring with monitoring requirements of other directives (WFD, Habitats), regional sea conventions (BSC) and other conventions (International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)); • Better use and coordination of the existing capacities of all organizations involved in the monitoring programmes (including monitoring infrastructure sharing)/avoid overlapping of activities and efforts; • Permanent agreements with other authorities/organisations in supporting the national monitoring programme (e.g. Port Authorities, Offshore companies, ROSA- Romanian Spatial Agency, etc); • More research for developing EUNIS habitat classification (see ongoing project EUSeaMap); define an agreement between MS on habitats description (EUNIS); • More research is needed for a better understanding of natural variation in biodiversity in order to update/improve the current monitoring program; • Improvement of knowledge related to the impact of relevant human activities on the seabed habitats; • Adjust/increase temporal and spatial coverage of the program; • New monitoring tools to be developed (e.g. ROV, satellite images, advanced modelling, etc); develop new devices and data transmission for the observation and study of deep-sea habitats; • Develop habitat suitability model; • Develop integrative methods enabling valorisation of incomplete and heterogeneous monitoring data; • Existing indicators to be developed (new parameters, indices to be considered and developed) and, where possible, additional indicators/parameters to be included; • Developing metagenomics for a faster, accurate and harmonized identification of species: DNA barcoding/ Metagenetics / Metagenomics; • Build up taxonomic competence; • Improving QA/QC • Improving data management.
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MONITORING PROGRAMME FOR DESCRIPTOR D1, 4 - BIODIVERSITY- PELAGIC HABITATS									
1. General									
1.1 Subject area	Programme name: BIODIVERSITY - WATER COLUMN HABITATS; BLKRO-D1, D4-W Programme ID: BLKRO-D1, D4-W								
1.2 Definition / Description	The monitoring activity is focused on pelagic communities and habitats and is referring to the following components: Phytoplankton The general approach consists in quantitatively and qualitatively seasonal estimation of phytoplankton populations in coastal, variable salinity and shelf (partially) water column habitats. Based on parameters measured: density (cells/L) and biomass (mg/m³), taxonomic structure (number of species) and temporal and spatial (horizontal and vertical) distribution, there were developed several indices in accordance with WFD and others are proposed to satisfy MSFD requirements. Zooplankton Zooplankton component is seasonally assessed in coastal and shelf (partially) habitats and, there are considered the main following parameters: taxonomic composition, density (ind./m³) and biomass (mg/m³), ratio fodder/nonfodder zooplankton. The present programme addresses state/impact parameters, including also physical, hydrological and chemical conditions of water column habitats. Also, the programme deals with relevant activities which significantly influence the water column biodiversity, but it does not address the pressures, which are subject to other monitoring programmes (Non-indigenous species, Commercial fish and shellfish, Eutrophication, Hydrographical changes, and Contaminants).								
2. Monitoring requirements and purpose									
2.2 GES criteria and indicators	D1C6. Primary: The condition of the habitat type, including its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), is not adversely affected due to anthropogenic pressures. Indicators: • Phytoplankton biomass (mg/m³) during warm season (April-September) • Copepoda biomass (mg/m³) for cold and warm season • Mesozooplankton biomass (mg/m³) for cold and warm season The assessment under D1C6 shall combine the assessments of the adverse effects from pressures, including under criteria D2C3, D5C2, D5C3, D5C4, D7C1, D8C2 and D8C4, of pelagic habitats under Descriptor 1.								
2.3 Features, pressures and impacts	The assessment under D1C6 shall combine the assessments of the adverse effects from pressures, including under criteria D2C3, D5C2, D5C3, D5C4, D7C1, D8C2 and D8C4, of pelagic habitats under Descriptor 1. Features and pressures/impacts (from Table 2, Part II of COMMISSION DECISION (EU) 2017/848 and Annex III, Table 1 of COMMISSION DIRECTIVE (EU) 2017/845) relevant for the programme are: Habitat types • Pelagic broad habitat types (variable salinity, coastal, shelf and offshore/beyond shelf) - with a description of the characteristic physical and chemical features, such as depth, water temperature regime, currents and other water movements, salinity. Biological features • a description of the biological communities associated with the predominant and water column habitats. This would include information on the phytoplankton and zooplankton communities, including the species and seasonal and geographical variability.								
2.4 GES	Phytoplankton biomass during warm season (mg/m³) <table> <tr> <td>MRU</td><td>GES</td></tr> <tr> <td>Variable salinity</td><td><3000</td></tr> <tr> <td>Coastal</td><td><950</td></tr> <tr> <td>Marine</td><td><800</td></tr> </table>	MRU	GES	Variable salinity	<3000	Coastal	<950	Marine	<800
MRU	GES								
Variable salinity	<3000								
Coastal	<950								
Marine	<800								

