

Analysis of the main elements of
the “**Good Environmental Status**”
from the 1st and 2nd MSFD cycles,
reported by the European Member States
for the **Descriptor 6** (sea floor integrity)
- links with Regional Seas’ Conventions and
D4 (food webs integrity) and D5 (eutrophication)



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Glossary of acronyms

BSC	The Commission on the Protection of the Black Sea Against Pollution (Bucharest Convention)
CFP	(EU) Common Fisheries Policy
EU	European Union
GES	Good Environmental Status (sensu MSFD)
HD, Habitats Directive	European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
HELCOM	The Baltic Marine Environment Protection Commission
ICES	International Council for the Exploration of the Sea
MAD, Adriatic	Adriatic Sea
MAL, A-L	Aegean-Levantine Sea
MED	Mediterranean Sea
MIC, Central	Ionian Sea & Central Mediterranean Sea
MSFD	Marine Strategy Framework Directive
MWE, Western	Western Mediterranean Sea
NEA	North-East Atlantic
OSPAR	The Oslo-Paris Commission: Convention for the Protection of the Marine Environment of the North-East Atlantic
OSPAR Region II	Greater North Sea
OSPAR Region III, Celtic	Celtic Seas
OSPAR Region IV, B-I	Bay of Biscay & Iberian Coast
OSPAR Region V, MAC	Wider Atlantic, including Macaronesia
UNEP/MAP	United Nations Environment Programme / Mediterranean Action Plan (Barcelona Convention)
WFD, Water Framework Directive	European Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy
WISE	Marine Information System for Europe, MSFD Reporting Data Explorer

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1 Introduction

1.1 Context and objectives

Adopted in 2008, the [Marine Strategy Framework Directive](#) (MSFD, [2008/56/EC](#); EU, 2008) is the European Union's (EU) legislative pillar for the management and protection of the marine environment and marine biodiversity, aiming to define, assess and achieve Good Environmental Status (GES) of European marine waters by 2020. This Directive applies to marine regions and sub-regions, based on geographical, administrative, and environmental criteria.

Cooperation for coherence between the European Union Member States of a marine region, and also with regional seas' neighbouring countries, takes place through several working groups, and notably, for biodiversity and non-indigenous marine species, those from the regional seas' conventions (See next chapters for details). To achieve GES, each Member State must develop a strategy for its marine waters, which must be reviewed and updated every 6 years.

In 2010, a European Commission Decision was adopted ([2010/477/UE](#); EU, 2010) to guide GES determinations to be reported by Member States for the first time in 2012, until its review in 2017. Descriptors 1 (Biodiversity) and 6 (Seafloor integrity), with associated criteria and indicators, were directly related to benthic habitats (table 1 and table 2).

In the context of the MSFD, "the term habitat addresses both the abiotic characteristics and the associated biological community, treating both elements together in the sense of the term biotope [...]. The three criteria for the assessment of habitats are their distribution, extent and condition (for the latter, in particular the condition of typical species and communities). [...] the interactions between the structural components of the ecosystem are fundamental for assessing ecosystem processes and functions for the purpose of the overall determination of good environmental status, [...]. Other functional aspects addressed through other Descriptors of good environmental status (such as Descriptors 4 and 6), as well as connectivity and resilience considerations, are also important for addressing ecosystem processes and functions" (from EU, 2010).

Table 1: criteria and indicators of the GES for Descriptor 1, as defined in the 1st MSFD cycle (EU, 2010)

Descriptor	Criteria	Indicator
1. Biological diversity	1.1. Species distribution	1.1.1 Distributional range
		1.1.2 Distributional pattern within the latter, where appropriate
		1.1.3 Area covered by the species (for sessile/benthic species)
	1.2. Population size	1.2.1 Population abundance and/or biomass, as appropriate
	1.3. Population condition	1.3.1 Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates)
		1.3.2 Population genetic structure, where appropriate
	1.4. Habitat distribution	1.4.1 Distributional range
1.4.2 Distributional pattern		
1.5. Habitat extent	1.5.1 Habitat area	
	1.5.2 Habitat volume, where relevant	
1.6. Habitat condition	1.6.1 Condition of the typical species and communities	
	1.6.2 Relative abundance and/or biomass, as appropriate	
	1.6.3 Physical, hydrological and chemical conditions	
1.7. Ecosystem structure	1.7.1 Composition and relative proportions of ecosystem components (habitats and species)	

Table 2: criteria and indicators of the GES for Descriptor 6, as defined in the 1st MSFD cycle (EU, 2010)

Descriptor	criteria	Indicator
6. Seafloor integrity	6.1. Physical damage, having regard to substrate characteristics	6.1.1 Type, abundance, biomass and areal extent of relevant biogenic substrate
		6.1.2 Extent of the seabed significantly affected by human activities for the different substrate types
	6.2. Condition of benthic community	6.2.1 Presence of particularly sensitive and/or tolerant species
		6.2.2 Multi-metric indices assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species
		6.2.3 Proportion of biomass or number of individuals in the macrobenthos above specified length/size
		6.2.4 Parameters describing the characteristics of the size spectrum of the benthic community

In 2017, new GES criteria were established in Commission Decision (EU) [2017/848](#) (EU, 2017) for 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" (Annex I):

Part I (Anthropic pressures):

D6C1 — Primary: **Spatial extent and distribution of physical loss** (permanent change) of the natural seabed.

D6C2 — Primary: **Spatial extent and distribution of physical disturbance pressures** on the seabed.

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.

Part II (Ecosystem state – Benthic habitats):

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

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

All D6 criteria are "primary", which means that all must be included in national reports under article 9 (GES determination) and article 8 (assessment).

An important change in this MSFD 2nd cycle (revised Decision) is also the use of the more generic term "methodological standards" (including recommended assessment scales, inter-Descriptor links and references to other legislation), instead of "indicators", which was confusing in the 1st MSFD cycle.

This study aims to compare, synthesize and analyse the main elements reported by the European Union Member States for the MSFD under article 9 (determination of GES), also informed by some related elements reported from articles 8 (assessment) and 10 (environmental targets), to guide the assessment of environmental quality status for benthic habitats through Descriptor 6 (seafloor integrity).

Moreover, in the context of the NEA PANACEA project, potential links with Descriptor 4 (food webs), Descriptor 5 (eutrophication) (see Annex I) and Regional Sea Conventions' methodological standards, notably from OSPAR (see Annex II) will be scrutinized, to conclude on current gaps and guide future progress to reinforce cooperation and coherence in next MSFD, Regional Sea Convention and national reporting cycles.

This report will also review and digest the main previous analyses and documentation (see next chapter), but it is **NOT an MSFD article 12 assessment** (technical assessment of country's reporting obligations under MSFD). This study, conducted under a scientific project, focuses on analysing technically the GES elements, to provide guidance on technical assessment methods, but not on the reporting process itself. The recommendations provided in the Chapter 7 are based on these analyses, but also including personal views from authors, according to their many years of professional experiences on European Directives, Regional Sea Conventions and Scientific expert groups on benthic habitats.

After the conclusions of this analysis, some key recommendations are provided to guide and encourage technical ways to progress towards a better harmonisation of GES elements and to guide future assessments of benthic habitats at European, regional and national scales.

1.2 Methodology

In 2012, European Union Member States reported, for the first time, the initial assessment of their marine waters (Art. 8), as well as the determination of the good environmental status (GES) (Art. 9) and the establishment of environmental targets and associated indicators (Art. 10). The elements reviewed for the 2nd MSFD cycle were to be reported by the Member States in 2018 for an update of their determination of GES and assessment of the extent to which it had been achieved. These official reports (HTML and text files) were researched and collected via the dedicated European portal EIONET (<http://cdr.eionet.europa.eu>) and WISE marine portal (<https://water.europa.eu/marine/policy-and-reporting/msfd-reports-and-assessments>).

The 1st and 2nd MSFD cycles were analysed through a review of existing documents describing reported GES determinations. The main contributing publications that were reviewed were:

- Regional and National technical MSFD reports (assessment, GES and targets) of the MSFD 2012 and 2018 reporting obligations, https://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm
- Palialexis A, Tornero Alvarez M, Barbone E, Gonzalez Fernandez D, Hanke G, Cardoso A, Hoepffner N, Katsanevakis S, Somma F, Zampoukas N (2014). In-Depth Assessment of the EU Member States' Submissions for the Marine Strategy Framework Directive under articles 8, 9 and 10. EUR 26473. Luxembourg (Luxembourg): Publications Office of the European Union; 2014. JRC88072, [DOI 10.2788/64014](https://doi.org/10.2788/64014)
- Commission Staff Working Document (2014) as an annexe accompanying the document, Commission Report to the Council and the European Parliament (2014). The first phase of implementation of the Marine Strategy Framework Directive (2008/56/EC) - The European Commission's assessment and guidance. SWD(2014) 49 final. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0049&from=EN> (EU, 2014).
- Boschetti S. T., Palialexis A., Connor D. (2021). Marine Strategy Framework Directive, Review and analysis of EU Member States' 2018 reports. Descriptor 6: Sea-floor integrity and Descriptor 1: Benthic habitats, EUR 30716 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-79-38014-6, doi:10.2760/355956, JRC125288. <https://publications.jrc.ec.europa.eu/repository/handle/JRC125288> (See also Annex III)

For the GES determinations, data from the WISE portal (<https://water.europa.eu/marine>) were also used to complement and double-check the information collected from the EIONET portal. Online translation tools were used to extract information from some reports which were in national languages. The detailed references to the documents (HTML and text) used here are listed at the end of this report (reference section). The term “reported” used here refers to the elements found in the official national reports (text and HTML), and the term “assessed” refers to the mention of their assessment for MSFD article 8, in these same reports.

From the 23 EU Member States, the 2nd MSFD cycle’s updated GES determinations, due in 2018, were reported by only seven countries: Latvia, the Netherlands, Belgium, Germany, Romania, Sweden and Greece (in Greek text only). In 2019, ten further countries also reported, and five others in 2020. Mid-2021, only Bulgaria still had not reported the revised GES elements for the 2nd MSFD cycle for the Descriptor 6 (Table 3). Besides, several EU Member States updated their reports during this period. Bulgaria’s report was published online on the 23rd of December 2021 and the last version was reported on the 31st of March 2022. Finally, for this report, information about the United-Kingdom’s GES elements was obtained from its official website: <https://moat.cefas.co.uk/>.

The latest versions of all reports (as available in May 2022) were used to conduct the analyses reported here. Table 3 presents, per country, the dates of the documents used. Details are provided in the following chapters and the references section.

Table 3: GES determination reporting dates for the 2nd MSFD cycle for Descriptor 6, and codes of the EU Member States (None = not available before May 2022)

		EU MSFD Good Environmental Status (Art 9)		
		First text report or XML data	Last update of the text report	Last update of the XML data
Belgium	BE	15/10/2018	21/11/2019	14/01/2020
Bulgaria	BG	23/12/2021	23/12/2021	31/03/2022
Croatia	HR	30/09/2019	11/12/2019	31/10/2019
Cyprus	CY	09/01/2020	13/05/2020	12/08/2020
Denmark	DK	05/07/2019	05/07/2019	30/08/2019
Estonia	EE	12/02/2019	14/02/2019	06/04/2020
Finland	FI	09/01/2019	16/01/2019	10/04/2019
France	FR	30/09/2019	15/10/2019	19/02/2020
Germany	DE	14/12/2018	14/12/2018	17/02/2020
Greece	EL	31/12/2018	31/12/2018	None
Ireland	IE	25/06/2020	26/06/2020	31/08/2020
Italy	IT	22/01/2019	22/01/2019	01/10/2020
Latvia	LV	21/06/2018	26/02/2019	08/05/2019
Lithuania	LT	31/03/2020	09/06/2020	09/06/2020
Malta	MT	23/03/2020	26/06/2020	16/04/2020
Netherlands	NL	01/10/2018	13/02/2019	15/04/2019
Poland	PL	04/04/2019	04/04/2019	28/01/2020
Portugal	PT	23/03/2020	19/06/2020	03/03/2021
Romania	RO	19/12/2018	30/09/2019	06/04/2020
Slovenia	SI	06/08/2019	09/01/2020	13/08/2020
Spain	ES	09/07/2019	11/07/2019	03/02/2020
Sweden	SE	27/12/2018	29/06/2020	06/07/2020
United-Kingdom	UK	23/10/2019	information was also obtained here from the official website https://moat.cefas.co.uk/	

The file containing all synthetic tables of this report is embedded here:



MSFD_D6_review_VF-checkedAL-LG-PS.xlsx

2 Comparison of D6 GES elements reported by EU Member States in the 1st MSFD cycle

Table 4 summarises the elements of GES determinations, that were reported by EU Member States in the 1st MSFD cycle. According also to the information available from the MSFD Technical Assessment of Article 12 for this first MSFD cycle, GES determinations and elements addressed for Descriptor 6 were diverse, rather descriptive, and none of the 23 EU Member States defined GES in the same way (Dupont et al 2014, Palialexis et al 2014, Commission Staff Working Documents 2014).

Table 4: criteria and indicators coverage of GES for Descriptor 6 reported by EU Member States in the 1st MSFD cycle (from national reports). Regional sea codes: NEA = North-East Atlantic Ocean (blue), BAL = Baltic Sea (purple), MED = Mediterranean Sea (orange), BLK = Black Sea (grey).

GES 1 st MSFD cycle			criteria 6.1	indicator 6.1.1	indicator 6.1.2	criteria 6.2	indicator 6.2.1	indicator 6.2.2	indicator 6.2.3	indicator 6.2.4
NEA	Belgium	BE								
BLK	Bulgaria	BG								
MED	Croatia	HR								
MED	Cyprus	CY	The national determination does not follow D6 elements from the EU Decision (EU, 2010)							
BAL/NEA	Denmark	DK								
BAL	Estonia	EE								
BAL	Finland	FI								
NEA/MED	France	FR								
BAL/NEA	Germany	DE	The national determination is mixing D1, D4 and D6 from the EU Decision (EU, 2010)							
MED	Greece	EL								
NEA	Ireland	IE	GES defined at Descriptor 6 level							
MED	Italy	IT								
BAL	Latvia	LV								
BAL	Lithuania	LT								
MED	Malta	MT								
NEA	Netherlands	NL	The national determination is reproduced verbatim from Annex I of the MSFD (EU, 2008)							
BAL	Poland	PL								
NEA	Portugal	PT								
BLK	Romania	RO								
MED	Slovenia	SI								
NEA/MED	Spain	ES								
BAL/NEA	Sweden	SE								
NEA/MED	United Kingdom	UK	GES defined at Descriptor 6 level							

		GES defined at criteria and/or indicator levels
		GES defined at Descriptor level
		others
		GES not defined

From the MSFD article 12 technical assessment, the level of coherence within and between regions (North-East Atlantic Ocean, Mediterranean Sea, Baltic Sea and Black Sea) was also very low (Table 4). The majority of EU Member States defined GES for Descriptor 6 at criterion level. Most countries defined GES for both criteria. Portugal covered only 6.1, while Estonia, Latvia and Poland covered only 6.2. Almost half of the Member States (Croatia, Denmark, Estonia, France, Greece, Latvia, Malta, Poland, Portugal, Spain and Sweden) completed at

least one of their reported criteria by an indicator level. Italy and Lithuania reported only at indicator level. Ireland and the United-Kingdom reported only at Descriptor level, like the Netherlands which moreover reported its determination verbatim from Annex I of the MSFD. Germany reported a GES determination mixed from Descriptors 1, 4 and 6 of the MSFD guidance, meanwhile, Cyprus didn't follow the MSFD Commission Decision (EU, 2010) at all.

Due to the very low coherence in the 1st MSFD cycle, and major changes at the updates for the 2nd MSFD cycle, both in national reports and EU Commission Decisions (EU, 2010; EU 2017), this report will mainly focus analyses on the most recent (2nd) MSFD cycle, within and between regions and, where feasible, only highlight links or nature of changes with the 1st MSFD cycle.

3 Comparison of D6 GES reported by EU Member States of the North-East Atlantic Ocean in the 2nd MSFD cycle

Table 5 summarises the evolution since the 1st MSFD cycle of GES elements reported for Descriptor 6 in the 2nd MSFD cycle. Despite major differences between the two EU GES Decisions, this analysis is based on the similarities of criterion 6.1 (EU, 2010) with D6C3 (EU, 2017) as well as criteria 1.6 and 6.2 (EU, 2010) with D6C5 (EU, 2017). According to this new Decision, many additional criteria were also reported, except by Germany, Portugal and United-Kingdom for which GES is still defined at Descriptor level. Belgium and Sweden adapted their previous determinations to address notably D6C5. Belgium, Netherlands and Spain reports covered all D6 criteria. Other countries reported various numbers of the five criteria. The GES determinations themselves for Descriptor 6 are still diverse and heterogeneous within this sea region. Belgium and Denmark followed the 2017 GES Decision criteria determinations (EU, 2017), while other Member States defined GES based on other EU Directives, such as the Water Framework Directive (WFD) or Habitats Directive (HD) (France, Netherlands and Sweden) or other agreements (Germany and Portugal). D6C3 and D6C5 are the most frequently reported criteria in the North-East Atlantic, even if only by 6 of the 9 Member States.

Table 5: evolution of GES elements, as reported (text, HTML) by NEA EU Member States in 2nd MSFD cycle (WISE + national reports)

GES 2 nd MSFD cycle		D1 Benthic habitats D6 Sea-floor integrity	D6C1	D6C2	D6C3	D6C4	D6C5
Belgium	BE						
Denmark	DK						
France	FR						
Germany	DE						
Ireland	IE						
Netherlands	NL						
Portugal	PT						
Spain	ES						
Sweden	SE						
United-Kingdom	UK						

	No changes between 1 st and 2 nd MSFD cycles
	GES element modified between 1 st and 2 nd MSFD cycle
	new GES element at 2 nd MSFD cycle
	GES not defined at any of the 2 MSFD cycles

The criteria determinations reported by Member States are still very often descriptive or not detailed, due also probably to the lack of agreed thresholds and baseline condition at the regional sea level. The general determinations of criteria were very diverse (Table 6). For example, criterion D6C1 was defined by five countries (Belgium, France, Ireland, Netherlands and Spain). Belgium provided a determination related to quantified changes in “km² or per cent relative to the natural size of the habitat in 12 years”. France follows the 2017 Decision determination (Decision (EU) 2017/848, EU 2017). The Netherlands defined the year 2012 as a benchmark for “no significant loss of the natural seabed compared to the situation in 2012 resulting from human activities.” The Spanish determination is about the changes in “spatial extent that compromises the maintenance of the benthic habitats”. Denmark provided details on what the assessment should include, while the Netherlands provided two determinations: one focussed on improvement of the assessment based on a Benthic Indicator Species Index, and the second one assumes a stable level of physical disturbance in habitats described under MSFD. Ireland reported having achieved GES within its maritime area under the criterion D6C1 defined as the “spatial extent and distribution of physical loss (permanent change) of the natural seabed”. Even the most commonly defined (by six countries) criteria D6C3 and D6C5 were reported with 7 different determinations each (table 6). According to the JRC Technical Report (Boschetti et al, 2021), there were 10 determinations of criterion D6C3, however, in the JRC report, some countries doubled (Spain) or tripled (France) information as they reported on several subregions.

All detailed GES determinations, as reported by the EU Member State for all MSFD criteria of the Descriptor 6, are in Annex IV.

The number of defined Art. 10 environmental targets was also very variable. Ireland defined four targets while the Netherlands reported 157 different targets connected with Descriptor 6. All Member States together defined 455 different targets.

Table 6: selection of GES determinations, as reported by NEA EU Member States in 2nd MSFD cycle, for criteria D6C3 and D6C5

	D6C3	D6C5
<i>Commission Decision (EU, 2017)</i>	<i>The spatial extent of each habitat type 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.</i>	<i>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</i>
BE	The spatial extent of each habitat type (km ² or% relative to the natural size of the habitat) that has been harmed by changes in the biotic and abiotic structure and its functions (e.g. due to changes in species composition and their relative density, non-habitat occurrence of particularly sensitive or vulnerable species or species having an essential function, the size composition of species), due to physical disturbances. Member States should set thresholds for the harmful effects of physical disruptions through regional or sub-regional cooperation.	The extent of the harmful effects of anthropogenic loads on the state of the habitat type, including modification of the biotic and abiotic structure and its functions (e.g. their characteristic species composition and their relative density, the non-occurrence of particularly sensitive or vulnerable species or species that have an essential function, the size composition of species), is no greater than a fixed proportion of the natural size of the habitat type in the area under assessment.
DK	In the assessment must consider whether the physical disturbance in question has a negative impact. This assessment must be made for the various physical disturbances that could potentially have a negative impact on the seabed. Whether a physical disturbance will cause a negative impact depends on the seabed's	Biodiversity has been maintained and the extent of adverse effects (D6C5) per habitat type does not exceed future EU thresholds for changes in biotic and abiotic structures and functions.

