European Commission

JRC TECHNICAL REPORT

Marine Strategy Framework Directive Review and analysis of EU Member States' 2018 reports

Descriptor 11: Underwater Noise and Energy

Assessment (Art.8), Good Environmental Status (Art. 9) and Targets (Art. 10)

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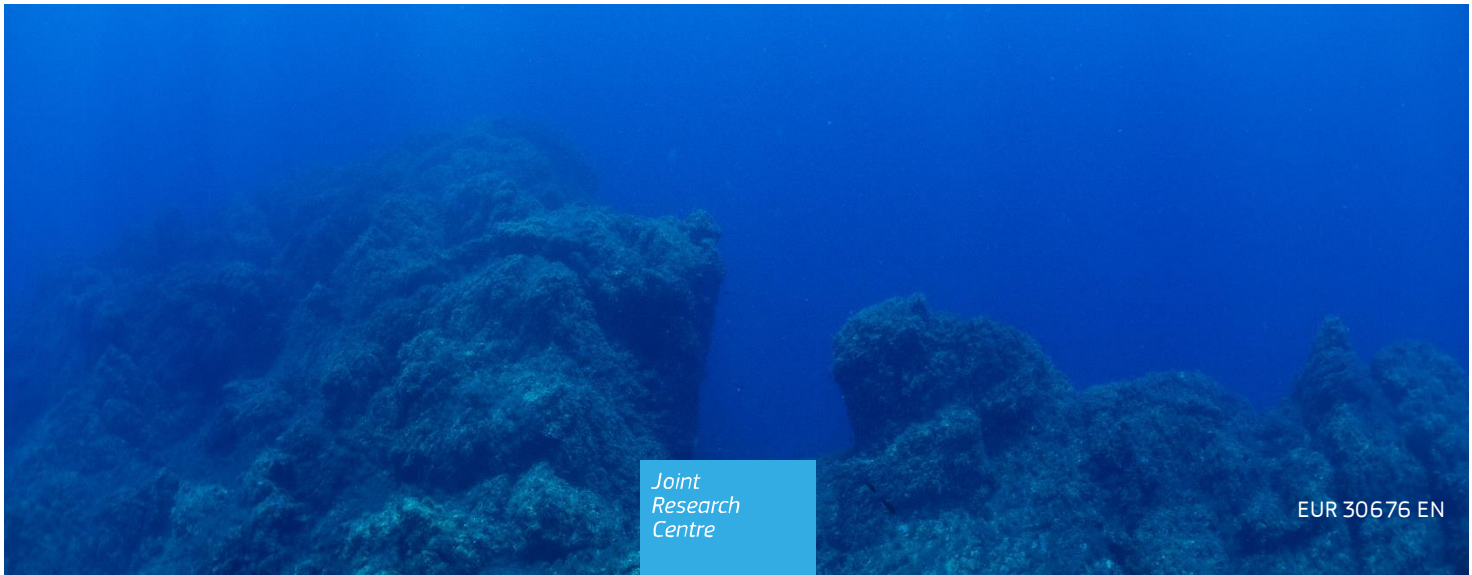
2021



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JRC124922

EUR 30676 EN

PDF ISBN 978-92-76-36186-2 ISSN 1831-9424 doi:10.2760/20326

Luxembourg: Publications Office of the European Union, 2021

How to cite this report: Vighi M, Boschetti S. T., Hanke G., Marine Strategy Framework Directive, Review and analysis of EU Member States' 2018 reports, Descriptor 11: Underwater Noise and Energy, Assessment (Art.8), Good Environmental Status (Art. 9) and Targets (Art. 10), EUR 30676 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-36186-2, doi:10.2760/20326, JRC124922.

Contents

Foreword

The Marine Directors of the European Union and all EU Member States have jointly developed a common strategy for supporting the implementation of the "Marine Strategy Framework Directive" (MSFD), 2008/56/EC, amended by Commission Directive (EU) 2017/845 of 17 May 2017.

The European Commission Joint Research Centre is delivering thematic technical reports to support MSFD implementation, such as guidance documents, technical background reports and analyses related to EU Member States reporting. These thematic reports are targeted at experts who are directly or indirectly implementing the MSFD and support the further development of the Directive.