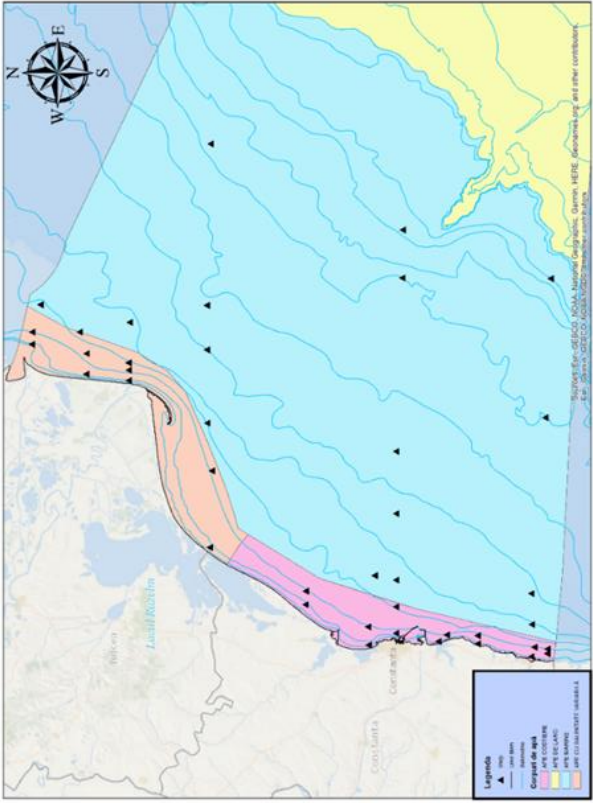
	Zooplankton Copepoda biomass (mg/m ³)					
	MRU	Variable salinity		Coastal	Marine	
	Season	GES	Non-GES	GES	Non-GES	Non-GES
	Warm	>45	<45	>65	<65	<45
	Cold	>10	<10	>15	<15	<13
	Mesozooplankton biomass (mg/m ³)					
	MRU	Variable salinity		Coastal	Marine	
	Season	GES	Non-GES	GES	Non-GES	Non-GES
	Warm	>240	<240	>210	<210	<70
	Cold	>15	<15	>30	<30	<15
2.5 Environmental targets MSFD	Romania has defined environmental targets according to MSFD requirements for plankton communities as follow:					
	- The 90th percentile of phytoplankton biomass values does not exceed the target values in the summer season over the past 6 years, for each pelagic habitat type. - Meso-zooplankton and copepods average biomass should not exceed the threshold values established for cold and warm season for each pelagic habitat type.					
3 Monitoring concept						
3.2 Description of monitoring network	Monitoring network comprises 45 sampling stations (bottom depths within 5 - 90 m), covering entire Romanian coastal water and, partially, shelf waters (either waters strongly affected by the Danube's inputs and coastal activities or marine waters, less affected by human induced eutrophication).					
	Physical-chemical (temperature, salinity, oxygen, nutrients, TOC, etc.) and biological (chlorophyll, phytoplankton, zooplankton) parameters are monitored seasonally					

	 Map of sampling stations of the environment routine monitoring carried out by NIMRD
6. Activities required to implement the concept 6.1 Changes to the current monitoring programme	Recommendations actions needed: • Regular monitoring of phytoplankton and zooplankton community with relevant frequency (seasonal), including all components of plankton fauna - micro-, meso- and macrozooplankton. • Sustain monitoring of transects with long-terms observations. • Phytoplankton functional types (PFTs) are relevant proxies of ecosystem functioning, incorporation of PFTs into the monitoring programs and biogeochemical models may improve our predictive capabilities and the capacity for a better ecosystem management. • Harmonize analytical techniques, indicators/reporting formats and assessment methodologies at regional level. • Better integration the MSFD monitoring with the monitoring requirements of other directives (WFD, HD, BWD, etc), regional sea conventions (BSC) and other conventions (International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)). • Additional indicators to be included (especially related to the microbial component). • New monitoring tools to be developed, with special emphasis on open waters (CRP, satellite images, etc). • Improving QA/QC. • Improving data management and increasing temporal and spatial coverage (to include open water habitats).