	D6C3	D6C5
	vulnerability and tolerance to the disturbance and how quickly the seabed ecosystem regenerates after the disturbance. For example, a sandy type is exposed to high current and wave influence is expected to be less vulnerable to certain disturbances than a type of habitat that is not normally affected by natural agitation of the water bodies. The extent of each adversely affected habitat type must be calculated in km ² or as a percentage (percent) of the total natural extent of the habitat in the assessment area. The results of the assessment of criterion D6C2 are used for the further assessment in criterion D6C3.	
ES	The extent of each benthic habitat type adversely affected by physical shocks keeps negative or stable trends in a way that ensures their preservation.	The extent of each habitat type in which benthic communities are kept within values to ensure their durability and performance is maintained or presented with increasing trends.
FR	Spatial extent of each habitat type adversely affected by changes in its biotic and abiotic structure and functions (e.g. change in species composition and relative abundance, absence of particularly sensitive or fragile species or species performing a key function, size structure of species) due to physical disturbance (Decision 2017/848/EU).	None
NL	No increase in time of the physical disturbance of the habitats described under the MSFD. Improvement in the quality of the assessed areas and habitats in the Dutch part of the North Sea (Benthic Indicator Species Index).	The diversity of benthos does not show a decreasing trend in the assessed areas (OSPAR- assessment value).
SE	Spatial extent of any habitat type adversely affected by physical disturbance, by alteration of its biotic and abiotic structure and functions (e.g. by changes in species composition and relative abundance of species, by absence of particularly sensitive or fragile species or species provides an important function, the size structure of the species). Physical disturbance of habitat types: Good environmental status: There is no method for quantitative assessment of this criterion.	Extent of adverse effects of human stress on the state of the habitat type, including alteration of its biotic and abiotic structure and functions (e.g. typical species composition and relative abundance of these species, absence of particularly sensitive or fragile species or species providing important function, the size structure of the species) does not exceed a certain proportion of the natural extent of the habitat type in the assessment area. Good environmental status:
IE	none	The environmental status under primary criterion 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 - is currently unknown within Ireland's maritime area.

3.1 Habitat types reported by NEA EU Member States in the 2nd MSFD cycle

Table 7 summarises the habitat types as reported by NEA EU Member States for the 2nd MSFD cycle.

Table 7: Habitat types as reported by the NEA EU Member States in the 2nd MSFD cycle: green - reported and assessed, orange - reported not assessed, pattern – not reported but existing in MS marine waters (from Boschetti et al 2022). *Since this analysis based on this version, an updated version from TG Seabed-9 (Jan 2022) is now (Oct. 2022) available at: <https://circabc.europa.eu/ui/group/326ae5ac-0419-4167-83ca-e3c210534a69/library/970714d8-3405-427d-8fc4-e8aa85b06b01/details>. Some of the “reported since at not existing in MS waters” were notably completed.*

MSFD broad habitat types	EU Regional sea	North-East Atlantic														
	sub-region	Greater North Sea						Celtic			B-I			Mac		
	country	SE*	DK	DE	NL	BE	FR	UK	UK	IE	FR	FR	ES	PT	PT	ES
Littoral rock and biogenic reef																
Littoral sediment																
Infralittoral rock and biogenic reef																
Infralittoral coarse sediment																
Infralittoral mixed sediment																
Infralittoral sand																
Infralittoral mud																
Circalittoral rock and biogenic reef																
Circalittoral coarse sediment																
Circalittoral mixed sediment																
Circalittoral sand																
Circalittoral mud																
Offshore circalittoral rock and biogenic reef																
Offshore circalittoral coarse sediment																
Offshore circalittoral mixed sediment																
Offshore circalittoral sand																
Offshore circalittoral mud																
Upper bathyal rock and biogenic reef																
Upper bathyal sediment																
Lower bathyal rock and biogenic reef																
Lower bathyal sediment																
Abyssal																

Other habitat types

Benthic habitats																
Benthic Broad Habitats																
Reefs																
Coastal Zone Sand (NL)																
Coastal/Muddy/Sandy habitats (WFD)																
Dogger Bank Sand (NL)																
Estuaries																
Frisian Front Sand (NL)																
Offshore Sand (NL)																
Oyster Banks Mud (NL)																
Mudflats and sandflats not covered by seawater at low tide																
Sandbanks which are covered by seawater all the time																
Sandbanks which are slightly covered by seawater all the time																
Sublittoral coarse sediment																
Sublittoral mud																
Submarine structures made by leaking gases																
Large shallow inlets and bays																
Species-rich gravel, coarse sand and shell-gravel areas																
Seapen and burrowing megafauna																
Sublittoral rocky and biogenic habitats																
Soft sediment habitats																
Intertidal habitats																

- reported and assessed
- reported but not assessed
- existing in MS waters (TG Seabed; Boschetti et al, 2021)
- IE reported to assess all benthic habitats types
- reported since as not existing in national waters (TG Seabed; Boschetti et al, 2021)

* as in Boschetti et al, 2021

Habitat types reported by countries for their assessment of GES in the 2nd MSFD cycle are compared here with the distribution of the MSFD broad habitat types, as published by Boschetti et al (2021) and taken from a TG Seabed working document, which provides a preliminary distribution of MSFD habitats, based on EUSeaMap and updated by TG Seabed members (reproduced here in Annex III). There are several discrepancies between this report and the elements reported for MSFD, probably partly due to different processes involving different experts. Some habitat types were reported for MSFD but were reported as not being present in their waters by Boschetti/TG Seabed: infralittoral coarse sediment for Sweden, Denmark, Belgium and Portugal, infralittoral rock and biogenic reef for Belgium, circalittoral and upper bathyal rocks and biogenic reefs for Denmark. Conversely, most countries indicated as present in national waters several habitat types (TG Seabed) but did not report them for MSFD. United-Kingdom and Spain only reported very broad and generic habitat types for the MSFD, while, Ireland and Portugal (Macaronesian sub-region) reported all broad habitat types. It is surprising that most countries didn't report littoral habitats for the MSFD (Sweden, Denmark, Netherlands, Belgium, France, United-Kingdom and Spain), or even mentioned it as existing (TG Seabed), even if not available through EUSeaMap. France and Portugal reported all other broad habitat types but didn't assess them. Some other habitat types were reported, notably by Denmark, Germany and the Netherlands, derived from other obligations (e.g. Habitats Directive) or their assessment units. Several broad habitat types were both reported and assessed, but by only 4 countries (Sweden, Germany, Belgium and Ireland).

3.2 Features reported by NEA EU Member States to assess pressure criteria D6C1 and D6C2 in the 2nd MSFD cycle

Table 8 presents features reported by NEA Member States about the pressure criteria D6C1 and D6C2. All (except Sweden and Portugal) reported the two pressures “physical loss” and “physical disturbance” respectively for D6C1 and D6C2. No assessment (MSFD article 8) is expected for these criteria from the EU Decision (EU, 2017), which may explain that only the United-Kingdom reported to assess it for both subregions. No specific habitat type was reported for these pressures, in line with EU (2017) which only refer to “Seabed” for these criteria.

Table 8: features reported (text, HTML) by NEA Member States about pressure criteria D6C1 and D6C2 in the 2nd MSFD cycle

EU Regional sea sub-region	North-East Atlantic														
	Greater North Sea							Celtic			B-I			Mac	
	SE	DK	DE	NL	BE	FR	UK	UK	IE	FR	FR	ES	PT	PT	ES
D6C1 - Broad habitat type															
D6C1 - Physical disturbance															
D6C1 - Physical loss															
D6C2 - Broad habitat type															
D6C2 - Physical disturbance															
D6C2 - Physical loss															

reported and assessed
 reported but not assessed

3.3 Links to Sea-floor Integrity in Descriptor 4 and Descriptor 5 as defined in reports of NEA EU Member States in the 2nd MSFD cycle

Links between Descriptor 6 and Descriptor 4 were detected in Descriptor and criteria determinations of seven countries (table 9). Only indirect links were found in the Belgian, Spanish, French, Dutch, Swedish, Portuguese and British reports. Belgium defined criteria of D4 with connections to the habitat condition and anthropogenic pressures, which linked with their criterion D6C5 (as in Table 6). In Spain, Descriptor 4 was presented as a general determination where “[...] the natural bottom-up and top-down control processes work efficiently by regulating the energy transfer of marine communities [...]” which indirectly considers also benthic habitats. The

Netherlands' D4C3 determination includes fish species but it is not clear if demersal fish are also considered. Sweden's Descriptor 4 criteria use parameters of trophic guilds without details about organisms which are considered. It is similar to the quite vague Portuguese determination of "D4 - Food webs / D1 - Biodiversity – ecosystems", where "all elements of the marine food chain, as far as they are known" are considered. The United-Kingdom has indirect connections with D6, as some of their targets for D4 are about the size composition of demersal fish.

Links to Descriptor 6 were also found in Descriptor 5 determinations of five countries (Table 9). Some connections are clear and direct, others more indirect. Belgium's criteria D5C5 (dissolved oxygen concentration), D5C6 (opportunistic macroalgae of benthic habitats) and D5C7 (macrophyte communities) assume no negative influence on benthic habitats and are in line with their determination of criterion D6C5. France's determinations of Descriptor 5 and its criteria are directly connected with the benthic habitat conditions (D6C5). The Netherlands mention "the lower water layer (stratified waters)" for the dissolved oxygen concentration criterion (D5C5), which may indirectly link to benthic habitats. Sweden explicitly mentions benthic habitats or communities in its determination of criteria D5C4 to D5C8. The United-Kingdom mention macroalgae and seagrass habitat as well as benthic animals' mortality.

Table 9: links with Descriptor 4 and Descriptor 5 reported by NEA EU Member States in the 2nd MSFD cycle

country	D4 Food Webs	D5 Eutrophication
BE	<p>INDIRECTLY</p> <p>D4C1 Trophic guild species diversity <u>All trophic guilds</u> The diversity (species composition and relative densities) in the trophic guilds (D4C1) and the balance of the total densities between the trophic guilds (D4C2) should not be negatively influenced by anthropogenic pressure.</p> <p>D4C2 Abundance across trophic guilds There will be cooperation in a regional framework to define the environmental targets and the threshold values. The aim will be to define (at least) three relevant trophic levels for which diversity, densities and the relationship between them will be determined.</p>	<p>DIRECTLY</p> <p>D5C5 Dissolved oxygen concentration Dissolved oxygen concentrations, as a result of nutrient enrichment, are not reduced to levels indicative of adverse effects on <u>benthic habitats</u> (and associated biota and mobile species) or other eutrophication effects. The threshold values are a) in coastal waters the values established in accordance with Directive 2000/60/EC; b) values outside coastal waters that are compatible with the values established in accordance with Directive 2000/60/EC.</p> <p>D5C6 Opportunistic macroalgae of benthic habitats The density of <u>opportunistic macroalgae</u> is not at a level that indicates harmful effects of nutrient fortification. The threshold values are: a) in coastal waters the values established in accordance with Directive 2000/60/EC; b) values outside coastal waters that are compatible with the values established in accordance with Directive 2000/60/EC.</p> <p>D5C7 Macrophyte communities of benthic habitats The species composition and relative density or depth distribution of <u>macrophyte communities</u> reach values that indicate that there are no adverse effects from nutrient enrichment, including those resulting from less transparent water.</p>
ES	<p>INDIRECTLY</p> <p>D4 – Food webs / D1 - Biodiversity - ecosystems The diversity, abundance and productivity of the <u>main trophic groups are maintained in such a way as to guarantee the perpetuity of the trophic chains</u>, and of the existing predator-prey relationships. The natural bottom-up and top-down control processes work efficiently by regulating the energy transfer of marine communities. The populations of the species selected as predators at the top of the trophic chain are maintained at values that guarantee their maintenance in the ecosystem and the existing predator-prey relationships. <u>Eutrophication, selective extraction, or other effects derived from human activities, occur at levels that do not endanger the maintenance of existing trophic relationships.</u></p>	
FR	no coherent assessment of Descriptor 4	<p>DIRECTLY</p> <p>D5 Eutrophication Human-induced eutrophication, particularly in terms of its adverse effects, such as biodiversity loss, ecosystem degradation, toxic algal blooms and <u>deoxygenation of bottom waters</u>, is reduced by minimum (directive 2008/56 / EC)</p> <p>D5C4 Photic limit</p>

country	D4 Food Webs	D5 Eutrophication
		<p>The photic limit of the water column is not reduced, by increasing the amount of algae in suspension, to a level indicating adverse effects (Decision 2017/848 / EU).</p> <p>D5C5 Dissolved oxygen concentration The dissolved oxygen concentration is not reduced to levels indicating <u>adverse effects on benthic habitats</u> (Decision 2017/848 / EU).</p> <p>D5C6 Opportunistic macroalgae of benthic habitats The abundance of opportunistic macroscopic algae is not at a level indicating adverse effects (Decision 2017/848 / EU).</p> <p>D5C7 Macrophyte communities of benthic habitats Species composition and relative abundance or depth distribution <u>of macrophyte communities reach values indicating no adverse effects</u> (Decision 2017/848 / EU).</p>
NL	<p>INDIRECTLY</p> <p>D4C3 Trophic guild size distribution The size structure (length) of the fish community remains above the historical minimum value</p>	<p>INDIRECTLY</p> <p>D5C5 Dissolved oxygen concentration Coastal waters: The <u>lower water layer</u> (stratified waters) or in the surface layer of mixed waters in the coastal waters is saturated with at least 60% oxygen. Offshore waters: In offshore waters, at least 6 mg/l oxygen is found in the lower water layer (stratified waters) or in the surface layer of mixed waters.</p>
SE	<p>INDIRECTLY no method for quantitative assessment per criterion</p> <p>D4C1 Trophic guild species diversity The diversity of the trophic group (species composition and relative abundance of species) is not adversely affected due to human stress</p> <p>D4C2 Abundance across trophic guilds The balance in total abundance between the trophic groups is not negatively affected due to human stress.</p> <p>D4C3 Trophic guild size distribution The size distribution of individuals within the trophic group is not negatively affected due to human strains.</p> <p>D4C4 Trophic guild productivity Productivity in the trophic group is not adversely affected due to human stresses</p>	<p>DIRECTLY</p> <p>D5C4 Photic limit Due to nutrient enrichment, the visibility depth of the water has not been reduced to levels that indicate <u>negative effects on benthic habitats</u> or other eutrophication effects</p> <p>D5C5 Dissolved oxygen concentration The content of dissolved oxygen has not, due to nutrient enrichment, been reduced to levels indicative of <u>adverse effects on benthic habitats</u> or other eutrophication effects. Good environmental status</p> <p>D5C7 Macrophyte communities of benthic habitats The species composition and relative abundance <u>of macrophyte communities</u> achieve values that indicate there is no adverse effect due to nutrient enrichment or organic enrichment.</p> <p>D5C8 Macrofaunal communities of benthic habitats The <u>species composition of the macrofauna communities</u> and relative abundance achieve values that indicate that there is no negative effect due to nutrient enrichment or organic enrichment</p>
PT	<p>INDIRECTLY</p> <p>D4 Food webs / D1 - Biodiversity – ecosystems All elements of the marine food chain, as far as they are known, occur at normal abundance and diversity and at levels likely to guarantee the long-term abundance of species and the maintenance of their full reproductive capacity</p>	
UK	<p>INDIRECTLY D4 defined targets connected with size composition of demersal fish</p>	<p>DIRECTLY D5 defined targets connected with macroalgae and seagrass habitat as well as benthic animals' mortality</p>

3.4 Descriptor 6 elements linked with Regional Sea Conventions, as reported by NEA EU Member States in the 2nd MSFD cycle

Table 10 illustrates reported Descriptor 6 GES elements which are explicitly linked to the [OSPAR Convention](#). (i.e. the use of OSPAR products by EU Member States for their MSFD reports). Belgium, Germany, Denmark and the Netherlands reported OSPAR indicators for GES elements, while Sweden and the Netherlands mentioned the OSPAR Convention assessments as a source for the reported habitat types.

Belgium reported the use of two OSPAR benthic habitat indicators: BH2 and BH3 (See annexe II for characteristics and details). BH2 is used to assess the condition of three Infralittoral habitats under criterion D6C5, while BH3 was mentioned, without details, as a tool to assess criterion D6C2. Germany reported the use of two OSPAR indicators: BH3 to assess physical disturbances for criteria D6C2 (without details) and D6C3 (for several broad habitat types). The OSPAR indicator BH2b is reported by Germany to assess criterion D6C5 for three habitat types. To assess coastal/muddy/sandy habitats under WFD and MSFD criterion D6C5, Denmark

used a parameter of habitat condition (HAB-CON) associated with an indicator reported as “ANS-OSPAR-BUND” [author's note: this indicator should be, by its definition, OSPAR BH2a]. To assess D6C5, the Netherlands reported assessment areas (rather than habitat types) sourced as OSPAR, and a parameter “HAB-CON” associated with an indicator reported as “ANSNL-OSPAR-D6C5” [author's note: this indicator should be OSPAR BH2b]. Sweden declared that broad habitat types reported under D6 and D1 were in line with OSPAR. The United-Kingdom, in their [Marine online assessment tool](#) (MOAT), mention using two OSPAR indicators: BH3 (Extent of Physical Damage to Predominant seafloor habitats), both for rocky and biogenic habitats and soft sediment habitats, and BH2a (Condition of benthic habitat communities for Assessment of coastal habitats in relation to nutrient and organic enrichment) for soft sediment habitats.

Table 10: D6 links with OSPAR Convention, as reported by NEA Member States in the 2nd MSFD cycle

	Criterion	Habitat type element	Element source	Parameter	Related indicator
BE	D6C5 Benthic habitat condition	Infralittoral coarse sediment, Infralittoral mud, Infralittoral sand	EU	HAB-CON	OSPAR-COND_BENT_HAB (BH2)
BE	D6C2 Physical disturbance to the seabed	none	none	EXT	OSPAR-PHYS_DAM (BH3)
DE	D6C2 Physical disturbance to the seabed	none	none	EXT	OSPAR-PHYS_DAM (BH3)
DE	D6C3 Adverse effects from physical disturbance	Circalittoral mud Circalittoral sand Infralittoral sand Offshore circalittoral coarse sediment Offshore circalittoral mud Offshore circalittoral sand	EU	OTH	OSPAR-PHYS_DAM (BH3)
DE	D6C5 Benthic habitat condition	Circalittoral sand Infralittoral sand Littoral sediment	EU	HAB-CON	OSPAR-COND_BENT_HAB (BH2)
DK	D6C5 Benthic habitat condition	Costal/Muddy/Sandy habitats (WFD)	EU	HAB-CON	ANS-OSPAR-BUND
NL	D6C5 Benthic habitat condition	Coastal Zone Sand (NL), Dogger Bank Sand (NL), Frisian Front Sand (NL), Offshore Sand (NL) Oyster Banks Mud (NL)	OSPAR	HAB-CON	ANSNL-OSPAR-D6C5
SE	D6 Sea-floor integrity/D1 Benthic habitats	Circalittoral coarse sediment, Circalittoral mixed sediment, Infralittoral coarse sediment, Infralittoral mixed sediment, Offshore circalittoral coarse sediment, Offshore circalittoral mixed sediment, Upper bathyal sediment	OSPAR	Not assessed	National ANSSE-6.3A_Fysisk_störning_bent_livsmiljö
UK	D6 Sea-floor integrity/D1 Benthic habitats	soft sediment habitats	OTH		OSPAR-PHYS_DAM_HAB
UK	D6 Sea-floor integrity/D1 Benthic habitats	soft sediment habitats	OTH		OSPAR-COND_BENT

	Criterion	Habitat type element	Element source	Parameter	Related indicator
UK	D6 Sea-floor integrity/D1 Benthic habitats	rocky and biogenic habitats.	OTH		OSPAR-PHYS_DAM_HAB

4 Comparison of D6 GES reported by EU Member States of the Mediterranean Sea for the 2nd MSFD cycle.

A comparison of GES criteria coverage as reported for the 2nd cycle is shown in table 11.