The JRC's technical report series "Marine Strategy Framework Directive - Review and analysis of EU Member States' 2018 reports", analyse, from a technical point of view, the MSFD reports submitted by EU Member States pursuant to MSFD Article 17. The analysis includes the GES Assessment (Article 8), the determination of Good Environmental Status (Article 9) and the Targets setting (Article 10). The outcome provides information for the further development of the policy implementation, supported by the EU Member States through established MSFD Technical Groups and Expert Networks.

Abstract

EU Member States (MS) have reported under Article 17 of the Marine Strategy Framework Directive (MSFD) for updating Articles 8, 9 and 10 of the Directive, for the last 6-year reporting cycle (2012-2018). This report analyses the information on MSFD Descriptor 11 (Underwater Noise and Energy). Information has been retrieved from 14, 19 and 16 MS for Art.8, Art.9, and Art.10, respectively (out of the 22 EU MS with a sea border).

This analysis evaluates the consistency and comparability among MS and marine regions in the consideration of different elements and parameters concerning D11 and in the application of methodological standards for their assessment. The main aim is to highlight gaps and limitations in current assessments, identify items that need further work and provide recommendations for improvement in the next MSFD reporting cycle.

1 Introduction

Marine Noise and Energy are among the pressures affecting the (good) environmental status of marine waters under the Marine Strategy Framework Directive (MSFD). According to the MSFD Commission Decision (EU) 2017/848, they are considered under the Descriptor 11.

Due to the ongoing development of harmonised methodologies for monitoring and assessment of noise and other forms of energy, D11 has been challenging. Here the results from the review of MS reports are being presented in order to provide input to discussions on the further development of harmonised approaches and to facilitate future reporting.

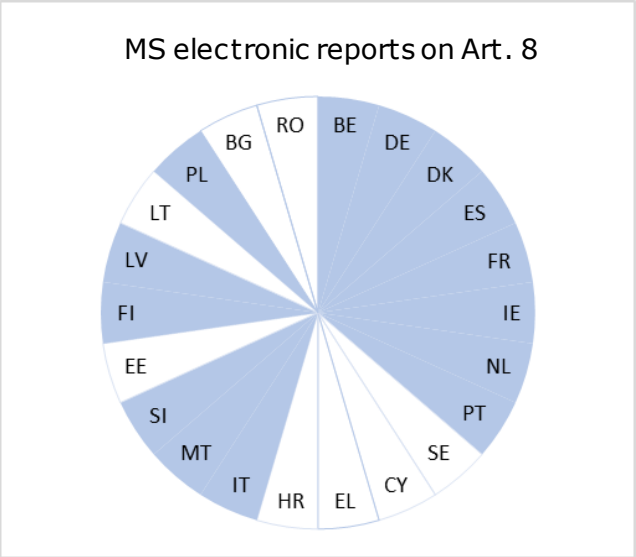
During 2018-2020, following the Article 17 requirements of updating reporting on Articles 8, 9 and 10, MS have reported information for the last 6-year MSFD reporting cycle. Information related to D11 is reviewed and analysed in the current report. The scope of the work is to evaluate the degree of completeness and comparability of MS assessments, consistency between MS/regions, coherence with relevant policies, and reporting gaps and needs. This review process will also support a systematic overview on the progress in the MSFD implementation, including the identification of priority needs for improving assessments approaches in the view of reaching or maintaining GES in EU.

The MS electronic reports are the primary source of information, which is complemented, where needed and feasible, with information from the MS text reports.

The information analysed here includes the reports provided by 14, 19 and 16 MS for Art.8, Art.9, and Art.10, respectively (out of the 22 EU MS with a sea border).

2 Results of Art. 8 analysis

The analysis of Art. 8, Assessment, was performed considering the electronic reports received from 14 MS.



North-East Atlantic (NEA): 88.9 %

- ANS 5/6
- ABI 3/3
- AMA 2/2
- ACS 2/2

Baltic Sea (BAL): 62.5%

Mediterranean Sea (MED): 62.5%

- MWE 3/3
- MAD 2/3
- MAL 0/2
- MIC 2/3

Black Sea (BLK): 0%

Figure 1. Proportion of MS providing electronic reports (in blue).

2.1 Consistency, comparability and adequacy of reported criteria elements and features assessed at EU and regional level

The level of consistency and comparability of information on the assessment of features and elements reported by the MS was explored considering the "Features" and "Elements" information reported in the MS reports.