MONITORING PROGRAMME FOR DESCRIPTOR 5 - EUTROPHICATION	
1. General	
1.1 Subject area	Programme name: EUTROPHICATION. Programme ID: BLKRO-D5 Eutrophication is a process driven by the nutrient enrichment, especially compounds of nitrogen and/or phosphorus, leading to increased growth, primary production and algal biomass; changes in the balance of organisms; and water quality degradation. The consequences of eutrophication are undesirable if they appreciably degrade ecosystem health and biodiversity and/or the sustainable provision of goods and services. The eutrophication causes and effects have been systematically monitored in the Romanian waters (with special emphasis on the coastal waters) for more than 3 decades ago. Over the years, the monitoring programme has been substantially improved (in terms of infrastructure, methodology, etc), now being well developed (coastal and shelf waters). The current monitoring programme is a function of: • size of area to be assessed; • number and distribution of land-based sources; • existing monitoring strategy (reference areas, former networks, existing long-term data series, existing logistics, etc); • sampling frequency and duration; • specificity, sensitivity of analytical technique; • magnitude of concentration expected; • available resources. The main objective of the programme is to characterize the present state and trends, as well as to identify the environmental impact of human activities as possible causes for observed environmental impairments. Thus, it addresses: • State and impact parameters: physical-chemical: transparency, nutrients (water column and sediment-water interface), TOC, dissolved oxygen/oxygen saturation (water column and sediment-water interface). • Biological parameters: pelagic community: chlorophyll a, phytoplankton (species composition, abundance - density and biomass) seabed community: phytobenthos (species composition, abundance - biomass). • Pressures: both at source - nutrient and organic matter loads from point and non-point sources (WWTP, riverine input, agriculture, industrial activities, atmosphere, etc.) and in the marine environment (nutrients level in the water column). • Activities (by measuring the extent and intensity).
2. Monitoring requirements and purpose	
2.1 GES criteria and indicators	D5C1. Primary: Nutrient concentrations are not at levels that indicate adverse eutrophication effects. D5C2. Primary: Chlorophyll <i>a</i> concentration are not at levels that indicate adverse effects of nutrient enrichment. D5C3. Secondary: The number, spatial extent and duration of harmful algal bloom events are not at levels that indicate adverse effects of nutrient enrichment. D5C4. Secondary: The photic limit (transparency) of the water column is not reduced, due to increases in suspended algae, to a level that indicates adverse effects of nutrient enrichment. D5C5. Primary (may be substituted by D5C8): The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse effects on benthic habitats (including on associated biota and mobile species) or other eutrophication effects. D5C6. Secondary: The abundance of opportunistic macroalgae is not at levels that indicate adverse effects of nutrient enrichment. D5C7. Secondary: not assessed D5C8. Secondary (except when used as a substitute for D5C5): The species composition and relative abundance of macrofaunal communities, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment.

2.2 Features, pressures and impacts	Table 2a - Features and pressures/impacts (from MSFD Annex III) relevant for the programme are: Characteristics Physical and chemical features • spatial and temporal distribution of nutrients (DIN, TN, DIP, TP, TOC) and oxygen. Biological features • a description of the biological communities associated with the predominant seabed and water column habitats (this would include information on the phytoplankton and zooplankton communities, including the species and seasonal and geographical variability). • information on angiosperms and macroalgae, including species composition, biomass and annual/seasonal variability. Pressures and impacts Nutrient and organic matter enrichment • inputs of fertilizers and other nitrogen and phosphorus-rich substances (e.g. from point and diffuse sources, including agriculture, aquaculture, atmospheric deposition). • inputs of organic matter (e.g. sewers, mariculture, riverine inputs).
2.4 GES	D5C1. DIN, TN, DIP, TP Variable salinity & coastal waters - National legislation (WFD) - Ord.161/2006 TP - 0.1mg/L - 3.23µM N-NO₃ - 1.5 mg/L -107.14µM N-NO₂ - 0.03mg/L - 2.14µM N-NH₄ - 0.1mg/L - 7.14µM Marine waters DIP - 0.23µM; DIN -10.50 µM D5C2. Chlorophyll a concentration - warm season (May - August) Variable salinity waters - 11.88 µg/L Coastal waters - 5.97µg/L Marine waters - 4.11µg/L - Northern area; 2.79µg/L - Southern area D5C3. Secondary: Harmful algal bloom events - <i>Noctiluca scintillans</i> biomass Variable salinity waters - 240 mg/m³ warm season (May-October); 70mg/m³ cold season (November - April). Coastal waters - 350 mg/m³ warm season; 100mg/m³ cold season Marine waters - 240 mg/m³ warm season; 60mg/m³ cold season D5C4. Secondary: The photic limit (transparency) of the water column - Secchi Disk (transparency) Variable salinity & coastal waters - National legislation (WFD) - Ord.161/2006 - 2.0m Marine waters - 6.8m D5C5 – Primary: The concentration of dissolved oxygen Marine waters - 5mg/L, no less than 60% at water-sediment interface D5C6. Secondary: The abundance of opportunistic macroalgae Biomass proportion of sensitive and opportunistic species from the total biomass ESG II ≤40%