Cyprus and Slovenia reported again their GES determinations of the 1st MSFD cycle, at Descriptor level, but indicating for Cyprus that it covers also both new criteria D6C1, D6C2 and D6C3. Croatia, France and Spain reported new GES determinations for several criteria, while Greece, Italy and Malta modified previous GES determinations to address several criteria. Only four countries report covering the “state” criteria D6C4 and D6C5 (Croatia, Greece, Malta and Spain). D6C3 is the most frequently reported criterion in the Mediterranean Sea, by 7 of the 9 Member States.

Table 11: evolution of GES elements, as reported by Mediterranean EU Member States in 2nd MSFD cycle (WISE + national reports)

GES 2 nd MSFD cycle		D1 Benthic habitats D6 Sea-floor integrity	D6C1	D6C2	D6C3	D6C4	D6C5
Cyprus	CY						
Croatia	HR						
France	FR						
Greece	EL						
Italy	IT						
Malta	MT						
Slovenia	SI						
Spain	ES						
United-Kingdom	UK						

	No changes between 1 st and 2 nd MSFD cycles
	GES element modified between 1 st and 2 nd MSFD cycle
	new GES element at 2 nd MSFD cycle
	GES not defined at any of the 2 MSFD cycles

However, as in the North-East Atlantic Ocean region, the GES determination is still very often descriptive or not detailed and differs markedly between countries. Seven countries developed seven different determinations of the criterion D6C3 (table 12). Three determinations (Croatia, France, Spain) consider the spatial extent of the affected habitat type, in line with the new EU Decision (EU, 2017). Greece included criteria and indicators developed under the previous Commission Decision (EU, 2010) related to benthic habitats and Descriptor D1. The Maltese GES determination was connected to the structure and functions of MSFD predominant habitat types.

In the Mediterranean Sea region, 139 different targets were defined. Cyprus defined only one general target while Spain defined 76 (combined targets for NEA and Mediterranean regions).

All the detailed GES determinations, as reported by the EU Member State for all MSFD criteria of the Descriptor 6, are given in Annex IV.

Table 12: selection of GES determinations, as reported by Mediterranean EU Member States in 2nd MSFD cycle, for criterion D6C3

	D6C3
<i>MSFD guidance (EU, 2017)</i>	<i>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.</i>
CY	Disturbance of species (e.g. where they breed, rest and feed) due to human presence Assuming that the above indicators contribute equally to criterion D6C3, an average value of 0.8 can be ascribed to the criterion itself.
HR	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.
FR	Spatial extent of each habitat types adversely affected by changes in its biotic and abiotic structure and functions (e.g. change in species composition and relative abundance, absence of particularly sensitive or fragile species or species performing a key function, size structure of species) due to physical disturbance (Decision 2017/848/EU).
EL	Criterion D6C3 concerns the assessment of the area of the seabed that does not achieve CFP [Common Fisheries Policy]. This criterion uses indicators and methodologies developed under the Directives. The calculation in all criteria is spatial and therefore requires some kind of spatial integration, also using large-scale modelled maps for reporting to level 2 of the EUNIS habitat classification. The criteria and indicators under the previous Commission Decision (2010/477/EU) related to benthic habitats and Descriptor D1.
IT	There is no significant pressure due to: a) physical perturbations caused by anthropogenic activities that operate actively on the seabed and b) physical loss on biogenic substrates connected to anthropic activities.
MT	The structure and functions of benthic habitats listed in Directive 92/43/EEC, in terms of species composition and relative abundance (as relevant), are in high/good status on the basis of biotic indices used under Directive 2000/60/EC for more than 75% of the area covered by the habitat.
	The structure and functions of MSFD predominant habitat types do not deviate from normal conditions and are in high/good status on the basis of biotic indices used under Directive 2000/60/EC, were established.
ES	The extent of each type of benthic habitat adversely affected by physical disturbances maintains negative or stable trends in such a way as to ensure its conservation.

4.1 Habitat types reported by Mediterranean EU Member States in the 2nd MSFD cycle






As for the North-East Atlantic, table 13 shows a strong heterogeneity between countries and many discrepancies between habitat types reported for MSFD by Mediterranean EU Member States, and their distribution (TG Seabed). Some habitat types are reported for MSFD but were also not reported as present in their waters, notably 6 habitat types for Malta, infralittoral rock & biogenic reef for the United-Kingdom, and offshore circalittoral coarse and mixed sediments for Croatia. Conversely, most countries indicated as present in national waters several habitat types (TG Seabed), which were not reported for MSFD. Spain only reported very broad and generic habitat types for MSFD; while Malta and Croatia reported almost all of their present broad habitat types. Even if less than in the North-East Atlantic, it is still surprising that most Mediterranean countries didn't report littoral habitats for MSFD (Spain, United-Kingdom, France, Italy, Greece, Cyprus), or even mentioned it as existing via Boschetti/TG Seabed. Several broad habitat types were both reported and assessed, by only 4 countries (Greece, Croatia, Malta and the United-Kingdom). Only Greece both reported and assessed all its broad habitat types (except infralittoral rock and biogenic reef in the Adriatic sub-region).

Table 13: Habitat types as reported by the Mediterranean EU Member States in the 2nd MSFD cycle (green - reported and assessed, orange - reported not assessed, pattern – not reported but existing in MS marine waters, from Boschetti et al 2022). *Since this analysis based on this version, an updated version from TG Seabed-9 (Jan 2022) is now (Oct. 2022) available at: <https://circabc.europa.eu/ui/group/326ae5ac-0419-4167-83ca-e3c210534a69/library/970714d8-3405-427d-8fc4-e8aa85b06b01/details>. Some of the “reported since at not existing in MS waters” were notably completed.*

MSFD broad habitat types	EU Regional sea	Mediterranean sea												
	sub-region	Western				Central			Adriatic				A-L	
	country	ES	UK	FR	IT	IT	MT	EL	IT	SI	HR	EL	EL	CY
Littoral rock and biogenic reef														
Littoral sediment														
Infralittoral rock and biogenic reef														
Infralittoral coarse sediment														
Infralittoral mixed sediment														
Infralittoral sand														
Infralittoral mud														
Circalittoral rock and biogenic reef														
Circalittoral coarse sediment														
Circalittoral mixed sediment														
Circalittoral sand														
Circalittoral mud														
Offshore circalittoral rock and biogenic reef														
Offshore circalittoral coarse sediment														
Offshore circalittoral mixed sediment														
Offshore circalittoral sand														
Offshore circalittoral mud														
Upper bathyal rock and biogenic reef														
Upper bathyal sediment														
Lower bathyal rock and biogenic reef														
Lower bathyal sediment														
Abyssal														

Other habitat types

Benthic Broad Habitats													
Coralligenous habitat													
Maerl beds													
Posidonia beds													
Soft bottom non biogenic habitat													
Pontic [Phyllophora nervosa] on vertical rock faces in the lower infralittoral													
[Cystoseira] spp. in eulittoral rockpools													
White corals													

-  reported and assessed
-  reported but not assessed
-  existing in MS waters (TG Seabed; Boschetti et al, 2021)
-  IE reported to assess all benthic habitats types
-  reported since as not existing in national waters (TG Seabed; Boschetti et al, 2021)

* as in Boschetti et al, 2021

4.2 Features reported by Mediterranean EU Member States to assess pressure criteria D6C1 and D6C2 in the 2nd MSFD cycle

Table 14 presents features reported by Mediterranean EU Member States about pressure criteria D6C1 and D6C2. Almost all countries (except the United-Kingdom, Croatia and Cyprus) reported the two pressures “physical loss” and “physical disturbance” respectively for D6C1 and D6C2. Only Italy reported also the feature “broad habitat type” for D6C1, but not for D6C2. Cyprus only reported (but also as assessed) physical loss for D6C1. The physical disturbance pressure for D6C2 was assessed by Greece and other national areas from the Ionian Sea & Central Mediterranean sub-region (Malta and Italy).

Table 14: features reported (text, HTML) by Mediterranean EU Member States about pressure criteria D6C1 and D6C2 (2nd MSFD cycle)

EU Regional sea sub-region country	Mediterranean sea												
	Western				Central			Adriatic				A-L	
	ES	UK	FR	IT	IT	MT	EL	IT	SI	HR	EL	EL	CY
D6C1 - Broad habitat type				■	■			■					
D6C1 - Physical disturbance													
D6C1 - Physical loss	■		■	■	■	■	■	■	■		■	■	■
D6C2 - Broad habitat type													
D6C2 - Physical disturbance	■		■	■	■	■	■	■	■		■	■	
D6C2 - Physical loss													

reported and assessed
 reported but not assessed

4.3 Links to Sea-floor Integrity in Descriptor 4 and Descriptor 5 as defined in reports of Mediterranean EU Member States in the 2nd MSFD cycle

Table 15 summarises the connections between Descriptor 4 and Descriptor 6 found in the reported GES determinations of Mediterranean EU Member States. Only indirect links were found in the Italian, Spanish, Maltese and Slovenian reports. The Italian GES determination of criterion D4C2 includes demersal mesopredators as one of the groups to be assessed against anthropogenic pressures. The Spanish general determination of Descriptor 4 considers food webs’ bottom-up and top-down connections, while Malta focuses on trophic guild species diversity. Slovenia provides a general determination of Descriptor 4 with links to the “production at different levels of guild feeding”. All these GES determinations include potential links to benthic habitat conditions, but no more detailed descriptions were available.

Five Mediterranean countries’ GES determinations for Descriptor 5 contain direct and/or indirect links to benthic habitats (table 15). Four countries (Italy, France, Croatia and Malta) directly include effects on benthic habitats in the determination of criterion D5C5. Criteria D5C6 and D5C7, which are connected with benthic macrophytes, were used by France and Malta to assess eutrophication under D5. Malta reported also Criterion D5C8 on benthic macrofaunal communities. Slovenia only mentioned “detrimental effects caused by eutrophication (e.g., biodiversity loss, ecosystem degradation, harmful algal blooms and lack of oxygen in the lower layers)” which could indirectly imply benthic habitats.

Table 15: links with Descriptor 4 and Descriptor 5 reported by Mediterranean EU Member States in the 2nd MSFD cycle

country	D4 Food Webs	D5 Eutrophication
IT	INDIRECTLY D4C2 Abundance across trophic guilds The balance of biomass (or its proxy) between selected trophic guilds representative of at least primary producers (e.g. phytoplankton), demersal mesopredators (fish species) and top predators do	DIRECTLY D5C5 Dissolved oxygen concentration The onset of hypoxic and anoxic phenomena in the bottom waters, induced by anthropic eutrophication, are such as not to have negative, significant and lasting effects on benthic ecosystems

country	D4 Food Webs	D5 Eutrophication
	not suffer significantly adverse effects due to anthropogenic pressures.	
ES	<p>INDIRECTLY D4 – Food webs / D1 - Biodiversity - ecosystems The diversity, abundance and productivity of the main trophic groups are maintained in such a way as to guarantee the perpetuity of the trophic chains, and of the existing predator-prey relationships. <u>The natural bottom-up and top-down control processes work efficiently by regulating the energy transfer of marine communities.</u> The populations of the species selected as predators at the top of the trophic chain are maintained at values that guarantee their maintenance in the ecosystem and the existing predator-prey relationships. Eutrophication, selective extraction, or other effects derived from human activities, occur at levels that do not endanger the maintenance of existing trophic relationships.</p>	none
FR	none	<p>DIRECTLY D5 Human-induced eutrophication, particularly in terms of its <u>adverse effects, such as biodiversity loss, ecosystem degradation</u>, toxic algal blooms and deoxygenation of bottom waters, is reduced by minimum (directive 2008/56 / EC). D5C5 The dissolved oxygen concentration is not reduced to levels indicating adverse effects on <u>benthic habitats</u> (Decision 2017/848 / EU). D5C6 The abundance of opportunistic macroscopic algae is not at a level indicating adverse effects (Decision 2017/848 / EU). D5C7 Species composition and relative abundance or depth distribution of macrophyte communities reach values indicating no adverse effects (Decision 2017/848 / EU).</p>
HR		<p>INDIRECTLY D5C1 Nutrient concentrations In most parts of the ecosystem the <u>biological community</u> remains balanced and retains all the functions in the absence of undesirable disturbances caused by eutrophication. DIRECTLY D5C5 Dissolved oxygen concentration values below the limit of hypoxia are not recorded.</p>
MT	<p>INDIRECTLY D4C1 Trophic guild species diversity Composition and abundance of <u>representative trophic guilds</u> are indicative of natural biotic and abiotic conditions of marine ecosystems.</p>	<p>DIRECTLY D5C5 Dissolved oxygen concentration Levels of dissolved oxygen in the <u>bottom of the water column</u> are in line with prevailing physiographic, geographic and climate conditions. D5C6 Opportunistic macroalgae of benthic habitats The composition and relative abundance of <u>macrophyte communities and macroalgae</u> are indicative of high/good status on the basis of biotic indices used under Directive 2000/60/EC for more than 75% of the area covered by the habitat. D5C7 Macrophyte communities of benthic habitats The composition and relative abundance of <u>macrophyte communities and macroalgae</u> are indicative of high/good status on the basis of biotic indices used under Directive 2000/60/EC for more than 75% of the area covered by the habitat. D5C8 Macrofaunal communities of benthic habitats The species composition and relative abundance of <u>macrofaunal communities</u> is indicative of high/good status on the basis of biotic indices used under Directive 2000/60/EC.</p>
SI	<p>INDIRECTLY D4 – Food webs / D1 - Biodiversity – ecosystems A good state of the marine environment with respect to the quality Descriptor of <u>food web elements</u> (D4) is achieved when an appropriate ratio between production at different levels of guild feeding is achieved in the selected ecosystem.</p>	<p>INDIRECTLY D5 Eutrophication A good state of the marine environment in relation to man-made eutrophication and its negative effects is achieved when the detrimental effects caused by eutrophication (e.g. biodiversity loss, ecosystem degradation, harmful algal blooms <u>and lack of oxygen in the lower layers</u>), minimal. Good status of the marine environment for man-made eutrophication (D5) is achieved when values relevant to the assessment</p>

country	D4 Food Webs	D5 Eutrophication
		of the status set out in the transition chapters for the relevant elements and parameters are reached.

4.4 Descriptor 6 elements linked with Regional Sea Conventions, as reported by Mediterranean EU Member States in the 2nd MSFD cycle

There was **no explicit mention of any Regional Sea Convention**, notably the [Barcelona Convention](#), in any Descriptor 6 GES element of the Mediterranean EU Member States. It might be due to the lack in this convention of GES, targets and indicators for its Ecological Objectives number 6 (sea-floor integrity), which was not agreed in 2013 under IMAP (when all other Ecological Objectives, except EO4 (Food webs) and EO6, were agreed).

5 Comparison of D6 GES reported by EU Member States of the Baltic Sea for the 2nd MSFD cycle

As in the North-east Atlantic and Mediterranean Sea regions, some Baltic Sea countries reported again their 1st MSFD cycle, under the 2017 Commission Decision's framework: Germany still reported at Descriptor level, Finland addressing criterion D6C3 and Lithuania for criterion D6C5, completed by a modified determination for D6C3 (table 16). Sweden modified its previous GES determination for Descriptor 6 to address criteria D6C3 and D6C5, and Poland did so to address Descriptor 6 level and all other criteria, except D6C4. Denmark and Estonia reported new GES determinations, both countries addressing criteria D6C3, D6C4 and D6C5. Moreover, Denmark covered also D1/D6 level, which is the only level covered by Latvia with its new GES determination. As in the North-east Atlantic and Mediterranean regions, D6C3 is the most frequently reported criterion, by 6 of the 8 Member States.

Table 16: evolution of GES elements, as reported by Baltic EU Member States in 2nd MSFD cycle (WISE + national reports)

GES		D1 Benthic habitats D6 Sea-floor integrity	D6C1	D6C2	D6C3	D6C4	D6C5
Denmark	DK						
Estonia	EE						
Finland	FI						
Germany	DE						
Latvia	LV						
Lithuania	LT						
Poland	PL						
Sweden	SE						

	No changes between 1 st and 2 nd MSFD cycles
	GES element modified between 1 st and 2 nd MSFD cycle
	new GES element at 2 nd MSFD cycle
	GES not defined at any of the 2 MSFD cycles

As in other regions, the GES determination is still very often descriptive or not detailed and differs markedly between countries. Some countries state, without providing details, that their MSFD D6 GES determinations are in line with other policies (notably HELCOM, OSPAR, the Habitats Directive or the Water Framework Directive). For D6C3, Estonia defined its GES very quantitatively, by the spatial extent of physical disturbance applied to some habitat types of the Habitat Directive, with a threshold set at 10% maximum of the total habitat type area (table 17). Lithuania refers to a very pressure-specific indicator, but without thresholds nor reference to any habitat type. On the other hand, all other countries have very qualitative determinations of this criterion:

Denmark refers to “potential negative impacts”, itself linked to habitat intrinsic recovery characteristics, without more details; Finland focuses on “proportioning” human activities that cause “loss or disturbances of the seabed”, and describes vague assessment units and baseline conditions; Poland defines it as “a sum of the results of indicator relevant for criteria D6C1 and D6C2”, without more details; and Sweden concludes its qualitative determination with a statement that “there is no method for quantitative assessment of this criterion”. In the Baltic Sea region, 105 different targets were defined. Denmark reported 37 targets, while Estonia defined 3 targets connected with the Descriptor 6. All the detailed GES determinations, as reported by the EU Member State for all MSFD criteria of the Descriptor 6, are in Annex IV.

Table 17: selection of GES determinations, as reported by Baltic EU Member States in 2nd MSFD cycle, for criterion D6C3

	D6C3
<i>MSFD guidance (EU, 2017)</i>	<i>The spatial extent of each habitat type 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.</i>
EE	GES under the criteria D6C3 is determined via the spatial area of physical disturbance to the habitat type sandbanks (code 1110), estuaries (code 1130), mudflats and sandflats (code 1140), large shallow inlets and bays (code 1160), reefs (code 1170). GES is achieved if the extent of the physically disturbed habitat is ≤ 10% of the total area of the habitat type.
DK	The assessment must consider whether the physical disturbance in question has a negative impact. This assessment must be made for the various physical disturbances that could potentially have a negative impact on the seabed. Whether a physical disturbance will cause a negative impact depends on the seabed's vulnerability and tolerance to the disturbance and how quickly the seabed ecosystem regenerates after the disturbance. For example, a sandy type is exposed to high current and wave influence is expected to be less vulnerable to certain disturbances than a type of habitat that is not normally affected by natural agitation of the water bodies. The extent of each adversely affected habitat type must be calculated in km ² or as a percentage (percent) of the total natural extent of the habitat in the assessment area. The results of the assessment of criterion D6C2 are used for the further assessment in criterion D6C3.
FI	Human activities that cause the loss or disturbance of the seabed do not endanger the occurrence or quality of the habitat and the extent of the disturbance must be proportionate to the ecological significance and endangerment of the habitat. The state of seabed integrity is assessed for broad habitat types by sea area, with each extensive habitat being assessed according to the weakest state of the indicators describing them.
LT	Extent of adverse effects of physical disturbance on each habitat type in each assessed area. The condition is assessed according to the indicator "Area of soil dumping (sanding) and sand excavation in the habitat".
PL	GES is determined as a sum of the results of indicator relevant for criteria D6C1 and D6C2.
SE	Spatial extent of any habitat type adversely affected by physical disturbance, by alteration of its biotic and abiotic structure and functions (e.g. by changes in species composition and relative abundance of species, by absence of particularly sensitive or fragile species or species provides an important function, the size structure of the species). Physical disturbance of habitat types: Good environmental status: There is no method for quantitative assessment of this criterion.

5.1 Habitat types reported by Baltic EU Member States in the 2nd MSFD cycle






Table 18 summarises the habitat types as reported by Baltic EU member states for the 2nd MSFD cycle.

Table 18: Habitat types as reported by the Baltic EU Member States in the 2nd MSFD cycle (green - reported and assessed, orange - reported not assessed, pattern – not reported but existing in MS marine waters, from Boschetti et al 2022). *Since this analysis based on this version, an updated version from TG Seabed-9 (Jan 2022) is now (Oct. 2022) available at: <https://circabc.europa.eu/ui/group/326ae5ac-0419-4167-83ca-e3c210534a69/library/970714d8-3405-427d-8fc4-e8aa85b06b01/details>. Some of the “reported since at not existing in MS waters” were notably completed.*

EU Regional sea sub-region	Baltic sea								
	country	FI	EE	LV	LT	PL	DE	DK	SE*
Littoral rock and biogenic reef									
Littoral sediment									
Infralittoral rock and biogenic reef									
Infralittoral coarse sediment									
Infralittoral mixed sediment									
Infralittoral sand									
Infralittoral mud									
Circalittoral rock and biogenic reef									
Circalittoral coarse sediment									
Circalittoral mixed sediment									
Circalittoral sand									
Circalittoral mud									
Offshore circalittoral rock and biogenic reef									
Offshore circalittoral coarse sediment									
Offshore circalittoral mixed sediment									
Offshore circalittoral sand									
Offshore circalittoral mud									
Upper bathyal rock and biogenic reef									
Upper bathyal sediment									
Lower bathyal rock and biogenic reef									
Lower bathyal sediment									
Abyssal									

Other habitat types

Reefs									
Coastal/Muddy/Sandy habitats (WFD)									
Estuaries									
Mudflats and sandflats not covered by seawater at low tide									
Sandbanks which are covered by seawater all the time									
Sandbanks which are slightly covered by seawater all the time									
Sublittoral coarse sediment									
Large shallow inlets and bays									
Species-rich gravel, coarse sand and shell-gravel areas									
Baltic muddy bottoms of the aphotic zone									
[Zostera] beds in infralittoral sediments									
Submerged or partially submerged sea caves									

	reported and assessed
	reported but not assessed
	existing in MS waters (TG Seabed; Boschetti et al, 2021)
	IE reported to assess all benthic habitats types
	reported since as not existing in national waters (TG Seabed; Boschetti et al, 2021)

* as in Boschetti et al, 2021

Similar to the North-East Atlantic and Mediterranean Sea region, table 18 shows a high heterogeneity between countries and many discrepancies between habitat types reported for MSFD by Baltic EU Member States and their distribution (TG Seabed). Again, it is surprising that most of the Baltic countries didn't report littoral habitats for MSFD, except Poland (who also assessed them). Finland, Lithuania, Denmark and Sweden reported some habitat types for D6 GES which were not noted in the national distributions (by TG Seabed). Conversely, all (Estonia) or several (Latvia, Poland, Sweden) broad habitat types reported as present in their marine waters (TG Seabed) but were not reported for MSFD. Estonia reported and assessed several other habitat types, notably from the Habitats Directive. Germany and Denmark reported also other habitat types from Habitats Directive, Water Framework Directive and specific conservation lists. Sweden only assessed offshore circalittoral coarse and mixed sediment, while Finland and Latvia assessed several along the coast-offshore bathymetric gradient. Only Lithuania and Poland assessed all their reported broad habitat types.

5.2 Features reported by Baltic EU Member States to assess pressure criteria D6C1 and D6C2 in the 2nd MSFD cycle

Table 19 presents features reported by Baltic Sea EU Member States about criteria D6C1 and D6C2. As in the North-east Atlantic and the Mediterranean Sea regions, the most frequently reported pressures were “physical loss” and “physical disturbance”, respectively for D6C1 and D6C2, by only 4 countries from the 8 (Estonia, Poland, Germany and Denmark), but all were reported as assessed for MSFD article 8. Poland reported and assessed also “physical disturbance” for criterion D6C1, and “physical loss” for criterion D6C2. Latvia only reported broad habitat types, assessed for criterion D6C1, and not for criterion D6C2. Finland, Lithuania and Sweden did not report any features for these criteria.

Table 19: features reported (text, HTML) by Baltic EU Member States about pressure criteria D6C1 and D6C2 (2nd MSFD cycle)

EU Regional sea sub-region	Baltic sea								
	country	FI	EE	LV	LT	PL	DE	DK	SE
D6C1 - Broad habitat type									
D6C1 - Physical disturbance									
D6C1 - Physical loss									
D6C2 - Broad habitat type									
D6C2 - Physical disturbance									
D6C2 - Physical loss									

	reported and assessed
	reported but not assessed

5.3 Links to Sea-floor Integrity in Descriptor 4 and Descriptor 5 as defined in reports of Baltic EU Member States in the 2nd MSFD cycle

Table 20 summarises the connections identified between Descriptor 4, Descriptor 5 and Descriptor 6. For Descriptor 4, only Finland reported direct links with benthic habitats (through trophic guilds and benthic features), and Poland indirect links (through trophic guilds not detailed).

Five Baltic Sea Member State's GES determinations for Descriptor 5 contain direct links to benthic habitats and communities (table 20): Estonia, Latvia, Lithuania, Poland and Sweden. All D5 criteria, even the abiotic ones, were directly related to benthic habitats by Poland and Sweden, referring also to water quality and notably the Water Framework Directive. Finland mentions indirect links through the photic limit and dissolved oxygen concentration.

Table 20: links with Descriptor 4 and Descriptor 5 reported by Baltic EU Member States in the 2nd MSFD cycle

Country	D4 Food Webs	D5 Eutrophication
EE	none	<p>DIRECTLY</p> <p>D5C6 Opportunistic macroalgae of benthic habitats indicator 'proportion of opportunistic species'.</p> <p>D5C7 Macrophyte communities of benthic habitats determined via three indicators: 'Depth distribution of <u>phytobenthos</u>', 'depth distribution of <i>Fucus vesiculosus</i>' and 'proportion of perennial species in <u>benthic vegetation</u>'</p> <p>D5C8 Macrofaunal communities of benthic habitats <u>zoobenthos</u> community index</p>
FI	<p>DIRECTLY</p> <p>D4C1 Trophic guild species diversity Features: Filter feeders, Deposit feeders The value of the BQI index of the high seas <u>benthic communities</u> above the halocline (<60 m depth) is 0.93 in the Gulf of Finland, 4.0 in the North Baltic Sea, 4.0 in the Åland Sea, 4.0 in the Bothnian Sea, 1.5 in the Kvarken and 1.5 in the Bay of Bothnia. The state of food webs is assessed descriptively for the Finnish sea area using data from all indicators The value of the Open Sea Regional Species Abundance Index exceeds 3.91 in the Gulf of Finland, 3.0 in the North Baltic Sea, 2.3 in the Bothnian Sea and 1.37 in the Bay of Bothnia. The state of food webs is assessed descriptively for the Finnish sea area using data from all indicators.</p> <p>D4C2 Abundance across trophic guilds Features: Benthic-feeding birds For more than 75% of wintering seabird species, the population size does not fall > 30% from the 1991-2000 average. Abundance is determined for each sea area separately. The state of food webs is assessed descriptively for the Finnish sea area using data from all indicators. Feature: Sub-apex demersal predators Cod: MSY Btrigger level recommended by ICES (not determined in 2018). The state of food webs is assessed descriptively for the Finnish sea area using data from all indicators The combined abundance of pike, perch and pikeperch increases in the Gulf of Finland, the Archipelago Sea, the Gulf of Bothnia and the Kvarken. The state of food webs is assessed descriptively for the Finnish sea area using data from all indicators.</p> <p>D4C3 Trophic guild size distribution Features benthic habitats In the outer Kvarken archipelago 0.56 / 0.59 (0-10 m /> 10 m), in the inland coastal waters of the Gulf of Bothnia 0.57 / 0.55 (0-10 m /> 10 m) and in the outer coastal waters of the Gulf of Bothnia 0.56 / 0, 55 (0-10 m /> 10 m). The state of food webs is assessed descriptively for the Finnish sea area using data from all indicators. The value of the BQI index of the high seas <u>benthic communities</u> above the halocline (<60 m depth) is 0.93 in the Gulf of Finland, 4.0 in the North Baltic Sea, 4.0 in the Åland Sea, 4.0 in the Bothnian Sea, 1.5 in the Kvarken and 1.5 in the Bay of Bothnia. The state of food webs is assessed descriptively for the Finnish sea area using data from all indicators. The value of the Open Sea Regional Species Abundance Index exceeds 3.91 in the Gulf of Finland, 3.0 in the North Baltic Sea, 2.3 in the Bothnian Sea and 1.37 in the Bay of Bothnia. The state of food webs is assessed descriptively for the Finnish sea area using data from all indicators.</p>	<p>INDIRECTLY</p> <p>Eutrophication status is determined using HELCOM's HEAT tool</p> <p>D5C4 Photic limit The <u>depths of visibility</u> set in HELCOM are exceeded: 5.5 m in the Gulf of Finland, 7.1 m in the North Baltic Sea, 6.9 m in the Åland Sea, 6.8 m in the Bothnian Sea, 6.0 m in the Kvarken and 5.8 m in the Bay of Bothnia.</p> <p>D5C5 Dissolved oxygen concentration Oxygen deficiency in the Baltic Sea must not exceed the oxygen debt index thresholds of 8.66 in the Gulf of Finland, 8.66 in the North Baltic Sea, 2.02 in the Åland Sea, 2.02 in the Bothnian Sea and 0.81 in the Gulf of Bothnia. Dissolved oxygen concentrations in coastal waters do not fall below 4 mg L⁻¹ (monthly average).</p>
LV	none	<p>DIRECTLY</p> <p>D5C8 Macrofauna community No determination</p>
LT	none	<p>DIRECTLY</p> <p>D5C7 Macrophyte communities of benthic habitats The species composition and relative abundance or depth distribution of <u>macrophyte communities</u> reach values indicating that the increase in nutrients does not cause adverse effects, including the loss of water transparency. The WFD indicator</p>

Country	D4 Food Webs	D5 Eutrophication
		"Maximum depth of distribution of the branched whale (<i>Furcellaria lumbricalis</i>)" (also used for criterion D6C3) is used to assess the condition.
PL	<p>INDIRECTLY</p> <p>D4C1 Trophic guild species diversity The diversity (species composition and their relative abundance) of the <u>trophic guild</u> is not adversely affected due to anthropogenic pressures. Threshold values established on national and regional level (HELCOM).</p> <p>D4C2 Abundance across trophic guilds The balance of total abundance between the <u>trophic guilds</u> is not adversely affected due to anthropogenic pressures. Threshold values established on national and regional level (HELCOM).</p> <p>D4C3 Trophic guild size distribution The size distribution of individuals across the <u>trophic guild</u> is not adversely affected due to anthropogenic pressures. Threshold values established on national and regional level (HELCOM).</p>	<p>DIRECTLY</p> <p>D5C5 Dissolved oxygen concentration The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse <u>effects on benthic habitats</u> (including on associated biota and mobile species) or other eutrophication effects. The threshold values are as follows: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Values were established through regional or subregional cooperation (HELCOM).</p> <p>D5C6 Opportunistic macroalgae of benthic habitats The abundance of <u>opportunistic macroalgae</u> 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.</p> <p>D5C7 Macrophyte communities of benthic habitats The species composition and relative abundance or depth distribution of <u>macrophyte communities</u> 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.</p> <p>D5C8 Macrofaunal communities of benthic habitats The species composition and relative abundance of <u>macrofaunal communities</u>, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment, as follows: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Values were established through regional or subregional cooperation (HELCOM).</p>
SE	none	<p>DIRECTLY</p> <p>D5C4 Photic limit Due to nutrient enrichment, the visibility depth of the water has not been reduced to levels that indicate negative effects on <u>benthic habitats</u> or other eutrophication effects.</p> <p>D5C5 Dissolved oxygen concentration The content of dissolved oxygen has not, due to nutrient enrichment, been reduced to levels indicative of adverse effects on <u>benthic habitats</u> or other eutrophication effects.</p> <p>D5C7 Macrophyte communities of benthic habitats The species composition of the <u>macrophytic communities</u> and relative abundance achieve values that indicate that there is no negative effect due to nutrient enrichment or organic enrichment.</p> <p>D5C8 Macrofaunal communities of benthic habitats The species composition of the <u>macrofauna communities</u> and relative abundance achieve values that indicate that there is no negative effect due to nutrient enrichment or organic enrichment.</p>

5.4 Descriptor 6 elements linked with Regional Sea Conventions, as reported by Baltic EU Member States in the 2nd MSFD cycle

The [HELCOM](#) Regional Sea Convention was only mentioned by Latvia which reported it as the source of habitat types under criterion D6C5 (table 21). Other countries mentioned occasionally HELCOM in their reports, but didn't directly reported its indicators or other GES elements. It was rather often reported national indicators, often adapted from HELCOM ones, but with specific thresholds or application.

Table 21: D6 elements linked with HELCOM Convention, as reported by Baltic EU Member States in the 2nd MSFD cycle

	Criterion	Habitat type element	Element source	Parameter	Related indicator
LV	D6C5 Benthic habitat condition (1.6, 1.6.1, 1.6.2, 1.6.3, 6.2, 6.2.1, 6.2.2, 6.2.3, 6.2.4)	Cirralittoral sand Infralittoral coarse sediment Infralittoral mixed sediment Infralittoral sand Cirralittoral mixed sediment Cirralittoral mud	HELCOM	HAB-CON	BAL-NATIONAL-habitat1

6 Comparison of D6 GES reported by EU Member States of the Black Sea for the 2nd MSFD cycle

Bulgaria reported for the 2nd MSFD cycle the same determination as reported for the 1st MSFD cycle, but complemented with new elements for all D6 criteria (table 22). Romania, which did not report any determination for D6 at the 1st MSFD cycle, reported new elements for all D6 criteria, except D6C3.

Table 22: evolution of GES elements, as reported by Black sea EU Member States in 2nd MSFD cycle (WISE + national reports)

GES 2 nd MSFD cycle		D1 Benthic habitats D6 Sea-floor integrity	D6C1	D6C2	D6C3	D6C4	D6C5
Bulgaria	BG						
Romania	RO						

	No changes between 1 st and 2 nd MSFD cycles
	GES element modified between 1 st and 2 nd MSFD cycle
	new GES element at 2 nd MSFD cycle
	GES not defined at any of the 2 MSFD cycles

As in the other three regions, the GES determination is descriptive and not detailed and differs markedly between the two countries. For D6C3 and D6C5, Bulgaria defines GES as a summary of the MSFD Decision; meanwhile, Romania modified and extended its determination for D6C5, notably with a reference to the M-AMBI indicator, but with a qualitative definition (table 23). Romania defined 15 targets linked to the Descriptor 6. All the detailed GES determinations, as reported by the EU Member State for all MSFD criteria of the Descriptor 6, are in Annex IV.

Table 23: selection of GES determinations, as reported by Black sea EU Member States in the 2nd MSFD cycle, for criteria D6C3 and D6C5

	D6C3	D6C5
MSFD guidance (EU, 2017)	<i>The spatial extent of each habitat type 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.</i>	<i>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</i>






	D6C3	D6C5
BG	The spatial extent of each habitat type adversely affected by physical disturbance.	The extent of adverse effects from anthropogenic pressures on the condition of the habitat type does not exceed a specified proportion of the natural extent of the habitat type in the assessment area.
RO	<i>GES criteria not reported</i>	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 (benthic communities typical species composition, absence of particularly sensitive or fragile species or species providing a key function) is at levels that is not adversely affecting the structure and functions of the ecosystem. GES is assessed using the multimetric index M-AMBI*(n) that should be above the threshold value.

6.1 Habitat types reported by Black Sea EU Member States in the 2nd MSFD cycle

For both Romania and Bulgaria, several habitat types which are listed as occurring in their waters (TG Seabed) were not reported for MSFD D6 GES (table 24), and few habitat types were reported by both countries. Romania only assessed 2 of the 11 broad habitat types (Infralittoral rock and biogenic reef; Circalittoral mud), whereas Bulgaria didn't assess any. Romania also reported and assessed 3 other habitat types, probably from conservation policies lists.

Table 24: Habitat types as reported by the Black Sea EU Member States in the 2nd MSFD cycle (green - reported and assessed; orange – reported, not assessed; pattern – not reported but existing in MS marine waters, from Boschetti et al 2022). *Since this analysis based on this version, an updated version from TG Seabed-9 (Jan 2022) is now (Oct. 2022) available at: <https://circabc.europa.eu/ui/group/326ae5ac-0419-4167-83ca-e3c210534a69/library/970714d8-3405-427d-8fc4-e8aa85b06b01/details>. Some of the “reported since at not existing in MS waters” were notably completed.*

MSFD broad habitat types	EU Regional sea	Black sea	
	sub-region	BG	RO
	country		
Littoral rock and biogenic reef			
Littoral sediment			
Infralittoral rock and biogenic reef			
Infralittoral coarse sediment			
Infralittoral mixed sediment			
Infralittoral sand			
Infralittoral mud			
Circalittoral rock and biogenic reef			
Circalittoral coarse sediment			
Circalittoral mixed sediment			
Circalittoral sand			
Circalittoral mud			
Offshore circalittoral rock and biogenic reef			
Offshore circalittoral coarse sediment			
Offshore circalittoral mixed sediment			
Offshore circalittoral sand			
Offshore circalittoral mud			
Upper bathyal rock and biogenic reef			
Upper bathyal sediment			
Lower bathyal rock and biogenic reef			
Lower bathyal sediment			
Abyssal			
Other habitat types			
[Zostera] beds in infralittoral sediments			
Pontic [Phyllophora nervosa] on vertical rock faces in the lower infralittoral			
[Cystoseira] spp. in eulittoral rockpools			



-  reported and assessed
-  reported but not assessed
-  existing in MS waters (TG Seabed; Boschetti et al, 2021)
-  IE reported to assess all benthic habitats types
-  reported since as not existing in national waters (TG Seabed; Boschetti et al, 2021)
- * as in Boschetti et al, 2021

6.2 Features reported by Black Sea EU Member States to assess pressure criteria D6C1 and D6C2 in the 2nd MSFD cycle

Only Bulgaria reported features to assess criteria D6C1 (physical loss) and D6C2 (physical disturbance) (table 25). These pressures were reported as “not assessed” due to the lack of agreed GES thresholds, although the extent of the seabed physically disturbed was quantified (km²).

Table 25: features reported (text, HTML) by Black Sea EU Member States about pressure criteria D6C1 and D6C2 (2nd MSFD cycle)

Features	EU Regional sea	Black sea	
	sub-region	BG	RO
	country		
D6C1 - Broad habitat type			
D6C1 - Physical disturbance			
D6C1 - Physical loss			
D6C2 - Broad habitat type			
D6C2 - Physical disturbance			
D6C2 - Physical loss			

-  reported and assessed
-  reported but not assessed

6.3 Links to Sea-floor Integrity in Descriptor 4 and Descriptor 5 as defined in reports of Black Sea EU Member States in the 2nd MSFD cycle

Table 26 summarises the connections identified between Descriptor 4, Descriptor 5 and Descriptor 6. No links with benthic habitats were identified for Descriptor 4. For Descriptor 5, Romania reported indirect links at Descriptor level (“adverse effect thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters”) and direct links through mention of benthic habitats and communities for criteria D5C5, D6C6 and D6C7. Bulgaria mentioned direct links with benthic vegetation for criteria D5C6 and D5C7.

Table 26: links with Descriptor 4 and Descriptor 5, as reported by Black Sea EU Member States in the 2nd MSFD cycle

country	D4 Food Webs	D5 Eutrophication
RO	none	<p>INDIRECTLY</p> <p>D5 Eutrophication Good Environmental Status in relation to Descriptor 5 is achieved when the human-induced eutrophication is minimised, especially the <u>adverse effect thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters</u>. GES is assessed with Black Sea Eutrophication assessment Tool (BEAST)</p> <p>DIRECTLY</p> <p>D5C5 Dissolved oxygen concentration The concentration of bottom dissolved oxygen is not reduced, in the warm season, due to nutrient enrichment, to levels that indicate adverse <u>effects on benthic habitat</u>, above the threshold values.</p> <p>D5C6 Opportunistic macroalgae of benthic habitats The biomass of <u>opportunistic macroalgae</u> (ESGII =opportunistic/total biomass, %) is not at levels that indicate adverse effects of nutrient enrichment and below the threshold values.</p> <p>D5C8 Macrofaunal communities of benthic habitats The species composition and relative abundance of <u>macrofaunal communities</u>, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment and are above the threshold values.</p>
BG		<p>DIRECTLY</p> <p>D5C6 - Opportunistic macroalgae of benthic habitats The abundance of <u>opportunistic macroalgae</u> is not at levels that indicate adverse effects of nutrient enrichment.</p> <p>D5C7 - Macrophyte communities of benthic habitats The community-level indicators (e.g. species composition, relative abundance and/or biomass and/or spatial coverage etc.), population-level indicators and/or depth distribution of <u>macrophyte communities</u> achieve values that indicate there is no adverse effect due to nutrient enrichment including via a decrease in water transparency.</p>

6.4 Descriptor 6 elements linked with Regional Sea Conventions, as reported by Black Sea EU Member States in the 2nd MSFD cycle

There was **no explicit mention of any Regional Sea Convention**, notably the [Bucharest Convention](#), as a direct source of a Descriptor 6 GES element by any the Black Sea EU Member States.