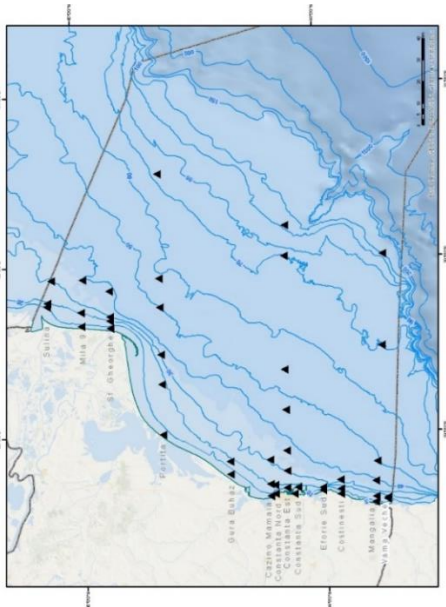
	D5C7. indicators not developed yet and GES not established. D5C8. Secondary: The species composition and relative abundance of macrofaunal communities. M-AMBI*(n) ≥ 0.68 <i>Mytilus galloprovincialis</i> biogenic circalittoral reefs EQR≥0.68 for all benthic sedimentary habitats. M-AMBI*(n) ≥ 0.61 <i>Modiolula phaseolina</i> circalittoral muds. Romania has defined environmental targets according to the MSFD requirements as follows: D5C1. In variable salinity and coastal waters, all measured values are lower than the maximum allowable concentrations according to national legislation. In marine waters, the 75th percentile of annual mean concentrations of nutrients should not exceed the target values. D5C2. The 75th percentile of summer chlorophyll a concentration should not exceed the threshold values. D5C3. <i>Noctiluca scintillans</i> biomass 50 percentile is lower than the target value for each water body and season. D5C4. In variable salinity and coastal waters all measured values should not be lower than the minimum permitted by national legislation. Beyond coastal waters - the 10th percentile of all sea water transparency values measured in the warm season (May-September) is not less than the threshold value. D5C5. The 10th percentile of all dissolved oxygen values at the water-sediment interface (for stations with a maximum depth of 50m) measured in the warm season (May-September) is not less than the threshold value. D5C6. The abundance of opportunistic macroalgae is not at levels that indicate negative effects of nutrient enrichment. ESG II < 40 % from total biomass D5C7. Indicators not developed yet and environmental targets not established. D5C8. Macrozoobenthic communities <table><tr><th colspan="6">Infralittoral sand and mud in waters with variable salinity</th></tr><tr><td>Ecological status</td><td>EQR</td><td>AMBI</td><td>H'</td><td>S</td><td>M-AMBI*n</td></tr><tr><td>Reference conditions</td><td>1</td><td>1.8</td><td>2.9</td><td>15</td><td>0.90</td></tr><tr><td>Good status</td><td>0.68</td><td>3.21</td><td>1.9</td><td>10</td><td>0.61</td></tr><tr><th colspan="6">Circalittoral sand/mud in waters with variable salinity</th></tr><tr><td>Reference conditions</td><td>1</td><td>1.8</td><td>2.9</td><td>15</td><td>0.90</td></tr><tr><td>Good status</td><td>0.68</td><td>3.21</td><td>1.9</td><td>10</td><td>0.61</td></tr><tr><th colspan="6">Circalittoral mud with <i>Mytilus galloprovincialis</i> biogenic reef and diverse fauna</th></tr><tr><td>Reference conditions</td><td>1</td><td>1.4</td><td>3.5</td><td>24</td><td>1.00</td></tr><tr><td>Good status</td><td>0.68</td><td>2.8</td><td>2.38</td><td>16</td><td>0.68</td></tr><tr><th colspan="6">Offshore circalittoral mud with <i>Modiolula phaseolina</i></th></tr><tr><td>Reference conditions</td><td>1</td><td>0.2</td><td>3.7</td><td>21</td><td>1.00</td></tr><tr><td>Good status</td><td>0.68</td><td>2.06</td><td>2.52</td><td>14</td><td>0.61</td></tr></table>	Infralittoral sand and mud in waters with variable salinity						Ecological status	EQR	AMBI	H'	S	M-AMBI*n	Reference conditions	1	1.8	2.9	15	0.90	Good status	0.68	3.21	1.9	10	0.61	Circalittoral sand/mud in waters with variable salinity						Reference conditions	1	1.8	2.9	15	0.90	Good status	0.68	3.21	1.9	10	0.61	Circalittoral mud with <i>Mytilus galloprovincialis</i> biogenic reef and diverse fauna						Reference conditions	1	1.4	3.5	24	1.00	Good status	0.68	2.8	2.38	16	0.68	Offshore circalittoral mud with <i>Modiolula phaseolina</i>						Reference conditions	1	0.2	3.7	21	1.00	Good status	0.68	2.06	2.52	14	0.61
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	 Map of sampling stations of the environment routine monitoring carried out by NIMRD
6. Activities required to implement the concept 6.1 Changes to the current monitoring programme	Recommendations and actions needed: • increasing financial assistance and securing sustainable financing at national levels; • better integration of the MSFD monitoring with the monitoring requirements of other directives (WFD, Habitats, Nitrate, UWT, etc.) and regional sea convention (BSC); • better use and coordination of the existing capacities of all organizations dealing with the monitoring programme (including monitoring infrastructure sharing); avoid overlapping of activities and efforts; • permanent agreements with other authorities/organizations in supporting the monitoring programme (e.g. ROSA, RNA, Port Authorities, offshore companies, etc.); • strengthening the regional cooperation/harmonization between the Black Sea MS (approaching common MSFD indicators/parameters, common methodologies for defining GES and targets, harmonized methodologies for sampling, samples analyses and data processing); consultations on the possible transboundary effects of human activities and the measures envisaged to reduce or eliminate such effects; • adjusting/increasing temporal and spatial coverage; • new monitoring tools to be developed (remote sensing tools, ferry boxes, smart buoys benthic observatories, ships-of-opportunity, models, etc.); • monitoring of atmospheric deposition of nutrients need to be developed; coupled atmosphere-river-coastal sea models need to be developed at the regional scale;