7 Synthesis, conclusions and recommendations

Some of the following conclusions and recommendations may seem paradoxical, obvious or difficult to implement, too vague or too technical, especially to people strongly involved in these works at different levels (as are the authors), but this is highlighting that **the MSFD**, as a quite recent and very ambitious Directive, **is still at an early stage of implementation and needs even more collective, coordinated, continuous and longer-term involvement of both scientists and policy makers, to reach its objectives**. The first, but not the least, objective of the MSFD is to “maintain biodiversity and provides diverse and dynamic oceans and seas which are clean, healthy and productive”: the future quality of life of all people and living organisms in Europe, and probably in the entire world considering current global changes, is more or less directly depending on this. European countries and Commission are currently reviewing, and possibly **revising, the MSFD itself**.

This is a strong **opportunity to improve the directive with lessons learnt from the first implementation cycles, and to make it more efficient through new related regulations to improve commitments and future progress, and associated resources**, in line with the emergency of all major environmental risks as explicated in this Directive and related Decisions.

In the limited time and resources available for this project and study, the next chapters aim to **synthesise, interpret and provide recommendations on main initiatives and the way forward** to guide future progress, and notably through cooperation at different but nested geographical scales, **towards harmonized and operational GES technical elements and assessment methods** at European, regional and national levels.

7.1 MSFD reported GES determinations and adequacy for assessments and targets

Tables 4, 5, 11, 16, 22 and Annex IV clearly show that despite big national efforts, **none of the 23 EU Member States’ GES determinations, and related assessments for Descriptor 6, are consistent or comparable between countries**, whether they are in the same sea region or not. In the 2nd MSFD reporting cycle, many countries provided new or modified GES determinations for the Sea-floor Integrity (Descriptor 6). Most of these determinations were descriptive or referred to quantitative elements without sufficient detail or a clear method to implement them in their assessments. Some countries defined GES for Descriptor 6 following the 2017 revised EU GES Decision strictly, while others also integrated references to other policies (mainly the Water Framework Directive, the Habitats Directive and conservation lists of habitats for related features), or independent re-interpretation of the different policies’ obligations. As a consequence, the **targets defined to guide measures towards GES are not measurable and mostly insufficient nor adapted to the required geographical and temporal scales and priority features** (both for pressures and habitat types exposed to these pressures). This is notably illustrated by the number of targets reported, ranging from 1 (Cyprus) to 157 (The Netherlands), with a total, across all EU Member States, exceeding 700.

It is clear, for the 1st and 2nd MSFD cycles, that there are **a lot of discrepancies in the way each country interpreted and applied** the first (EU, 2010), but also the new revised **EU MSFD Decision** (EU, 2017). This could be due to both:

- the major changes of the Descriptor 6 and related criteria in the revised Decision;
- the lack of concrete technical integration for MSFD of other policy’s and Regional Sea Convention’s methodological standards;
- the lack of agreed international thresholds, baselines and targets.

Despite all this, **during the 2nd MSFD cycle**, there has been substantial **progress in data collection and development of suitable indicators**, particularly in HELCOM and OSPAR, thereby leading to improved assessments for some aspects of D6 (especially physical disturbance). However, there was still a gap in how the RSCs integrate indicators into a multi-pressures D6C5 assessment per habitat. Another key issue was that while there were huge efforts towards indicators development, there was hardly any regional **efforts to coordinate GES determinations**, leading to the heterogeneity in text described in this report.

The need for **improvement through more (sub)regional cooperation and awareness of a common approach/understanding for assessment methods for benthic habitats is obvious**. For the next MSFD cycle, with reporting in 2024, countries should **further reinforce cooperation through Science-Policy interactions at regional seas and European levels**, and moreover, also **implement these common methods** and coordinated assessments and targets **at each national level** (to be reflected in respective future MSFD national reports). In the meantime, **the precautionary principle and the use of collective experts' judgments**¹ should be an integral part, also driving priorities, to conserve and assess the marine environment. The precautionary principle enables decision-makers to adopt precautionary measures when scientific evidence is uncertain and the stakes are high; see [EU \(2016\) definition at European level](#) and regional ones (e.g. [OSPAR precautionary principle](#)).

This work should be done **through already existing working groups and nominated experts**, with strong science-policy interactions and supporting processes. As those ongoing for many years in the **Regional Sea Conventions and at EU levels** (notably, for benthic habitats, the TG Seabed and other related committees like WG GES and MSCG) to produce clear, illustrated and **tested (real data) guidance, including articulation between the main policies** and hyperlinks to **recommended operational methods**. Some analysis and guidance were already produced at EU level by the EU Joint Research Center (JRC), and a summary for D6 was adopted by MSCG for MSFD Article 8, for which a more detailed version is still worked through the TG Seabed (TG Seabed, 2022). Besides, **other guidance for GES (Art. 9) and environmental targets (Art.10)**, including links with other policies, should also be planned, discussed and produced.

The **lack of data, due to the lack of ground-truth monitoring (notably offshore and in risk areas)**, is a priority gap to be addressed to enable the development and testing of assessment methods, and thresholds, for benthic habitats at regional and national scales. Harmonised or common methods developed should also facilitate **coordinated or joint monitoring**, which would reinforce data quality and compatibility, and could also be more cost-efficient. A priority should be notably to share between countries, in the same biogeographic areas, **monitoring to establish quantitative pressure-state relationships for each prioritised habitat and pressure types**, and address several requirements of benthic indicators².

7.2 MSFD reported habitat types

The comparison between habitat types reported by the EU Member States for the 2nd cycle of MSFD shows a **high heterogeneity between countries, within and between regional seas** (table 27). There are also many **discrepancies between the broad habitat types reported and those which occur** in each of the national waters (Annex III; TG SEABED; Boschetti et al, 2021), which suggests that this heterogeneity is not only due to natural variation of habitat types occurring per country. The **lack of reporting of intertidal (littoral) habitats** is notably a significant gap, even if not available in EuSeaMap, notably for the North-East Atlantic where they are widely extended, as they are usually highly exposed to several types of anthropogenic pressures. Several countries reported and/or assessed **other habitat types**, which are often linked to other policies or conservation lists.

To report other habitat types is a good way to optimise and coordinate different policy obligations, but it needs to be **more coherent between countries and better articulated, both with the links to the MSFD broad habitat types and links with the GES determination**, assessments and targets. Indeed, some policies do not address all habitats and pressure types, or operate at different scales, and need then complementary efforts to fulfil MSFD requirements. The MSFD, as more recent and referring to other marine Directives, could be **the holistic 'full coverage' policy**, to which other policies (notably WFD, HD, Natura 2000, Marine Spatial Planning Directive, Regional Seas' strategies and priority conservation lists) would need to be clearly linked and nested within MSFD approaches **to improve synergies and efficiencies**.

Discussions and **guidance on habitat occurrence lists, correspondences and common use and implementation for marine policies (notably through MSFD and its annexes)** should be provided at Regional Sea and EU levels. The [EUNIS typology](#) and main European and regional policies, notably Regional Seas' priority conservation lists (currently not EUNIS-compatible), should be the common basis and referential.

¹ See notably [McQuatters-Gollop et al \(2022\)](#) for the use of expert judgement about marine biodiversity at regional scale.

² See notably [Elliott et al. \(2018\)](#) for integration method between OSPAR benthic indicators to inform model-based ones (risk-based) by ground-truthed ones (state-pressure relationships' curves).

Table 27: list of habitat types as reported by the EU Members States in the 2nd MSFD cycle. Since this analysis based on the available version published in Boschetti et al (2019), the latest version from TG Seabed-9 (Jan 2022) is now (Oct. 2022) available at: <https://circabc.europa.eu/ui/group/326ae5ac-0419-4167-83ca-e3c210534a69/library/970714d8-3405-427d-8fc4-e8aa85b06b01/details>. Some of the “reported since at not existing in MS waters” were notably completed.

EU Regional sea sub-region	North-East Atlantic													Mediterranean sea										Baltic sea							Black sea										
	Greater North Sea						Celtic			B-I		Mac		Western			Central			Adriatic				A-L		Baltic sea							Black sea								
	country	SE*	DK	DE	NL	BE	FR	UK	UK	IE	FR	FR	ES	PT	PT	ES	ES	UK	FR	IT	IT	MT	EL	IT	SI	HR	EL	EL	CY	FI	EE	LV	LT	PL	DE	DK	SE*	BG	RO		
Littoral rock and biogenic reef																																									
Littoral sediment																																									
Infralittoral rock and biogenic reef																																									
Infralittoral coarse sediment																																									
Infralittoral mixed sediment																																									
Infralittoral sand																																									
Infralittoral mud																																									
Circalittoral rock and biogenic reef																																									
Circalittoral coarse sediment																																									
Circalittoral mixed sediment																																									
Circalittoral sand																																									
Circalittoral mud																																									
Offshore circalittoral rock and biogenic reef																																									
Offshore circalittoral coarse sediment																																									
Offshore circalittoral mixed sediment																																									
Offshore circalittoral sand																																									
Offshore circalittoral mud																																									
Upper bathyal rock and biogenic reef																																									
Upper bathyal sediment																																									
Lower bathyal rock and biogenic reef																																									
Lower bathyal sediment																																									
Abyssal																																									

Other habitat types																																									
Benthic habitats																																									
Benthic Broad Habitats																																									
Reefs																																									
Coastal Zone Sand (NL)																																									
Coastal/Muddy/Sandy habitats (WFD)																																									
Dogger Bank Sand (NL)																																									
Estuaries																																									
Frisian Front Sand (NL)																																									
Offshore Sand (NL)																																									
Oyster Banks Mud (NL)																																									
Mudflats and sandflats not covered by seawater at low tide																																									
Sandbanks which are covered by seawater all the time																																									
Sandbanks which are slightly covered by seawater all the time																																									
Sublittoral coarse sediment																																									
Sublittoral mud																																									
Submarine structures made by leaking gases																																									
Large shallow inlets and bays																																									
Species-rich gravel, coarse sand and shell-gravel areas																																									
Seapen and burrowing megafauna																																									
Sublittoral rocky and biogenic habitats																																									
Soft sediment habitats																																									
Intertidal habitats																																									
Baltic muddy bottoms of the aphotic zone																																									
[Zostera] beds in infralittoral sediments																																									
Submerged or partially submerged sea caves																																									
Coralligenous habitat																																									
Maerl beds																																									
Posidonia beds																																									
Soft bottom non biogenic habitat																																									
Pontic [Phyllophora nervosa] on vertical rock faces in the lower infralittoral																																									
[Cystoseira] spp. in euittoral rockpools																																									
White corals																																									

reported and assessed
 reported but not assessed
 existing in MS waters (TG Seabed; Boschetti et al, 2021)
 IE reported to assess all benthic habitats types
 reported since as not existing in national waters (TG Seabed; Boschetti et al, 2021)
 * as in Boschetti et al, 2021

7.3 Features reported to assess pressure criteria D6C1 and D6C2

Most countries reported the pressures “Physical loss” for criterion D6C1 and “Physical disturbance” for criterion D6C2 but only Poland, Estonia, Denmark and Germany (Baltic Sea), as well as Malta and Italy (Mediterranean Sea), reported to have “assessed” them for MSFD article 8 (table 28). This example illustrates well the need to **better define in general the meaning of the “assess” term** (quantifying versus threshold / target setting). **The lack of data and agreed thresholds** was a clear limitation reported by several countries, despite the fact that physical pressures were probably often quantified, and is anyway a major and widely occurring pressure on European benthic habitats.

Since the new revised Decision (EU, 2017), **other pressure types** also have to be addressed under other Descriptors. Even if the links with other relevant related Descriptors/criteria are described under the Descriptor 6, **few direct links are made in national reports between benthic habitat assessments and other Descriptors/pressures**.

Future GES determinations and assessments for each of the other relevant pressure types should be more clearly related to benthic habitats, where they are exposed to these pressures, and notably documented on the way to link and contribute to “state” criteria D6C4 and D6C5.

Thresholds and integration rules for benthic habitats should then be based on quantitative ecological state-pressure relationships, notably for the **integration of cumulative effects of various pressure types**, which is a complex but important characteristic of benthic habitats and their sessile communities, which in turn make these features very relevant to monitor to assess the effects of anthropogenic pressures, and then effects of related policies’ measures to limit these pressures.

Table 28: feature reported (text, HTML) by the EU Member State about pressure criteria D6C1 and D6C2 (2nd MSFD cycle)

EU Regional sea sub-region	North-East Atlantic										Mediterranean sea										Baltic sea						Black sea													
	Greater North Sea					Celtic			B-I		Mac		Western				Central			Adriatic			A-L																	
Features country	SE	DK	DE	NL	BE	FR	UK	UK	IE	FR	FR	ES	PT	PT	ES	ES	UK	FR	IT	IT	MT	EL	IT	SI	HR	EL	EL	CY	FI	EE	LV	LT	PL	DE	DK	SE	BG	RO		
D6C1 - Broad habitat type																																								
D6C1 - Physical disturbance																																								
D6C1 - Physical loss																																								
D6C2 - Broad habitat type																																								
D6C2 - Physical disturbance																																								
D6C2 - Physical loss																																								

reported and assessed
 reported but not assessed

7.4 Links with MSFD Descriptors 4 and 5

Most of the few reported links connecting **Descriptor 4 (Ecosystem, food webs)** with Descriptor 6 (Sea-floor integrity) GES elements **were indirect and descriptive** (table 29). Descriptor 4, at the ecosystem level, is complex and suffers generally with many gaps in knowledge, data and monitoring, notably about benthic habitats.

Further development is needed, notably for **common understanding and methodological standards**, including **links to benthic habitat features and Descriptor 6 GES elements**. These developments for the MSFD should be **closely linked notably to the Habitat Directive** (for the state and functional aspects), and also **to the most recent scientific ecological approaches**.

More links, and more direct links, were both reported and assessed (notably in the Baltic Sea, where it is a major threat) connecting **Descriptor 5 (Eutrophication)** with Descriptor 6 (Sea-floor integrity) GES elements (table 29). Many of these links were **referring to the Water Framework Directive and related methodological standards**, including quantitative indicators. Several countries assess eutrophication based on benthic habitat features, notably by monitoring the state of benthic habitats in connection with oxygen concentration in the bottom layers, condition indices for macrophytes and macrofauna communities, and photic limitations to the benthic vegetation.

However, it was very often not clear, and always different between countries, **how these WFD standards contribute to which MSFD D6 criteria**. The footprint of benthic effects from eutrophication should primarily contribute to D6C5. A key issue from the eutrophication assessment perspective is to get outputs of this ‘footprint’ that are suitable for D6 use (i.e. to distinguish pelagic and benthic effects of nutrient enrichment, feeding outputs respectively into D1C6 pelagic and D6C5 benthic assessments). **Future developments and integration rules** for this pressure type should be **closely linked to those made under the Water Framework Directive**, even if the objectives, features and assessment scales are different.

This comparison between two different Descriptors (state-based for D4 and pressure-based for D5) also indicates that **elements linked to policies with more clear objectives, quantitative standardised methods and monitoring are more often and directly reported by EU Member States**, even if **the articulation in both cases still need to be clarified** for a common understanding and implementation of the MSFD. The links might also be made more often to D5 because it has a long establish history of assessment, while D4 is very new and conceptually challenging, lacking methodologies. **Links between the Descriptor 6 and other Descriptors and features should be explored**, notably for those criteria mentioned in the GES Decision (EU, 2017), to guide future progress and integration rules.

Table 29: links with Descriptor 4 and 5, as reported by the EU Member States in the 2nd MSFD cycle

EU Regional sea	North-East Atlantic										Mediterranean sea								Baltic sea				Black Sea							
	country	SE	DK	DE	NL	BE	UK	IE	FR	ES	PT	ES	UK	FR	IT	MT	EL	SI	HR	CY	FI	EE	LV	LT	PL	DE	DK	SE	BG	RO
D4																														
D4C1																														
D4C2																														
D4C3																														
D4C4																														
D5																														
D5C1																														
D5C2																														
D5C3																														
D5C4																														
D5C5																														
D5C6																														
C5C7																														
D5C8																														

■ direct link (benthic habitat mentioned)
■ indirect link (seafloor's ecosystem or environment related)

7.5 MSFD Descriptor 6 and Regional Sea Conventions’ methodological standards

Table 30 highlights that **very few links were found between the Descriptor 6 GES elements and Regional Sea Conventions**. Considering one of the initial objectives of this study, it is very frustrating that the 2nd MSFD cycle reporting was almost totally disconnected from Regional Sea Conventions’ methodological standards and assessments for almost all EU Member States. But, “from the half-full side of the glass”, it leaves plenty of room for interpretation and recommendations, from the synthesis in the next chapters of the main key initiatives, works and documents at Regional Sea Convention and EU levels.

Table 30: D6 links with Regional Sea Conventions, as explicitly reported by EU Member States in the 2nd MSFD cycle

EU Regional sea	North-East Atlantic										Mediterranean								Baltic						Black Sea						
	Reported RSC link	country	SE	DK	DE	NL	BE	UK	IE	FR	ES	PT	ES	UK	FR	IT	MT	EL	SI	HR	CY	FI	EE	LV	LT	PL	DE	DK	SE	BG	RO
Indicator																															
Habitat type																															

Regional Sea Convention
■ Oslo-Paris ■ Barcelona ■ Helsinki ■ Bucharest

Two types of links with the Oslo-Paris (**OSPAR**) Convention were reported by the North-East Atlantic countries:

- Five countries reported that assessed GES elements are related to **OSPAR indicators BH2 (BH2a and BH2b) and BH3** (see Annex II);
- Some **specific assessment units** (The Netherlands) and some **EU MSFD broad habitat types** (Sweden), were sourced as OSPAR.

The OSPAR Convention, supported by the EU-funded [EcApRHA](#) project for food webs, pelagic and benthic habitats, published online in 2017 its “[OSPAR Intermediate Assessment 2017](#)” (OSPAR, 2017), where three common methodological standards for benthic habitats were assessed ([BH2a](#), [BH2b](#), [BH3](#), See Annex II). One of them (BH2a) was referring to WFD standards (indices) and assessments for coastal waters, and the others to the physical disturbances on benthic habitats. These **standards aligned with MSFD Descriptors 5 and 6 requirements, assessed at a regional scale and published in 2017**, have facilitated their adoption and use by several Atlantic EU Member States for their 2nd MSFD cycle reports. **Further common developments on benthic methodological standards**, addressing the **prioritised local pressures** (currently focussed on physical pressures and eutrophication), and **more cooperation with other Regional Sea Conventions** should be encouraged through the OSPAR Convention, notably via sharing and working on the well-documented European and regional guidance. Some ongoing projects are in 2022 charge of these developments, notably for the [next OSPAR Quality Status Report](#), via the [NEA PANACEA](#) project for seabirds, food webs, pelagic and benthic habitats, planned to be published in 2023. In this context, some more details and recommendations will be provided in the next chapter.

In the Baltic Sea, only Latvia reported the Helsinki (**HELCOM**) Convention as a source of a D6 GES elements: some **EU MSFD broad habitat types**.

The HELCOM Convention, via [HOLAS II](#) and [CORESET II](#) projects, published in 2018 its “[State of the Baltic Sea – Second HELCOM holistic assessment 2011-2016](#)” (HELCOM, 2018), where the common methodological standard “[core indicator: State of the soft- bottom macrofauna community](#)” for benthic habitats was assessed, combined with the “core indicator: Oxygen debt” for eutrophication, and referring to WFD standards (indices) and assessments for coastal waters. **It is surprising, according to these existing quantitative and assessed methodological standards**, that Baltic Sea EU Member States sometimes refer to them in their 2nd MSFD cycle reports, but never directly for GES determination. A reason may be **the use, even at the HELCOM level, of the national WFD standards and assessments for coastal and national waters**, which also referred several countries at a national level for MSFD. **Further common developments of benthic methodological standards** (currently focussed on the status of natural habitats), addressing the **prioritised local pressures**, and **more cooperation with other Regional Sea Conventions** should be encouraged through the HELCOM Convention, notably via sharing and working on the well-documented regional guidance. Some ongoing projects are in 2022 in charge of these developments, notably for the [next HELCOM holistic assessment, via HOLAS III](#) and [HELCOM BLUES](#) projects, planned to be published in 2023.

No direct links were reported for the Descriptor 6 GES elements, both for the **Barcelona Convention** (Mediterranean Sea) and the **Bucharest Convention** (Black Sea).