	• more research on development of an integrative tool to assess eutrophication (e.g. BEAST); • additional parameters to be included in order to develop existing/new indicators; • more research on the primary production and algal biomass regulation; • more research is needed for developing indicators/parameters that considered the effects of eutrophication on nutrients, DO, chlorophyll distribution within the water column (with special emphasis on the open waters); • more research on natural background nutrient enrichment (e.g. import by upwelling; import from pristine/ good status rivers) for determination of pristine state and separation of naturally productive status from anthropogenically eutrophic status; climate change impacts on availability and transformation of nutrients and organic matter from land to the sea; • improving QA/QC • improving data management.
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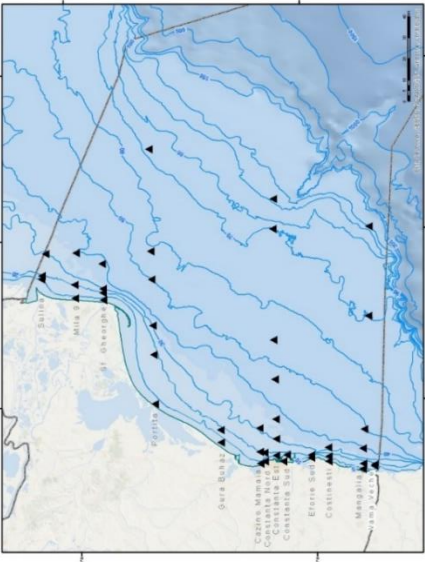
MONITORING PROGRAMME FOR DESCRIPTOR D8 - CONTAMINANTS	
1. General	
1.1 Subject area	Programme name: CONTAMINANTS. Programme ID: BLKRO-D8
1.2 Definition / Description	Chemical contaminant concentrations are an aspect of the objective of achieving clean, safe, healthy, biologically diverse and productive seas in the MSFD context. A potential consequence of seas that are chemically contaminated is that organisms or biological processes may be adversely affected. Two main approaches are used to study the pollution effects: measurements of biological effect parameters and contaminants concentrations. The current programme mainly deals with the assessment of concentrations of priority contaminants in environmental matrices (water, sediment, and biota) as pressure in the marine environment. The quantification of biological effects of contaminants at different levels of biological organization has not approached yet by the programme; major efforts, especially knowledge, have to be done for developing indicators/parameters related to the Criteria D8C2. Some biological effect techniques like oxidative enzymes, metallothionein's, lysosomal stability, etc. were tested, but not included yet in contaminants program. Contaminants are monitor in the marine waters. The parameters monitored are: • Heavy metals (Cu, Cd, Pb, Ni, Cr) in water (surface layer), sediment and biota (molluscs - <i>Mytilus galloprovincialis</i>, <i>Rapana venosa</i>, <i>Scapharca inequivalvis</i>, <i>Mya arenaria</i> and fish); • Total Petroleum Hydrocarbons (TPHs) in water (surface layer) and sediment; • Polycyclic Aromatic Hydrocarbons (PAHs) in water, sediment and biota (molluscs - <i>Mytilus galloprovincialis</i>, <i>Rapana venosa</i>, <i>Scapharca inequivalvis</i>, <i>Mya arenaria</i> and fish); • Organochlorine pesticides (aldrin, dieldrin, endrin, lindane, heptachlor, p,p'DDT, p,p'DDD, p,p'DDE, HCB) in water, sediment and biota (molluscs - <i>Mytilus galloprovincialis</i>, <i>Rapana venosa</i>, <i>Scapharca inequivalvis</i>, <i>Mya arenaria</i> and fish); • PCBs (PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, PCB 180) in water, sediment, and biota (molluscs - <i>Mytilus galloprovincialis</i>, <i>Rapana venosa</i>, <i>Scapharca inequivalvis</i>, <i>Mya arenaria</i> and fish).
2. Monitoring requirements and purpose	
2.1 GES criteria and indicators	GES criteria and indicators (COMMISSION DECISION (EU) 2017/848) D8C1. Primary: Within coastal and territorial waters, the concentrations of contaminants do not exceed the following threshold values: (a) for contaminants set out under point 1(a) of criteria elements, the values set in accordance with Directive 2000/60/EC; (b) when contaminants under point (a) are measured in a matrix for which no value is set under Directive 2000/60/EC, the concentration of those contaminants in that matrix established by Member States through regional or subregional cooperation; (c) for additional contaminants selected under point 1(b) of criteria elements, the concentrations for a specified matrix (water, sediment or biota) which may give rise to pollution effects. Member States shall establish these concentrations through regional or subregional cooperation, considering their application within and beyond coastal and territorial waters. Beyond territorial waters, the concentrations of contaminants do not exceed the following threshold values: (a) for contaminants selected under point 2(a) of criteria elements, the values as applicable within coastal and territorial waters; (b) for contaminants selected under point 2(b) of criteria elements, the concentrations for a specified matrix (water, sediment or biota) which may give rise to pollution effects. Member States shall establish these concentrations through regional or subregional cooperation. D8C2. Secondary: The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergetic effects.

	Member States shall establish those adverse effects and their threshold values through regional or subregional cooperation. D8C3. Primary: The spatial extent and duration of significant acute pollution events are minimised. D8C4. Secondary (to be used when a significant acute pollution event has occurred): The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated. Pressures (COMMISSION DIRECTIVE (EU) 2017/845) relevant for the programme are: Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events GES definition at descriptor level as follows: the contaminants concentrations measured in relevant matrices do not pose any risk of occurrence of pollution effects, which are showed by high levels of hazardous substances. GES definition at criteria level, related to the D8C1: Concentrations of the relevant contaminants measured in appropriate matrices (water, sediment or biota) are lower than concentrations at which negative effects may occur or demonstrate a downward tendency. - Coastal waters (up to 12 nautical miles): the concentrations of relevant contaminants, measured in appropriate matrices (water, sediment or biota) complies with environmental quality standards used in the WFD in 12 nm zone (for priority substances) or 1 nm area (for all other substances). - Waters of the wide area (from 1 or 12 nautical miles, respectively): the concentrations of relevant contaminants in the appropriate matrices (water, sediment or biota) comply with environmental quality standards or demonstrate a downward tendency. More improvements are needed in terms of knowledge and data acquisition for providing a more robust GES definition (at descriptor level) by considering also the effects of contaminants. The programme provides data/information needed to establish if the descriptor is at GES (as is defined at present) or not. In the latter case, the data/information can contribute to determine the distance to GES as difference between data provided by the programme and the thresholds. Also trends can be derived from programme and contribute to determine if GES is achieved or not.
2.2 Features, pressures and impacts	
2.3 GES	
2.4 Environmental targets MSFD	The environmental objectives refer to: State - The concentrations of contaminants in water, sediment and biota do not show an increased trend. Pressures - The contaminants input in the marine environments is reduced. Impact - The percent of samples of water, sediment and biota which exceed the values proposed as limits for a good ecological status to be reduced (<25%). To meet above mentioned objectives, the following targets have been proposed: - The 75th percentile of heavy metal concentrations in water is lower than the levels from which the adverse effects are expected to occur (WFD-EQS/ Directive 2013/39/EU; /Ord. 161/2006) - The 75th percentile of synthetic contaminants concentrations in water is lower than the levels from which the adverse effects are expected to occur (WFD-EQS/ Directive 2013/39/EU) - The 75th percentile of polycyclic aromatic hydrocarbons in water is lower than the levels from which the adverse effects are expected to occur (ERL/US EPA; EAC/OSPAR; SQC) - The 75th percentile of heavy metal concentrations in sediments is lower than the levels from which the adverse effects are expected to occur (ERL/US EPA; EAC/OSPAR; SQC/Order 161/2006) - The 75th percentile of synthetic contaminants concentrations in sediments is lower than the levels from which the adverse effects are expected to occur (ERL/US EPA; EAC/OSPAR)

	• The 75th percentile of polycyclic aromatic hydrocarbons concentrations in sediments is lower than the levels from which the adverse effects are expected to occur (ERL/US EPA) • The 75th percentile of heavy metal concentrations in <i>Mytilus galloprovincialis</i> is lower than the levels from which the adverse effects are expected to occur (Commission Regulations (EC) no. 1881/2006 and 629/2008) • The 75th percentile of synthetic contaminants concentrations in <i>Mytilus galloprovincialis</i> is lower than the levels from which the adverse effects are expected to occur (EAC/OSPAR) The programme addresses all above mentioned targets and provides quite sufficient data/information for assessing progress towards their achievement (difference between data provided and thresholds) and also for regular updating of the established targets. However, there are some gaps, especially in knowledge, for defining targets as regarding the effects of contaminants.
3 Monitoring concept	
3.2 Description of monitoring network	The national network of marine monitoring covers the national transitional, coastal and marine waters (territorial waters and part of the EEZ) and is currently represented by 45 permanent stations, with some transects reaching up to 100 m depth, respectively 65 nautical miles from the base line, positioned on 13 transects arranged throughout the length of the Romanian coastline. The stations in the shallow area (5 - 20 m) allow the assessment of the direct impact of terrestrial pressures such as the Danube mouths, the discharges of municipal and industrial sewage stations, ports, urban agglomerations, hydrotechnical works. Scientific cruises are conducted as an average 2 times/year. Heavy metals, TPHs, PAHs, PCBs, and organochlorine pesticides are measured in water, sediment and biota (molluscs, mainly species of commercial interest - <i>Mytilus galloprovincialis</i> and <i>Rapana venosa</i>, collected during scientific cruises with beam trawl). NIMRD is also dealing with the monitoring of contaminants level in the commercial fish (not very well developed). Generally, the samples are collected from the trawling zones within the research cruises related to the study of pelagic and demersal fishery resources, supported by the National Fisheries Data Collection Programme. 
6. Activities required to implement the concept	NIMRD Integrated Marine Monitoring Network
6.1 Changes to the current monitoring programme	Recommendations and actions needed: • increasing financial assistance and securing sustainable financing at national levels;