The Barcelona Convention, via its [Mediterranean Action Plan](#), published in 2017 its “[Mediterranean 2017 Quality Status Report](#)” (UNEP-MAP, 2017), where two related methodological standards on the state of benthic habitats were assessed together: “[Common Indicator 1: Habitat distributional range](#)” and “[Common Indicator 2: Condition of the habitat’s typical species and communities](#)”. But these assessments were **mainly based on habitat maps and did not assess quantitatively the effects of pressures**. That may be a reason why no links were reported by Mediterranean EU Member States, notably for the assessment of physical loss and disturbances, at the 2nd MSFD cycle. **Further common developments of benthic methodological standards** (currently focussed on the distribution of natural habitats), addressing the **prioritised local pressures**, and **more cooperation with other Regional Sea Conventions** should be encouraged through the Bucharest Convention. Some ongoing EU-funded projects ([IMAP-MPA](#), [ABIOMMED](#)) and UNEP/MAP projects and subcontractors are in 2022 in charge of these developments, **notably for the sea-floor integrity and benthic habitats standardised monitoring**, for the [next Mediterranean Quality Status Report](#), planned to be published in 2023.

The [Black Sea Commission on the protection of the Black Sea against Pollution, for the Bucharest Convention](#), published in 2019 its “[Black Sea state of environment report](#)” (BSC, 2019), which include the assessment of **some benthic features**: macrozoobenthos in Turkish coasts and a compilation of macrophytes national assessments from Turkiye, Bulgaria, Romania, Ukraine and the Russian Federation (Georgia reported no data). But **benthic parameters used were very diverse** and it seems that **no common methodological standards were used**. Besides, this **publication in 2019** may have compromised its use for the two EU Member States (Bulgaria and Romania) for their 2018 2nd MSFD assessment, notably as Romania’s national report was published in 2018, even if Bulgaria published their MSFD report in 2021. **Further common developments of benthic methodological standards**, addressing the **prioritised local pressures** (currently mainly focussed on pollution), and **more cooperation with other Regional Sea Conventions** should be encouraged through the Bucharest Convention and via the [Black Sea Integrated Monitoring and Assessment Programme](#).

At European Regional Sea scales, and notably in the Regional Sea Conventions, **the representativity of EU Member States in all Contracting Parties, and respective contributions to resources for works**, are key elements to align with MSFD requirements.

At the European scale, the previous conclusions highlighted that the **EU-funded projects, implemented through Regional Sea Conventions’ working groups and Science-Policy processes**, even if involving quite limited resources, are key to driving convergence towards more harmonised methodological standards at the EU level, aligned with its Directives, but also with involving non-EU Member States and benefiting of mutual knowledge and technical objectives.

It would be very important, for the EU Member States, even if not mandatory nor legally binding, to try to **coordinate MSFD and Regional Sea Conventions’ works and assessment timelines**, to enable the use of this work, without duplication and with enough time to adapt it, for national MSFD reports.

7.6 The way forward and recent initiatives and propositions for the North-East Atlantic’s methodological standards (OSPAR Convention)

Several key initiatives have already been undertaken **at the European scale** to clarify and provide guidance on how to harmonise the assessment of Descriptor 6.

The **International Council for the Exploration of the Sea (ICES)**, contracted by the European Commission following a TG Seabed request, notably conducted a series of workshops, focusing on MSFD Descriptor 6, to provide recommendations on sea-floor integrity assessment for the Marine Strategy Framework Directive. The main outcomes of these workshops, according to documents available and also summarised as a formal advice in [ICES \(2019\)](#), were:

- [WKBEDPRES1](#) (ICES 2018): Focus on D6C2 (physical disturbance pressures) - Key human activities that resulted in a physical disturbance on the seabed were similar for the 4 EU regions examined, with bottom fishing found to be the most extensive cause of physical abrasion, with aggregate extraction and dredging also of relevance in most regions but much less extensive. Detailed technical guidance is provided for data and assessment requirements.
- [WKBEDLOSS](#) (ICES 2019a): Focus on D6C1 (physical loss, permanent change at EUNIS 2019 level 2) - Three types of physical loss (and related activities) were distinguished: sealed physical loss, un-sealed physical loss and the loss of biogenic habitat. Assessing sealed and unsealed physical loss comprises five generic steps: (1) to identify the MSFD-competent authorities who may hold or have access to suitable physical loss data, (2) to request spatial data and attribute information for each physical loss-causing activity, (3) to assess the surface area of physical loss, (4) to assess and document the level of confidence for each feature in the attribute table, and (5) to manage data according to the FAIR principles (Wilkinson et al, 2016). To distinguish unsealed physical loss from physical disturbance, unsealed loss requires further qualification (i.e. in situ observation of habitat change). Assessing the loss of biogenic habitat comprises three steps: (1) to identify the present and historic biogenic habitat-forming species, (2) to assess the natural spatial distribution and extent of the biogenic habitat and (3) to assess the loss of biogenic habitat.
- [WKBEDPRESS2](#) (ICES, 2019b): Focus on evaluating and testing data to assess human activities causing physical loss and disturbance to seabed habitats (D6C1, D6C2 and D6C4). key pressures drivers and activities were identified. The methodology laid out in WKBEDPRESS2 is generally applicable to each ecoregion and pressure type thought to have a main impact upon sea-floor integrity. The resultant demonstration product confirmed the current availability of reliable methods and data requirements, with limitations in terms of supporting models and data gaps. There was also guidance on perspectives to assess multiple pressures, arising from multiple activities, in a cumulative and biologically relevant manner, also appropriate to assess adverse effects (D6C3 and D6C5), both for the single pressure and the cumulative of all pressures.

Since 2019, as mandated by the **EU Marine Strategy Coordination Group (MSCG)**, the **TG Seabed** expert group has been working on comparing methods and providing guidance at the EU level for MSFD Descriptor 6 implementation. Recent works include an initial synthesis of seabed habitat characteristics and how they are affected by anthropogenic pressures. The document "[Adverse effects on seabed habitats](#)" (TG Seabed 2020) discusses methodological standards for the EU level requirements of the GES Decision concerning seabed habitats and sea-floor integrity, including threshold values. Following the recent update of the [EUNIS marine habitats classification](#), and the related 2021 update of the [EMODnet/ EUSeaMap database](#), the inventory of the distribution of the MSFD broad habitat types per region, sub-region and Member State (as published by Boschetti et al, 2021 and TGSeabed, 2022) facilitates the future updates of EMODnet to ensure full coverage of seabed habitat maps in Europe. This group and other EU committees are working for years on guidance for the MSFD Article 8 assessments, published initially in 2016 (Walmsley et al, 2016) and currently updated as an advanced draft (TG Seabed, 2020), to be published soon (2023).

In the document "[Review of relevant methods for assessing habitat status under other policies](#)", prepared by the Working Group on Good Environmental Status (TG Seabed, 2021), a review of similarities and differences between the MSFD and other Directives in terms of relevant methods for assessing habitat status was undertaken. Three possible methods were proposed for integrating assessment results from the WFD and HD into the MSFD assessment. The document also indicates the area where monitoring should be specific to the MSFD, as it is seen as a complementary Directive, aiming to fill the gaps of the other pre-existing main Directives and a higher resolution for the assessments. It underlines that, for example, the spatial extent of physical disturbance, as well as habitat loss, are not fully covered by other Directives. Therefore, specific assessments of criteria D6C3 and D6C4, considering cumulative impacts, are needed through MSFD to comprehensively assess the real environmental status of benthic habitats.

The JRC report ([Boschetti et al., 2021](#)), which provided a key basis for this complementary study (planned before this JRC report), summarises the changes made by 20 EU Member States for the 2nd MSFD reporting cycle, in particular about (i) the convergence of the reported criteria elements and methodological standards with Commission Decision (EU) 2017/848; (ii) the consistency of the reported criteria elements across regions and sub-regions of MS; (iii) gaps and future steps. The JRC report was prepared based on the electronic version of the Member States' reports, whereas the present report also included analysis of national pdf reports.

Focus on the OSPAR (North-East Atlantic) methodological standards for benthic habitats

Continuous use of all the EU-level guidance was made possible at the OSPAR level (**OSPAR Benthic Habitat Expert Group (OBHEG)**), notably and mainly through the several experts involved in both groups and processes. The organisation of technical work on biodiversity and notably benthic habitats for other Regional Sea Conventions (Helsinki, Barcelona and Bucharest) are different, and will not be detailed here. For the Barcelona Convention, its organisation and the recent re-activation of technical working groups, notably for the benthic habitats, are described in [Lizińska & Guérin \(2021a\)](#). In the context of the NEA PANACEA project, the next recommendations will be focused on current main efforts and initiatives in the North-East Atlantic, and notably the OSPAR Convention process. However, **similar analyses could be planned with other Regional Sea Conventions, and recommendations here could be transposed to other Regional Seas.**

The ongoing project "[North East Atlantic project on biodiversity and eutrophication assessment integration and creation of effective measures](#)" (**NEA PANACEA**) support notably works to the (further) development of assessments at the regional sea scale, and technical description of 7 OSPAR benthic indicators (Annex II, except BH5 still only conceptual). Each of these indicators is complementary and was developed in both OSPAR and MSFD contexts, to assess the effects of anthropogenic pressures on benthic habitats. This report, as part of this project, aims to compare these most recent NEA standards to MSFD Descriptor 6 GES elements, and initiate future works for mutual improvements, including with other regional seas, and at the EU level. In addition, OSPAR and the NEA PANACEA project will produce a "thematic assessment" of the seabed habitats to combine and interpret together all information provided by each indicator assessment, per assessed sub-region.

The **proposed links between MSFD Descriptor 6 and some other related Descriptors (both for state and pressures aspects), with the most recent OSPAR methodological standards**, for which technical documentation will be published in 2023, are proposed in table 31 (for Descriptors 1 and 6) and table 32 (for Descriptors 2, 4, 5 and 7). The full and joint table is in the embedded file in the methodology chapter. Benthic-related methodological standards from the Barcelona Convention are also linked in these tables, both to MSFD criteria and OSPAR standards, to initiate discussions and facilitate cooperation opportunities. This work could also be done in the future with other Regional Sea Conventions (HELCOM and Bucharest Conventions), with relevant committees, experts and secretariats, depending on resources and time available.

As part of perspectives on other pressures to be considered, a review of the MSFD Descriptor 2 (Non-indigenous species) national reports, at the 1st and 2nd MSFD cycles, was published by [Lizińska & Guérin \(2021b\)](#). **This could also be crossed-analysed with the present report, and further worked through European and Regional Sea Conventions' mixed expert groups** to progress on methods to assess the effects of this major biological pressure on benthic habitats and produce guidance for MSFD.

Table 31: Correspondence and cooperation opportunities for the development of methodological standards related to benthic habitats, between OSPAR and Barcelona Regional Sea Conventions, and the EU MSFD (Part 1/2 = MSFD Descriptors 1 and 6)

MSFD GES Descriptor Reference list GES component from EC	MSFD GES Primary / secondary criteria Reference list GES component from EC (NB : a criteria can be primary or secondary under certain conditions)	OSPAR GES (North-East Atlantic) methodological standard	Lead	Region I	Region II	Region III	Region IV	Region V	UNEP-MAP GES (Mediterranean sea) methodological standard (and related Ecological Objective's code)	coherence opportunity between RSC
D1 - Biodiversity - Benthic Habitats	old criteria 1.4 (distribution) and 1.5 (extend) of habitats (Decision BEE 2010/477/UE)								IC01 - Habitat distributional range (OE1)	
	D6C4 - Extent of loss of habitat type, resulting from anthropogenic pressures, (...)	BH4 - Area of habitat loss	UK/ DE		new					
	D6C5 - Extent of adverse effects from anthropogenic pressures on the condition of the habitat type, (...)	BH2 - Condition of benthic habitat-defining communities: the common conceptual approach	FR	update	update	update	update	update	IC02 - Condition of the habitat's typical species and communities	
		BH2-A - Assessment of coastal habitats in relation to nutrient and/or organic enrichment	FR		update	update	update			
		BH2-B - Condition of benthic habitat-defining communities: Subtidal habitats of the North Sea	FR/ NL		[update]					
		BH1 - Sentinels of the Seabed (SoS)	ES				new			
		BH6 - Benthic Indicator Species Index (BISI)	NL							
		BH3 - Extent of physical disturbances to benthic habitats	UK/ DE		update	update	update			
	BH5 - Size distribution of bivalves or other sensitives species	ES								
								IC15 - Location and extent of the habitats impacted directly by hydrographic alterations (OE7 + OE1 about habitat extent)		
D6 - Seafloor integrity	D6C1 - Spatial extent and distribution of physical loss (permanent change) of the natural seabed	BH4 - Area of habitat loss	UK/ DE		new					
	D6C2 - Spatial extent and distribution of physical disturbance pressures on the seabed	BH3 - Extent of physical disturbances to benthic habitats	UK/ DE		update	update	update			
	D6C3 - Spatial extent of each habitat type which is adversely affected, (...), by physical disturbance	BH1 - Sentinels of the Seabed (SoS)	ES				new			
		BH2 - Condition of benthic habitat-defining communities: the common conceptual approach	FR	update	update	update	update	update		
		BH2-B - Condition of benthic habitat-defining communities: Subtidal habitats of the North Sea	FR/ NL		[update]					
		BH3 - Extent of physical disturbances to benthic habitats	UK/ DE		update	update	update			
		BH5 - Size distribution of bivalves or other sensitives species	ES							
	BH6 - Benthic Indicator Species Index (BISI)	ES		[new]						

Key:

- : commonly agreed methodological standard (at least 1 sub-region) and contributing to QSR 2023
- : candidate methodological standard (under development)
- : Pilot assessment proposed to contribute to QSR 2023
- new:** new assessment for QSR2023
- update:** update of 2017 assessment
- [...]:** ressources limitations
- : coherence/cooperation opportunity from OSPAR to UNEP/MAP
- : harmonisation/cooperation opportunity for both OSPAR and UNEP-MAP
- : coherence/cooperation opportunity from UNEP/MAP to OSPAR

Table 32: Correspondence and cooperation opportunities for the development of methodological standards related to benthic habitats, between OSPAR and Barcelona Regional Sea Conventions, and the EU MSFD (Part 2/2 = MSFD Descriptors 2, 4, 5 and 7)

MSFD GES Descriptor Reference list GES component from EC	MSFD GES Primary / secondary criteria Reference list GES component from EC (NB : a criteria can be primary or secondary under certain conditions)	OSPAR GES (North-East Atlantic) methodological standard	Lead	Region I	Region II	Region III	Region IV	Region V	UNEP-MAP GES (Mediterranean sea) methodological standard (and related Ecological Objective's code)	coherence opportunity between RSC
D2 - Non indigenous species	D2C1 - Number of non-indigenous species, which are newly-introduced via human activity into the wild, (...)	NIS3 - Trends in new records of non-indigenous species (NIS) introduced by human activities	DK		update	update	update		IC06 - Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, notably in risk areas (OE2, ,in relation to the main vectors and pathways of spreading of such species)	Yellow
	D2C2 - Abundance and spatial distribution of established non-indigenous species, (...)	NISx - NIS abundance/spread	FR/DK							
	D2C3 - Proportion of the species group or spatial extent of the broad habitat type which is adversely altered due to non-indigenous species, (...)	NISy - Extent of disturbances by non-indigenous species to benthic habitats	FR							
D4 - Ecosystem, Food webs	D4C1 - Diversity (...) of the trophic guild is not adversely affected due to anthropogenic pressures	FW9 - Ecological Network Analysis diversity	DE		new					
	D4C2 - Balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures	FW7 - Fish biomass and abundance of dietary groups	UK/ES		new	new	new			
		FW9 - Ecological Network Analysis diversity	DE		new					
	D4C3 - Size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures	BH5 - Size distribution of bivalves or other sensitives species	ES							
D4C4 - Productivity of the trophic guild is not adversely affected due to anthropogenic pressures	FW9 - Ecological Network Analysis diversity	DE		New						
D5 - Eutrophication	D5C1 - Nutrient concentrations (...) in the water column	Nutrient Inputs to the Regions I, II, III and IV of the OSPAR Maritime Area	?	new	update	update	update		IC13 - Concentration of key nutrients in water column (OE5)	Yellow
		Winter Nutrient Concentrations in OSPAR Regions II, III and IV	?		update	new	new			
	D5C2 - Chlorophyll-a concentrations (...) in the water column	Concentrations of Chlorophyll-a in the Greater North Sea and Celtic Seas	?		update	update			IC14 - Chlorophyll-a concentration in water column (OE5)	Yellow
	D5C3 - Number, spatial extent and duration of harmful algal bloom events (...)	Trends in blooms of the nuisance phytoplankton species Phaeocystis in Belgian, Dutch and German waters	?		[update]					
	D5C4 - Photic limit (transparency) of the water column (...)									
	D5C5 - Dissolved oxygen concentration (...) in the bottom of the water column	Concentrations of dissolved oxygen near the seafloor	?		update	update	update			
	D5C6 - Abundance of opportunistic macroalgae (...)	BH2-A - Assessment of coastal habitats in relation to nutrient and/or organic enrichment	FR		update	update	update			
	D5C7 - Macrophyte communities (...) of benthic habitats	BH2-A - Assessment of coastal habitats in relation to nutrient and/or organic enrichment	FR		update	update	update			
D5C8/D5C8 - Macrofaunal communities (...) of benthic habitats	BH2-A - Assessment of coastal habitats in relation to nutrient and/or organic enrichment	FR		update	update	update				
D7 - Changes to hydrological conditions	D7C1 - Spatial extent and distribution of permanent alteration of hydrographical conditions (...) to the seabed and water column, associated in particular with physical loss of the seabed									
	D7C2 - Spatial extent of each benthic habitat type adversely affected (...) due to permanent alteration of hydrographical conditions								IC15 - Location and extent of the habitats impacted directly by hydrographic alterations (OE7 + OE1 about habitat extent)	Purple
									IC16 - Length of coastline subject to physical disturbance due to the influence of manmade structures (OE8)	Purple

Key:

- : commonly agreed methodological standard (at least 1 sub-region) and contributing to QSR 2023
- : candidate methodological standard (under development)
- : Pilot assessment proposed to contribute to QSR 2023
- new**: new assessment for QSR2023
- update**: update of 2017 assessment
- [...]**: resources limitations
- : coherence/cooperation opportunity from OSPAR to UNEP/MAP
- : harmonisation/cooperation opportunity for both OSPAR and UNEP-MAP
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Annexe I – MSFD GES elements for Descriptors 1, 4, 5 and 6 (Commission Decision (EU) 217/848)

Descriptor 1 – Theme Benthic habitats (relating to Descriptors 1 and 6)

Table 33: Descriptor 1 - Benthic habitats: criteria, including criteria elements, and methodological standards (EU, 2017)

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.	<p>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.</p> <p>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.</p>
	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.	

Specifications and standardised methods for monitoring and assessment

1. Species composition shall be understood to refer to the lowest taxonomic level appropriate for the assessment.
2. The trophic guilds selected under criteria elements shall take into account the ICES list of trophic guilds ⁽¹⁾ and shall meet the following conditions:
 - (a) include at least three trophic guilds;
 - (b) two shall be non-fish trophic guilds;
 - (c) at least one shall be a primary producer trophic guild;
 - (d) preferably represent at least the top, middle and bottom of the food chain.

Units of measurement:

- D4C2: total abundance (number of individuals or biomass in tonnes (t)) across all species within the trophic guild.

⁽¹⁾ ICES Advice (2015) Book 1, ICES special request advice, published 20 March 2015.

Descriptor 4 – Theme Ecosystem

Table 34: Descriptor 4 - criteria, including criteria elements, and methodological standards (EU, 2017)

Criteria elements	Criteria	Methodological standards
Trophic guilds of an ecosystem. Member States shall establish the list of trophic guilds through regional or subregional cooperation.	<p>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.</p>	<p>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.</p> <p>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.</p>
	<p>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.</p>	
	<p>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.</p>	
	<p>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.</p>	

Specifications and standardised methods for monitoring and assessment

1. Species composition shall be understood to refer to the lowest taxonomic level appropriate for the assessment.
 2. The trophic guilds selected under criteria elements shall take into account the ICES list of trophic guilds ⁽¹⁾ and shall meet the following conditions:
 - (a) include at least three trophic guilds;
 - (b) two shall be non-fish trophic guilds;
 - (c) at least one shall be a primary producer trophic guild;
 - (d) preferably represent at least the top, middle and bottom of the food chain.
- Units of measurement:
- D4C2: total abundance (number of individuals or biomass in tonnes (t)) across all species within the trophic guild.