	• permanent agreements with other authorities/organizations in supporting the monitoring programme (e.g. ROSA, RNA, Port Authorities, offshore companies, etc.); • better integration of the MSFD monitoring with the monitoring requirements of other directives (WFD, EQS Directive, Shellfish Directive, Habitats, etc.), regional sea conventions (BSC) and other convention (MARPOL); • strengthening the regional cooperation/harmonization between the Black Sea MS (to share their knowledge, identify best practices and ensure a harmonized monitoring methodology); • developing an incident-specific monitoring subprogramme which could establish, as cost-effectively as possible, any impacts on environmental status; • development of ecotoxicology monitoring (will offer more information/knowledge for a better understanding of contaminants effects on biological components); • improving of radionuclides monitoring; more research related to pressures and impacts of radionuclides; • inclusion of additional matrices (e.g. fish) for a better understanding of contaminants effects; • more research related to the contaminant's effects on mobile species (fish, mammals, birds); • more research focusing on the assessment of biological effects of pollution based on biomarkers analyses; • more research dedicated to interaction of substances (hazardous substances, especially synthetic chemicals, occur in the environment as mixtures); development of tools/methods for their combined effect on organisms and the ecosystem); • to develop monitoring and research on "novel" compounds such as hormones, veterinary medicines and pharmaceuticals; • development of new sampling and observation techniques (passive sampling, <i>in situ</i> voltammetry, satellite images, etc.); • new modeling techniques (e.g. biogeochemical modeling, bioaccumulation modeling, etc.) to be developed; • improving QA/QC; • improving data management.
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MONITORING PROGRAMME FOR DESCRIPTOR 9 - CONTAMINANTS IN SEAFOOD	
1. General	
1.1 Subject area	Programme name: CONTAMINANTS IN SEAFOOD. Programme ID: BLKRO-D9
1.2. Definition / Description	So far, the Romanian monitoring activity dealing with the contaminants in seafood has been part of the programme Contaminants. According to the MSFD requirements, a special programme need to be developed, which aims to approach the commercial seafood monitoring, more related to public health than to assessment of environmental status. Results from the monitoring of contaminants carried out under the descriptors D8 and D9 should be integrated. When results from the monitoring programme Contaminants indicate a very low likelihood for elevated levels in seafood for human consumption, additional monitoring, under D9, on these commodities is not justified. Results from monitoring programme under the descriptor D8 are an important element in selecting contaminants for D9. The following parameters are monitored within the programme: - heavy metals (Cu, Cd, Pb, Ni, and Cr) in biota (<i>Mytilus galloprovincialis</i> and <i>Rapana venosa</i>) - organochlorine pesticides (aldrin, dieldrin, endrin, lindane, heptachlor, p,p'DDT, p,p'DDD, p,p'DDE, HCB) in biota (<i>Mytilus galloprovincialis</i> and <i>Rapana venosa</i>) - PAHs (benzo(a)piren) - PCBs (PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, PCB 180) in biota (<i>Mytilus galloprovincialis</i> and <i>Rapana venosa</i>) - NIMRD measures also the level of contaminants (heavy metals, organochlorine pesticides, PAH and PCBs) in commercial fish (eg. Sprat (<i>Sprattus sprattus sulinus</i>), turbot (<i>Psetta maxima maeotica</i>), whiting (<i>Merlangius merlangus euxinus</i>), goby (<i>Neogobius melanostomus</i>). The programme address the pressures in the marine environment (contaminants levels in species concerned - distribution, concentrations) and related activities (distribution in space and time, intensity). However, the program has to be significantly improved for approaching in future also the monitoring of measures (not defined yet according to the MSFD requirements).
2. Monitoring requirements and purpose	
2.2 GES criteria and indicators	D9C1. Primary: The level of contaminants in edible tissues (muscle, liver, roe, flesh or other soft parts, as appropriate) of seafood (including fish, crustaceans, molluscs, echinoderms, seaweed and other marine plants) caught or harvested in the wild (excluding fin-fish from mariculture) does not exceed: (a) for contaminants listed in Regulation (EC) No 1881/2006, the maximum levels laid down in that Regulation, which are the threshold values for the purposes of this Decision; (b) for additional contaminants, not listed in Regulation (EC) No 1881/2006, threshold values, which Member States shall establish through regional or subregional cooperation.
2.3 Features, pressures and impacts	Pressures (COMMISSION DIRECTIVE (EU) 2017/845) relevant for the programme are: Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events.
2.4 GES	The concentration of contaminants does not exceed the levels regulated by European legislation: Regulation (EC) No. 1881/2006 laying down maximum levels for certain contaminants in foodstuffs (including molluscs and fish), with further amendments, and by national legislation - Order 147/2004 for the approval of Sanitary veterinary and Food safety rules on pesticide residues in products of animal origin. The programme provides data/information needed to establish if the descriptor is at GES (as is defined at present) or not. In the latter case, the data/information can contribute to determine the distance to GES as difference between data provided by the programme and the thresholds (set in accordance to European/national regulations).