⁽¹⁾ ICES Advice (2015) Book 1, ICES special request advice, published 20 March 2015.

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

Table 35: Descriptor 5 - criteria, including criteria elements, and methodological standards (EU, 2017)

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: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) 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:
Chlorophyll <i>a</i> in the water column	D5C2 — Primary: Chlorophyll <i>a</i> concentrations are not at levels that indicate adverse effects of nutrient enrichment. The threshold values are as follows: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) 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.	(a) 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; (b) 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.	(c) 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: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC;	Beyond coastal waters, the use of the secondary criteria shall be agreed at regional or subregional level.

Criteria elements	Criteria	Methodological standards
	(b) 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.	The outcomes of the assessments shall also contribute to assessments for pelagic 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);
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: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) 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.	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).
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: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) 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.	
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: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) should this criterion be relevant for waters beyond coastal waters, values consistent with those for coastal waters	

Criteria elements	Criteria	Methodological standards
	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: (a) in coastal waters, the values for benthic biological quality elements set in accordance with Directive 2000/60/EC; (b) 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.	

Specifications and standardised methods for monitoring and assessment

1. In coastal waters, the criteria elements shall be selected in accordance with Directive 2000/60/EC.
2. For D5C2 and D5C3, Member States may in addition use phytoplankton species composition and abundance.
3. Information on the pathways (atmospheric, land- or sea-based) for nutrients entering the marine environment shall be collected, where feasible.
4. Monitoring beyond coastal waters may not be necessary due to low risk, such as in cases where the threshold values are achieved in coastal waters, taking into account nutrient input from atmospheric, sea-based including coastal waters, and transboundary sources.
5. Assessments under Directive 2000/60/EC shall be used for the assessments of each criterion in coastal waters.
6. Values set in accordance with Directive 2000/60/EC shall refer either to those set by intercalibration under Commission Decision 2013/480/EU ⁽¹⁾ or to those set in national legislation in accordance with Article 8 and Annex V of Directive 2000/60/EC. These shall be understood as the 'Good-Moderate boundary' for Ecological Quality Ratios.
7. Species composition shall be understood to refer to the lowest taxonomic level appropriate for the assessment.

⁽¹⁾ Commission Decision 2013/480/EU of 20 September 2013 establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration exercise and repealing Decision 2008/915/EC (OJ L 266, 8.10.2013, p. 1).

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 a permanent change of seabed substrate or morphology and to the extraction of seabed substrate); physical disturbance to the seabed (temporary or reversible)

Table 36: Descriptor 6 - criteria, including criteria elements, and methodological standards (EU, 2017)

Criteria elements	Criteria	Methodological standards
Trophic guilds of an ecosystem. Member States shall establish the list of trophic guilds through regional or subregional cooperation.	D6C1 — 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.
	D6C2 — 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.	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.
	D6C3 — 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.	

Specifications and standardised methods for monitoring and assessment

1. Species composition shall be understood to refer to the lowest taxonomic level appropriate for the assessment.
2. The trophic guilds selected under criteria elements shall take into account the ICES list of trophic guilds ⁽¹⁾ and shall meet the following conditions:
 - (a) include at least three trophic guilds;
 - (b) two shall be non-fish trophic guilds;
 - (c) at least one shall be a primary producer trophic guild;
 - (d) preferably represent at least the top, middle and bottom of the food chain.

Units of measurement:

- D4C2: total abundance (number of individuals or biomass in tonnes (t)) across all species within the trophic guild.

⁽¹⁾ ICES Advice (2015) Book 1, ICES special request advice, published 20 March 2015.

Annexe II – Characteristics of OSPAR Benthic Habitat Indicators (July 2022 status)

Table 37: The benthic habitats ecosystem components and associated indicator characteristics used for the OSPAR 2017 intermediate assessment. Agreement status (common in bold, candidate in italic), the underlying data, method, time period, region(s)/sub-region(s) assessed, and spatial coverage are also identified. Lastly, links to its use in OSPAR IA2017, its methodology, published as part of the OSPAR Coordinated Environmental Monitoring Programme (CEMP), and further publications using the indicator are included (from McQuatters-Gollop et al, 2022). OSPAR Regions: I = Arctic waters; II = Greater North Sea; III = Celtic Seas; IV = Bay of Biscay & Iberian Coast; V = Wider Atlantic

Indicator short code	Indicator name	Underlying data	Agreement status	(Sub)-region(s) assessed in 2017	Spatial coverage of data	Data analysis method	IA2017, CEMP method guidelines, and additional references
BH1	Sentinels of the Seabed (SoS)	Habitat maps and sensitivities matrices, benthic communities species relative abundances & sensitivities and pressure extent and intensity	Common in Region IV. <i>Candidate in Region II and III</i>	None	Data throughout these regions	Species sensitivities classification, baseline values, multi-metric index, pressure state relationship curves (ground-truthed data assessment) and spatial analysis of habitat (model risk-based approach)	Serrano et al (2022) https://doi.org/10.1016/j.ecolind.2022.108979 CEMP <i>In prep</i> through NEA PANACEA project and for OSPAR QSR 2023
BH2	The common conceptual approach to assessing the condition of benthic habitat-defining communities	Benthic communities' species' relative abundances and pressure extent and intensity	Common in Regions II, III and IV	Not assessed per se	Not assessed per se	Common conceptual approach, assessment scales, and parameters (common concepts)	IA2017: https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/condition-of-benthic-habitat-defining-communities/common-conceptual-approach/ (OSPAR, 2017a) CEMP: https://www.ospar.org/documents?v=39000 (OSPAR, 2018)
BH2-A	Assessment of coastal habitats in relation to nutrient and/or organic enrichment	Benthic macrofauna and macroalgae and angiosperms communities' species and relative abundances	Common in Regions II, III and IV	Greater North Sea (coastal) Celtic Seas (coastal) Bay of Biscay & Iberian Coast (coastal)	WFD stations (coastal) throughout these regions	Multi-metric indices (notably reported for Water Framework Directive (WFD) (ground-truthed data assessment)	IA2017: https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/condition-of-benthic-habitat-defining-communities/condition-benthic-habitat-communitites-assessment-coastal-habita/ (OSPAR, 2017b) CEMP: https://www.ospar.org/documents?v=39000 (OSPAR, 2018)

Indicator short code	Indicator name	Underlying data	Agreement status	(Sub)-region(s) assessed in 2017	Spatial coverage of data	Data analysis method	IA2017, CEMP method guidelines, and additional references
BH2-B	Subtidal habitats of the southern North Sea	Benthic macrofauna communities' species relative abundances and abrasion pressure extent and intensity.	Common in Regions II, III and IV	The southern part of the Greater North Sea	Data throughout this sub-region	Multi-metric indices and area-related baseline values (ground-truthed data assessment)	IA2017 : https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/condition-of-benthic-habitat-defining-communities/subtidal-habitats-southern-north-sea/ (OSPAR, 2017c) CEMP: https://www.ospar.org/documents?v=39000 (OSPAR, 2018) Van Loon et al. (2018) https://doi.org/10.1016/j.ecolind.2017.09.029 <i>Updates In prep through NEA PANACEA project and for OSPAR QSR 2023</i>
BH3	Extent of physical damage to benthic broad habitat types	Habitat maps and sensitivities matrices and abrasion pressure extent and intensity. Physical pressures are currently limited to bottom-trawling fisheries surface and sub-surface abrasion.	Common in Regions II, III and IV	Greater North Sea Celtic Seas Bay of Biscay & Iberian Coast (coastal)	Data throughout these regions	Spatial analysis of habitat distribution and sensitivity, versus pressure extent and intensity (model risk-based approach)	IA2017: https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/extent-physical-damage-predominant-and-special-habitats/ (OSPAR, 2017d) CEMP: https://www.ospar.org/documents?v=37641 (OSPAR, 2017e) <i>Updates In prep through NEA PANACEA project and for OSPAR QSR 2023</i>
BH4	<i>Area of habitat loss</i>	<i>Habitat maps and sensitivities matrices and physical pressures extent and intensity.</i>	<i>Under development. Candidate in Region II</i>	<i>None. Pilot assessment planned in Region II</i>	<i>Data throughout this region</i>	<i>Spatial analysis of habitat distribution and sensitivity, versus pressure extent and intensity (model risk-based approach)</i>	<i>CEMP In prep through NEA PANACEA project and for OSPAR QSR 2023</i>
BH5	<i>Size distribution of bivalves or other sensitives species</i>	<i>Benthic communities' selected species' size distribution and pressure extent and intensity</i>	<i>Under an early stage of development.</i>	<i>None. No Pilot assessment is planned for QSR 2023</i>			
BISI	<i>Benthic Indicator Species Index (BISI)</i>	<i>Benthic communities' species' relative abundances & sensitivities and pressure extent and intensity</i>	<i>Under development. Candidate in Region II</i>	<i>None. Pilot assessment planned in Region II</i>	<i>Data throughout this region</i>	<i>Species sensitivities classification, baseline values, multi-metric index and pressure state relationship curves</i> <i>(ground-truthed data assessment)</i>	<i>CEMP In prep through NEA PANACEA project and for OSPAR QSR 2023</i>

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Annexe III – National distributions of MSFD broad habitat types (from TG Seabed, Dec. 2020)

Table 38: National distribution of MSFD broad habitat types (In Boschetti et al 2021, from TG Seabed). *Since this analysis based on this version, an updated version from TG Seabed-9 (Jan 2022) is now (Oct. 2022) available at: <https://circabc.europa.eu/ui/group/326ae5ac-0419-4167-83ca-e3c210534a69/library/970714d8-3405-427d-8f4c-e8aa85b06b01/details>. Some of the “reported since at not existing in MS waters” were notably completed.*

Region	Baltic Sea								North-east Atlantic Ocean										Mediterranean Sea										Black Sea														
	Subregion								Greater North Sea					Celtic Seas			Bay of Biscay & Iberian Coast		Macaronesia		Western Mediterranean Sea				Ionian Sea & Central Mediterranean Sea			Adriatic Sea			Aegean-Levantine Sea												
MSFD broad habitat type	FI	EE	LV	LT	PL	DE	DK	SE	SE	DK	DE	NL	BE	FR	UK	UK	IE	FR	FR	ES	PT	PT	ES	ES	UK	FR	IT	IT	MT	EL	IT	SI	HR	EL	EL	CY	BG	RO					
Littoral rock and biogenic reef											Y			Y			Y	Y	Y		Y	Y				Y						Y	Y						Y	Y			
Littoral sediment											Y	Y			Y		Y	Y	Y		Y	Y				Y						Y	Y							Y	Y		
Infralittoral rock and biogenic reef	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Infralittoral coarse sediment			Y			Y					Y			Y			Y	Y	Y		Y					Y						Y	Y							Y	Y		
Infralittoral mixed sediment	Y	Y	Y		Y	Y	Y	Y	Y	Y	N			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	
Infralittoral sand	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Infralittoral mud	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Circalittoral rock and biogenic reef	Y	Y	Y	Y	Y	Y	Y	Y			Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y					Y	Y	Y	Y	Y		
Circalittoral coarse sediment	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y		Y	Y	Y				Y	Y	Y	Y	Y	Y		
Circalittoral mixed sediment	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y		Y	Y	Y			Y	Y	Y	Y	Y	Y	Y		
Circalittoral sand	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Circalittoral mud	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Offshore circalittoral rock and biogenic reef			Y					Y			Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y				Y		N	N					
Offshore circalittoral coarse sediment	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y		Y						Y		Y	N					
Offshore circalittoral mixed sediment	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y					Y		Y		Y	Y	Y	Y		
Offshore circalittoral sand	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y			
Offshore circalittoral mud	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Upper bathyal rock and biogenic reef								Y							Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y						Y		N	Y					
Upper bathyal sediment								Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Lower bathyal rock and biogenic reef															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y		N	?					
Lower bathyal sediment															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y		Y	Y	Y	Y			
Abyssal															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y		Y	Y	Y	Y			
Checked																																											
Date																																											
Key	Habitat present (Y) or absent (blank) based on 2016 EMODnet MSFD broad habitat								Y	Y	Y	Y	Y	Y																													
	Habitat present (Y) or absent (N) based on feedback from TG Seabed members								Y	Y	Y	Y/N	Y	N																													

Annexe IV – National reported determinations of GES for MSFD Descriptor 6 for the 2nd MSFD cycle

Table 39: Descriptor 6 GES determinations as reported by European Members States in HTML versions of the reports (2nd MSFD cycle)

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
BE	NEA	The integrity of the seabed is such that the structure and functions of the ecosystems are ensured and that benthic ecosystems in particular are not disproportionately affected.	Permanent changes to the seabed (km ² or per cent relative to the natural size of the habitat) due to different human activities (including permanent changes to the seabed substrate or natural seabed morphology through physical restructuring, infrastructure development and loss of substrate through the extraction of seabed raw materials). Physical loss shall be understood as a permanent change to the seabed which has lasted or is expected to last for a period of two reporting cycles (12 years) or more. The assessment includes quantification of the lost area compared to the total natural size of all benthic habitats	Physical disturbances (km ² or per cent relative to the natural size of the habitat) due to different human activities (such as seabed disturbances) which change the seabed, but whose seabed can recover if the activities causing disturbances are eliminated.	The spatial extent of each habitat type (km ² or% relative to the natural size of the habitat) that has been harmed by changes in the biotic and abiotic structure and its functions (eg due to changes in species composition and their relative density, non-habitat occurrence of particularly sensitive or vulnerable species or species having an essential function, the size composition of species), due to physical disturbances. Member States should set thresholds for the harmful effects of physical disruptions through regional or sub-regional cooperation.	The extent of the loss of the habitat type as a result of anthropogenic loads is no greater than a determined part of the natural size of the habitat type in the area under assessment. Member States shall determine the maximum allowable extent of habitat loss as part of the total natural size of the habitat type, through cooperation at Union level, taking into account regional or sub-regional specificities.	The extent of the harmful effects of anthropogenic loads on the state of the habitat type, including modification of the biotic and abiotic structure and its functions (eg their characteristic species composition and their relative density, the non-occurrence of particularly sensitive or vulnerable species or species that have an essential function, the size composition of species), is no greater than a fixed proportion of the natural size of the habitat type in the area under assessment.

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
			in the area under assessment (e.g. due to the magnitude of the anthropogenic change).				
BG	BLAC		Spatial extent and distribution of physical loss (permanent change) of the natural seabed.	Spatial extent and distribution of physical disturbance pressures on the seabed.	The spatial extent of each habitat type adversely affected by physical disturbance.	The extent of habitats subjected to physical loss.	The extent of adverse effects from anthropogenic pressures on the condition of the habitat type does not exceed a specified proportion of the natural extent of the habitat type in the assessment area.
CY	MED	The marine environment of Cyprus is considered to be in good environmental status by the year 2020 if the structure and function of the ecosystem are safeguarded and not adversely affected. Specifically, diversity and productivity are maintained, and any pressures do not hinder the ecosystem components to recover and/or retain their natural diversity, productivity and dynamic ecological processes. Given the available data, the determination of the GES of this Descriptor relies heavily on criterion 6.2, which in turn is based on indicator 6.2.2. Indicator 6.2.2 is calculated using the various multimetric indices that have been developed in the framework of the Water-Framework Directive (2000/60/EC) for angiosperms, macroalgae and macrobenthos (and presently assigned a value of 0.9875)..	The length of permanently altered coastline and estimated 100 m wide coastal water band have increased by 44% and 8% between 2012 and 2019. However, the actual fraction of affected coastline remains relatively low. A value of 0.75 is ascribed to this criterion.	Percent change from 2012 to 2019. Based on the information compiled for this reporting, a conservative overall score of 0.75 is ascribed to this criterion.	Assuming that the above indicators contribute equally to criterion D6C3, an average value of 0.8 can be ascribed to the criterion itself.	None	None
DE	NEA	It can be said that overall GES for D6 cannot yet be established, but at the minimum, good environmental status is achieved if: ... the coastal waters in accordance with the Water Framework Directive are in good environmental status and in good chemical status. ... are in a favourable conservation status for the habitat types of Annex I (habitat type 11) to the Habitats Directive relevant to the marine sector in the North Sea. ... the species of Annex II to the Habitats Directive, relevant for the marine sector in the North Sea, as well as species of the Birds Directive relevant to the marine sector in the North Sea, are in favourable	None	None	None	None	None

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
		<p>conservation status due to the quality of their food habitat. ... the species, species groups and habitats listed in the Wadden Sea are in good condition. ... the objectives are achieved by single species or group specific conventions (e.g. ASCOBANS, seal agreement). ... the Ecological Quality Objectives (EcoQO), as defined by OSPAR. The criteria for assessing GES for D6-benthos are set out in Commission Decision (EU) 2017/848: D6C1, D6C2, D6C3, D6C4, D6C5. Explanation: Germany does not update the general description of good environmental status (GES) from 2012 at Descriptor level in this reporting exercise. Over the reporting period, Germany has worked with the North Seas countries in the framework of the EU's MSFD process and in OSPAR to develop methodological standards (indicators, evaluation procedures). Specific aspects of criteria and indicators that contribute to a quantitative assessment of good environmental status are reported in the reporting scheme Art. 8_GES. For the assessment of the criteria set out in Commission Decision (EU) 2017/848, the relevant assessments under other EU directives shall be taken into account under Article 8_GES, taking into account, as far as possible, the regional assessments that have been coordinated so far and, on a case-by-case basis, supplemented by national assessments.</p>					
DE	BAL	<p>It can be said that the GES for D6 as a whole cannot yet be established, but at least as a prerequisite is the achievement of good environmental status if: ?... the coastal waters in accordance with the Water Framework Directive are in good environmental condition and in good chemical status. ... are in a favourable conservation status for the habitat types of Annex I (habitat type 11) to the Habitats Directive relevant to the marine environment in the Baltic Sea. ... the species of Annex II to the Habitats Directive, relevant for the</p>	None	None	None	None	None

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
		<p>marine sector in the Baltic Sea, as well as species of the Birds Directive relevant for the marine sector in the Baltic Sea, are in favourable conservation status due to the quality of their food habitat. ... the objectives are achieved by single species or group specific conventions (e.g. ASCOBANS, Jastarnia plan). ... HELCOM's biodiversity is in good condition. For the purpose of assessing GES in relation to D1/D6-Benthos, the following criteria are used in Commission Decision (EU) 2017/848: D6C1, D6C2, D6C3, D6C4, D6C5. Explanation: Germany does not update the general description of good environmental status (GES) from 2012 at Descriptor level in this reporting exercise. During the reporting period, Germany has worked with the countries bordering the Baltic Sea in the framework of the EU's MSC CIS process and in HELCOM to develop methodological standards (indicators, evaluation procedures). Specific aspects of criteria and indicators that contribute to a quantitative assessment of good environmental status are reported in the reporting scheme Art. 8_GES. For the assessment of the criteria set out in Commission Decision (EU) 2017/848, the relevant assessments under other EU directives shall be taken into account under Article 8_GES, taking into account, as far as possible, the regional assessments that have been coordinated so far and, on a case-by-case basis, supplemented by national assessments.</p>					
DK	NEA/ BAL	<p>The integrity of the seabed is at a level where the structure and functions of ecosystems are preserved and where benthic ecosystems in particular are not adversely affected. The description also covers D6C1, D6C2 and D6C3.</p>	None	None	<p>The assessment must consider whether the physical disturbance in question has a negative impact. This assessment must be made for the various physical disturbances that could potentially have a negative impact on the seabed. Whether a physical disturbance will cause a negative impact depends on the seabed's vulnerability and tolerance</p>	<p>Extent of loss per habitat type does not exceed a certain proportion of the habitat type's natural extent.</p>	<p>Biodiversity has been maintained and the extent of adverse effects (D6C5) per habitat type does not exceed future EU thresholds for changes in biotic and abiotic structures and functions.</p>