2.5 Environmental targets MSFD	• The ' 75 percentile of the concentrations of heavy metals measured in fish and mollusks is less than the levels regulated by European legislation: Regulation (EC) No. 1881/2006 laying down maximum levels for certain contaminants (metals - Cd, Pb, Hg) of foodstuffs (including molluscs and fish), as amended by: Regulation (EC) No 1126/2007; Regulation (EC) No 565/2008; Regulation (EC) No 629/2008; Regulation (EU) No 105/2010; Regulation (EU) No 165/2010 . • The ' 75 percentile of the concentrations of polychlorinated biphenyls measured in fish and mollusks is less than the levels regulated by European legislation: Regulation (EC) No. 1881/2006 completed by Regulation (EC) No 1259/2011 on maximum levels for dioxins, dioxin-like PCBs and PCBs in different food products. • The ' 75 percentile of the concentrations of organochlorinated pesticides measured in fish and mollusks is less than the levels regulated by national legislation: Order 147/2004 for the approval of Sanitary veterinary and Food safety rules on pesticide residues in products of animal origin. • The ' 75 percentile of the concentrations of polynuclear aromatic hydrocarbons measured in fish and mollusks is less than the levels regulated by European legislation: Regulation (EC) No. 1881/2006 establishing maximum levels for certain contaminants (Benzo (a) Piren) in food products (including mollusks and fish).
3 Monitoring concept 3.2 Description of monitoring network	The national network of marine monitoring covers the national transitional, coastal and marine waters (territorial waters and part of the EEA) and is currently represented by 45 permanent stations, with some transects reaching up to 100 m depth, respectively 65 nautical miles from the base line, positioned on 13 transects arranged throughout the length of the Romanian coastline. The stations in the shallow area (5 - 20 m) allow the assessment of the direct impact of terrestrial pressures such as the Danube mouths, the discharges of municipal and industrial sewage stations, ports, urban agglomerations, hydrotechnical works, s.a. Scientific cruises are conducted as an average 2 times/year. Heavy metals, TPHs, PAHs, PCBs, and organochlorine pesticides are measured in water, sediment and biota (molluscs, mainly species of commercial interest - <i>Mytilus galloprovincialis</i> and <i>Rapana venosa</i>, collected during scientific cruises with beam trawl, along relevant transects, 20-30 m depth). NIMRD is also dealing with the monitoring of contaminants level in the commercial fish (not very well developed). Generally, the samples are collected from the trawling zones within the research cruises related to the study of pelagic and demersal fishery resources, supported by the National Fisheries Data Collection Programme. 

6. Activities required to implement the concept	
6.1 Changes to the current monitoring programme	Recommendations and actions needed: • increasing financial assistance and securing sustainable financing at national levels; • strengthening the regional and inter-regional cooperation/harmonization between the MS (to share their knowledge, identify best practices and ensure a harmonized monitoring methodology); • developing/maintaining permanent agreements with other authorities/organizations in supporting the current monitoring programme (e.g. food safety authorities, s.a.); • additional contaminants (e.g. Hg, radionuclides, dioxins, etc.) to be included in the programme; • more species (more commercial fish species) to be included in the programme; • more research related to the establishing of a well-defined quantitative link between levels of contaminants in marine environment and levels in fish and other seafood (to identify possible relations between contaminant levels in sediment, and tissues of fish and other seafood); • improving the infrastructure (laboratories, equipment, sampling tools, etc) and human resources (e.g. trainings for implementation of new analytical procedures); • improving QA/QC; • improving data management.

Partners:

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Project partner 2 - Mare Nostrum Non-Governmental Organization (Romania)

Project partner 3 - Institute of Oceanology - Bulgarian Academy of Sciences (IO-BAS) (Bulgaria)

Project partner 4 - Ukrainian Scientific Center of Ecology of Sea (UkrSCES) (Ukraine)

Project partner 5 - Scientific and Technological Research Council of Turkey/Marmara Research Center (TUBITAK-MAM) (Turkey)

Project partner 6 - Turkish Marine Research Foundation (TUDAV) (Turkey)



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