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
					to the disturbance and how quickly the seabed ecosystem regenerates after the disturbance. For example, a sandy type is exposed to high current and wave influence is expected to be less vulnerable to certain disturbances than a type of habitat that is not normally affected by natural agitation of the water bodies. The extent of each adversely affected habitat type must be calculated in km ² or as a percentage (percent) of the total natural extent of the habitat in the assessment area. The results of the assessment of criterion D6C2 are used for the further assessment in criterion D6C3.		
EE	BAL	None	None	None	GES under the criteria D6C3 is determined via the spatial area of physical disturbance to the habitat type sandbanks (code 1110), estuaries (code 1130), mudflats and sandflats (code 1140), large shallow inlets and bays (code 1160), reefs (code 1170). GES is achieved if the extent of the physically disturbed habitat is ≤ 10% of the total area of the habitat type.	GES under the criteria D6C4 is determined via the spatial area of loss of the habitat type sandbanks (code 1110), estuaries (code 1130), mudflats and sandflats (code 1140), large shallow inlets and bays (code 1160) and reefs (code 1170) resulting from anthropogenic loss of the natural seabed. GES is achieved if the habitat type loss resulting from anthropogenic loss of the natural seabed is ≤ 5% of the total area of the habitat type.	GES under the criteria D6C5 is determined via quality of habitat type reefs (code 1170), mudflats and sandflats (code 1140), sandbanks (code 1110), estuaries (code 1130), large shallow inlets and bays (code 1160). GES is achieved if the numerical value of the habitat type quality indicator is above 0,6 (in addition, all the elements assessed in the indicator must be in the good status). Element threshold values for each habitat type, are listed below. Reefs: distributional range (1x1 km ² grid): 24210 km ² ; area (1x1 km ² grid): 1304 km ² ; structure and functions: ≥90% of the monitoring stations in GES; future perspectives: good. Mudflats and sandflats: distributional range (1x1 km ² grid): 8581 km ² ; area (1x1 km ² grid): 353 km ² ; structure and functions: ≥90% of the monitoring stations in GES; future perspectives: good. Sandbanks: distributional range (1x1 km ² grid): 20823 km ² ; area (1x1 km ² grid): 1007 km ² ;

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
							structure and functions: ≥90% of the monitoring stations in GES and in addition <i>Furcellaria lumbricalis</i> population in Kassary bay in GES; future perspectives: good. Estuaries: distributional range (1x1 km ² grid): 125 km ² ; area (1x1 km ² grid): 108 km ² ; structure and functions: ≥90% of the monitoring stations in GES; future perspectives: good. Large shallow inlets and bays: distributional range (1x1 km ² grid): 10708 km ² ; area (1x1 km ² grid): 495 km ² ; structure and functions: ≥90% of the monitoring stations in GES; future perspectives: good.
EL	MED		Spatial extent and distribution of physical loss (permanent change) of natural seabed.	Spatial extent and distribution of natural disturbance pressures on the seabed.	Spatial extent of any habitat type that is adversely affected by natural disturbances through changes in its biotic and abiotic structure and functions (e.g. through changes in species composition and relative abundance, the absence of particularly sensitive or vulnerable species or species performing a key function, and changes in species size structure). Member States shall set threshold values for the adverse effects of natural disturbances through regional or sub-regional cooperation.	The amount of loss per habitat type caused by anthropogenic pressures does not exceed the specified proportion of the natural area of the habitat type in the assessment area. Member States shall determine the maximum allowable area of habitat loss in the form of a proportion of the total natural area of the habitat type, through cooperation at Union level, taking into account the specificities of each region or sub-region.	The extent of adverse effects of anthropogenic pressures on the condition of the habitat type, including the biotic and abiotic structure and functions of the habitat type (e.g. the composition of typical species and their relative abundance, the absence of particularly sensitive or vulnerable species or species performing a particular function, species size structure), does not exceed the specified proportion of the natural area of the habitat type in the assessment area.
ES	NEA/MED	None	The physical loss of sea bottoms produced by human activities does not reach a spatial extent	Seabed potentially affected by physical disturbance does not reach a spatial extent that would jeopardise the	The extent of each type of benthic habitat adversely affected by physical disturbances maintains negative or stable trends so that their conservation is ensured.	The proportion of the loss surface of each benthic habitat type due to anthropogenic pressures does not	The extent of each habitat type in which benthic communities are kept within values to ensure their durability and performance is maintained or presented with increasing trends.

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
			that would jeopardise the maintenance of the benthic habitats.	maintenance of benthic habitats.		threaten the maintenance of the habitat type.	
FI	BAL				The occurrence or quality of the habitat is not endangered by human activities that cause loss or disturbance to the seabed, and the magnitude of the disturbance must be commensurate with the ecological importance of the habitat and its threat. The integrity of the seabed is assessed for broad habitat types by marine area, with each broad habitat assessed according to the weakest status of the relevant indicators.	The distribution of benthic habitats is equivalent to their natural range and losses are identified only at local level. The state of the integrity of the seabed shall be evaluated for quality habitats by sea basin, so that each broad habitat is assessed according to the weakest status of the relevant indicators.	<p>The lower limit of the bladder wrack zone (5% coverage in 6 m² area; ELS values in brackets) is 3.0 / 3.5 m (0.75 / 0.7) (in shelter / open) in the coastal waters of the Gulf of Finland, in the outer coastal waters of the Gulf of Finland 4.0 / 5 , 0 m (0.73 / 0.77) (sheltered / open), in the southwestern archipelago 3.2 / 4.0 m (0.76 / 0.73) (sheltered / open), in the southwestern archipelago 4.0 / 4 , 5 m (0.73 / 0.75) (shelter / open), in the southwestern archipelago 5.5 / 6.0 m (0.79 / 0.75) (sheltered / open), in the coastal waters of the North Sea 3.0 / 5.2 m (0.76 / 0.74) (sheltered / open), in the outer waters of the Bothnian Sea (not determined), in the Kvarken Inner Archipelago 3.7 m (0.74) (open), in the outer archipelago of Kvarken 4.4 m (0 , 74) (open). There is no species in the Bothnian Bay. The seabed integrity status is assessed for broad habitat types by sea area, with each broad habitat being assessed according to the weakest status of the indicators that characterize them.</p> <p>The value of BQI in the benthic communities in the open sea above the halocline (< 60m in depth) is 0,93 in the Gulf of Finland, 4,0 in the Northern Baltic Sea, 4,0 in the Åland Sea, 4,0 in the Bothnian Sea, 1,5 in the Quark and 1,5 in the Bay of Bothnia. Seabed integrity status shall be evaluated for broad habitat types per sea basin, so that each broad habitat is assessed according to the weakest status of the relevant indicators.</p> <p>The lower limit of the red algae (the lowest individual) for the species <i>Furcellaria lumbricalis</i>, <i>Rhodomela confervoides</i>,</p>

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
							<p>Polysiphonia fucoides and Phyllophora pseudoceranoides is 9.1 m, 7.7 m, 7.7 m and 8.8 m in the inland coastal waters of the Gulf of Finland, 10.2 m in the outer coastal waters of the Gulf of Finland 8.8 m, 8.8 m and 16.5 m, in the southwestern archipelago 10.2 m, 8.8 m, 8.8 m and 11.7 m, in the southwestern archipelago 11.25 m, 9.7 m, 9.7 m and 13.5 m, in the southwestern archipelago 14.2 m, 11.8 m, 11.8 m and 16.5 m, in the coastal waters of the Bothnian Sea 7.0 m, 6.1 m, 6.1 m and 8.5 m, in the northern coastal waters of the Bothnian Sea (not specified), in the Kvarken Inner Archipelago 9.0 m, 7.5 m, 7.5 m and 10.5 m, in the outer archipelago of Kvarken 10.9 m, 9.0 m, 9.0 m and 12.6 m. The seabed integrity status is assessed for broad habitat types by sea area, with each broad habitat being assessed according to the weakest status of the indicators that characterize them.</p> <p>The concentration of dissolved oxygen on the seabed does not fall below the monthly average of 4 mg L⁻¹. The seabed integrity status is assessed for broad habitat types by sea area, with each broad habitat being assessed according to the weakest status of the indicators that characterize them.</p> <p>Seabed habitat plant and animal communities contain habitat-specific species that are sensitive to eutrophication and clouding and / or non-predominant species. The integrity of the seabed is assessed for large habitat types by marine region, with each broad habitat assessed according to the weakest status of the indicators that characterize them.</p>

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
							<p>The water management thresholds (ELS) for coastal benthic communities in the BBI Index are 0.52 / 0.51 (0-10 m /> 10 m) in the Gulf of Finland and 0.56 / 0.56 (0-10 m /> 10 m), In the southwestern inner archipelago 0.53 / 0.57 (0-10 m /> 10 m), In the southwestern intermediate archipelago 0.56 / 0.53 (0-10 m /> 10 m), In the southwestern outer archipelago 0.55 / 0.54 (0-10 m /> 10 m), 0.56 / 0.57 (0-10 m /> 10 m) in the inland coastal waters of the Bothnian Sea, 0.53 / 0.55 (0-10 m) in the outer coastal waters of the Bothnian Sea /> 10 m), Inner Kvarken Archipelago 0.57 / 0.58 (0-10 m /> 10 m), Outer Kvarken Archipelago 0.56 / 0.59 (0-10 m /> 10 m), Inland Gulf Coast 0, 57 / 0.55 (0-10 m /> 10 m) and 0.56 / 0.55 (0-10 m /> 10 m) in the outer Gulf of Bothnia. The integrity of the seabed is assessed for large habitat types by marine region, with each broad habitat assessed according to the weakest status of the indicators that characterize them.</p> <p>The regional species abundance index of the high seas exceeds 3,91 in the Gulf of Finland, 3,0 in Northern Baltic Sea, 2,3 in the Bothnian Sea and 1,37 in the Bay of Bothnia. The state of the integrity of the seabed shall be evaluated for quality habitats by sea basin, so that each broad habitat is assessed according to the weakest status of the relevant indicators.</p>
FR	NEA/MED	None	Spatial extent and distribution of physical loss (permanent change) of the natural seabed (Decision 2017/848/EU).	Spatial extent and distribution of pressures from physical disturbance of the seabed (Decision 2017/848/EU).	Spatial extent of each habitat type adversely affected by changes in its biotic and abiotic structure and functions (e.g. change in species composition and relative abundance, absence of particularly sensitive or fragile species or species performing	None	None

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
					a key function, size structure of species) due to physical disturbance (Decision 2017/848/EU).		
HR	MED	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.	None	None	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.	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.	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.
LT	BAL	None	None	None	<p>For each habitat type that is adversely affected by physical disturbance causing changes in its biotic and abiotic structure and functions (e.g. changes in species composition and relative abundance of species, disappearance of highly sensitive, vulnerable and key function species, changes in size structure of species), spatial scale. The condition is assessed according to the indicator - the area of the soil dumping (sanding) and sand excavation area in the habitat.</p> <p>For each habitat type that is adversely affected by physical disturbance causing changes in its biotic and abiotic structure and functions (e.g. changes in species composition and relative abundance of species, disappearance of highly sensitive, vulnerable and key function species, changes in size structure of species), spatial scale. The condition is assessed by the indicator - the size of</p>	None	The species composition and relative abundance of macrofauna communities reach values indicating that the increase in nutrients and organic matter does not cause adverse effects. The indicator is assigned to criterion D5C8.

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
					the bottom trawling area in the habitat. Extent of adverse effects of physical disturbance on each habitat type in each assessed area. The status is assessed according to the indicator "Size of bottom trawling area in the habitat"		
LV	BAL	D6C1 Physical loss of benthic habitats D6C5 Anthropogenic impact on benthic habitat	None	None	None	None	None
MT	MED	None	None	None	The structure and functions of benthic habitats listed in Directive 92/43/EEC, in terms of species composition and relative abundance (as relevant), are in high/good status on the basis of biotic indices used under Directive 2000/60/EC for more than 75% of the area covered by the habitat.	The area covered by benthic habitats listed in Directive 92/43/EEC is stable and is not smaller than the Favourable Reference Area values where established under Directive 92/43/EEC.	The structure and functions of benthic habitats listed in Directive 92/43/EEC, in terms of species composition and relative abundance (as relevant), are in high/good status on the basis of biotic indices used under Directive 2000/60/EC for more than 75% of the area covered by the habitat.
					The structure and functions of MSFD predominant habitat types do not deviate from normal conditions and are in high/good status on the basis of biotic indices used under Directive 2000/60/EC, where established.	The area covered by MSFD broad benthic habitats is stable and is representative of all its natural distributional range.	The structure and functions of MSFD predominant habitat types do not deviate from normal conditions and are in high/good status on the basis of biotic indices used under Directive 2000/60/EC, where established.
NL	NEA	None	No significant loss of the natural seabed compared to the situation in 2012 resulting from human activities.	No increase in time of the physical disturbance of the entire sea bed of the whole North Sea and the NCP.	No increase in time of the physical disturbance of the habitats described under the MSFD.	No significant loss due to human activities of the habitats described under the MSFD.	The diversity of benthos does not show a decreasing trend in the assessed areas (OSPAR- assessment value).
					Improvement in the quality of the assessed areas and habitats in the Dutch part of the North Sea (Benthic Indicator Species Index).		
PL	BAL	Regional threshold values have not been established yet. National values have been used instead. GES is determined on the basis of the modified indicator relevant for criterion D6C2 for WFD waters	GES is determined on the basis of the modified indicator relevant for criterion D6C1 for WFD waters.	GES is determined on the basis of the indicator relevant for criteria D6C2.	GES is determined as a sum of the results of indicator relevant for criteria D6C1 and D6C2.	None	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

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
		<p>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. The threshold values are as follows: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Values were established through regional or subregional cooperation (HELCOM)</p>					<p>species or species providing a key function, size structure of species), is not adversely affected due to anthropogenic pressures. The threshold values are as follows: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Values were established through regional or subregional cooperation (HELCOM).</p>

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
RO	BLK	None	Spatial extent and distribution of physical loss (permanent change) of the natural seabed are at levels that are not adversely affecting the structure and functions of the marine environment	Spatial extent and distribution of physical disturbance of the natural seabed are at levels that are not adversely affecting the structure and functions of the marine environment	None	The extent of loss of the habitat type, resulting from anthropogenic pressures, is at levels that are not adversely affecting the structure and functions of the benthic habitats.	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 (benthic communities typical species composition, absence of particularly sensitive or fragile species or species providing a key function) is at levels that is not adversely affecting the structure and functions of the ecosystem. GES is assessed using the multimetric index M-AMBI*(n) that should be above the threshold value.
SE	NEA/BAL	Good state of the marine environment according to the quality Descriptor The integrity of the seabed (D6) is achieved when the state of the seabed is at a level that ensures the protection of the structure and function of ecosystems and prevents adverse impacts on benthic ecosystems in particular.	None	None	Spatial extent of any habitat type adversely affected by physical disturbance, by altering its biotic and abiotic structure and its functions (eg by changes in species composition and species relative abundance, by the absence of particularly sensitive or delicate species or species that provides an important function, the size structure of the species). Physical disturbance of habitat types: Good environmental status: Method for quantitative assessment of this criterion is missing. D6C3 Spatial extent of each habitat type adversely affected by physical disturbance, through change in its biotic and abiotic structure and its functions (eg 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). GES: Definition of GES at criteria level is not yet available.	None	The extent of adverse effects of human stress on the habitat type condition, including alteration of its biotic and abiotic structure and its functions (eg, typical species composition and relative abundance of these species, absence of particularly sensitive or fragile species or species providing an important function) , species size structure) does not exceed a certain proportion of the habitat type's natural extent in the assessment area. Good environmental status: When 90% of the area for each habitat type meets the thresholds for relevant indicators. 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 (eg, its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing key function, size structure of species) does not exceed a specified proportion of the natural extent of the habitat type in the assessment area. GES: When at least 90% of each habitat type area achieves the threshold values for the relevant indicators.

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
SI	MED	<p>Good state of the marine environment according to the quality Descriptor The integrity of the seabed (D6) is achieved when the state of the seabed is at a level that ensures the protection of the structure and function of ecosystems and prevents adverse impacts on benthic ecosystems in particular.</p> <p>A good state of the marine environment in relation to the state of benthic habitat types is achieved when their quality, presence, distribution are in accordance with the prevailing physiographic, geographical and climatic conditions.</p>	None	None	None	None	None
IE	NEA	None	Ireland has achieved Good Environmental Status within its maritime area under primary criterion D6C1 - spatial extent and distribution of physical loss (permanent change) of the natural seabed.	The environmental status under primary criterion D6C2 - spatial extent and distribution of physical disturbance pressures on the seabed - is currently unknown within Ireland's maritime area.	None	Ireland has achieved Good Environmental Status within its maritime area under primary criterion D6C4 - the extent of loss of the habitat type, resulting from anthropogenic pressures.	The environmental status under primary criterion 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 - is currently unknown within Ireland's maritime area.
IT	MED	G 1.2 The marine habitats listed in the Habitats Directive and referred to the SPA / BD protocol of the Barcelona Convention maintain or achieve a satisfactory conservation status. G 6.1 There is no significant pressure due to: a) physical perturbations caused by anthropogenic activities that operate actively on the seabed and b) physical loss on biogenic substrates connected to anthropic activities. These GES G1.2 and G 6.1 include primary criteria D6C4 and D6C5.	G 6.1 There is no significant pressure due to: (a) physical disturbances caused by human activities active on the seabed and (b) physical loss on biogenic substrates linked to anthropogenic activities.	G 6.1 There is no significant pressure due to: (a) physical disturbances caused by human activities active on the seabed and (b) physical loss on biogenic substrates linked to anthropogenic activities.	G 6.1 There is no significant pressure due to: (a) physical disturbances caused by human activities active on the seabed and (b) physical loss on biogenic substrates linked to anthropogenic activities.	None	
PT	NEA	The evaluation of the Red List of Habitats in Europe considers that for most of the habitats that occur in the North-east Atlantic, the existing data are insufficient by the fact that GES cannot be assessed (Gubbay et al., 2016), although pressures, trends and conservation measures can be determined. According to the list, there are six natural habitats,	None	None	None	None	None

Country	Region	D6 Sea-floor integrity/ D1 Benthic habitats	D6C1 Physical loss of the seabed	D6C2 Physical disturbance to the seabed	D6C3 Adverse effects from physical disturbance	D6C4 Benthic habitat extent	D6C5 Benthic habitat condition
		<p>four classified as vulnerable and two as In Danger. The habitats identified in the regulated area are distributed by a variety of ECOCS contexts and in a depth range ranging from 3 to 4 metres above the coast ate at depths of more than 4.000 m (above at abyssal, Schmoning et al., 2015).</p> <p>GES was not determined at the sub-region level as set out in art. 3 of the MSFD. The assessment under art. 8th was based on the level of risk, considering that if the level of risk is reduced, given that activities that affect or alter the integrity of the seabed are not known, the GES is reached.</p>					
UK	NEA	<p>“At the level of the Marine Strategy Framework Directive sub-regions, and in line with prevailing conditions, the loss of biodiversity has been halted and where practicable, restoration is underway: The abundance, distribution, extent and condition of species and habitats in UK waters are in line with prevailing environmental conditions as defined by specific targets for species and habitats. Marine ecosystems and their constituent species and habitats are not significantly impacted by human activities such that the specific structures and functions for their long-term maintenance exist for the foreseeable future. Habitats and species identified as requiring protection under existing national or international agreements are conserved effectively through appropriate national or regional mechanisms.”</p> <p>Seafloor habitats (physically and structurally) are both productive and sufficiently extensive at the level of the Marine Strategy Framework Directive sub-regions, to carry out natural functionality, including the necessary ecological processes which underpin ecosystem goods and services, and are capable of supporting a healthy and sustainable ecosystem for the long term.</p>					

Summary

This study aims to compare, synthesize and analyse the main elements reported by the 23 European Union Member States for the MSFD under article 9 (determination of GES) to guide the assessment of environmental quality status for benthic habitats through Descriptor 6 (sea-floor integrity).

Moreover, in the context of the NEA PANACEA project, potential links with MSFD Descriptor 4 (food webs), Descriptor 5 (eutrophication) and Regional Sea Conventions' methodological standards, notably from OSPAR, were scrutinized, to conclude on current gaps and guide future progress to reinforce cooperation and coherence in next MSFD, Regional Sea Convention and national reporting cycles.

This report also reviewed and digested the main previous related analyses and documentation, but it is not an MSFD article 12 assessment (technical assessment of countries reporting obligations under MSFD). This study, conducted under a scientific project, focuses on analysing technically the GES elements, to provide guidance on technical assessment methods, but not on the reporting process itself.

After the conclusions of this analysis, some key recommendations and views are provided, also including personal views from experienced authors, to guide and encourage technical ways to progress towards a better harmonisation of GES elements and to guide future assessments of benthic habitats at European, regional and national scales.

The proposed links between MSFD Descriptor 6 and some other related Descriptors (both for state and pressures aspects), with the most recent OSPAR methodological standards, for which technical documentation will be published in 2023, are proposed in two summary tables (for benthic habitat aspects in Descriptors 1, 2, 4, 5, 6 and 7).

All results data are included in this report as an embedded file, and main related documentation as references and hyperlinks.