According to the data extracted from the electronic reports, all MS referred the information reported either to the feature "PresEnvSoundImpulsive", corresponding to the criterium D11C1, or the feature "PresEnvSoundContinuous", corresponding to the Criterion D11C2.

No MS reported information regarding other elements and their source, except FR, which included for criterion D11C1 the elements *Potentially annoying impulsive emissions* and *Potentially lethal impulsive emissions* ("PresEnvSoundImpulsiveAnnoy" and "PresEnvSoundImpulsiveLethal" respectively), and for Criterion D11C2 the elements *Ambient noise from maritime traffic with frequency band centered on 125 Hz* and *on 63 Hz* ("PresEnvSoundContinious125" and "PresEnvSoundContinious63" respectively). The element source was referred as to National for all the reported elements.

2.2 Extension in use of MSFD criteria reported at EU, regional and (sub)regional level

Most MS that reported on Art. 8 did so for both criteria D11C1 and D11C2.

In the NEA region, all MS except SE used the MSFD criteria for their reporting, with DK, IE and NL only reporting on D11C1 and the other MS reporting on both criteria.

In the BAL and MED regions, the MS providing electronic reports reported for both criteria, except DK, which only reported on D11C2 (see Table 1 for details).

Table 1. Extension in the use of D11 MSFD criteria (and features) reported by MS, at regional level.

	REGION			
Criteria/Feature	**NEA**	**BAL**	**MED**	**BLK**

D11C1 - PresEnvSoundImpulsive	BE, DE, DK, FR, IE, NL, PT, ES	DE, FI, LV, PL	FR, IT, ML, SI, ES	
D11C1 - PresEnvSoundImpulsive	BE, DE, DK, FR, PT, ES	DE, DK, FI, LV, PL	FR, IT, ML, SI, ES	

2.3 Legislation/policies related to D11 at EU and regional level

Most MS did not provide reference threshold values or qualitative thresholds in their assessments. The MS that provided a source for their threshold values either indicated a National source (BE, FR), or referred to OSPAR guidelines (NL) or the EU MSFD-CIS TG NOISE (IT). ES referred to a document prepared by USA NOAA in 2013 that provides thresholds that can cause effects on marine mammals.

Within the NEA region, most MS listed OSPAR indicators as related indicators to D11C1: OSPAR-D11 impulsive sounds (NL, DK); OSPAR-DIST_IMP_SOUND (DE); OSPAR-Ruido Impulsivo (PT).

In the BAL region, HELCOM and ICES were also mentioned as policy frameworks providing indicators related to D11 (PL indicated ICES Underwater noise as related indicator to D11C1 and BAL-HELCOM-CONTINUOUS LOW FREQUENCY SOUNDS as related indicator to D11C2). DE stated that it has been working with the North Sea and Baltic Sea countries during the reporting period in the framework of the EU, OSPAR and HELCOM to develop monitoring plans and define indicators, which are still under development.

In the MED region, IT and FR mainly referred to the indicators provided within the MSFD (D11 TG Noise) and national related indicators (FR-D11-SoundImpulsive and FR-D11-SoundImpulsive-HighLevel for D11C1; FR-D11-SoundContinuous for D11C2).

Evaluation of MSFD assessment methodology

2.4 Completeness of reported MSFD methodology and reuse of RSC assessments

The extension of the assessment provided differed among MS.

Most MS did not define or use threshold values and thus could not provide an assessment for any of the two criteria. However, even though they did not define trends or describe the status of criteria, some MS (e.g., FR, ES) determined values for the parameters monitored and some other MS provided references to descriptive assessments made through the relative RSC assessment (e.g., FI, DE: HELCOM report, available online at http://stateofthebalticsea.helcom.fi/pressures-and-their-status/underwater-sound, and OSPAR report, available online at https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/distribution-reported-impulsive-sounds-sea).

An overview of the extension of the assessment done by each MS is provided in Table 2.

Table 2. Extension of assessment reported by MS, at regional level, for the two criteria of D11.

	REGION			
Extension of assessment	**NEA**	**BAL**	**MED**	**BLK**
D11C1 Parameter achieved	BE, IE, PT (AMA-PT-SD-PCE)	PL		
D11C1 Criterion status	BE, IE, PT (AMA-PT-SD-PCE)	PL		
D11C1 GES achieved	BE, IE, PT (AMA-PT-SD-PCE)			
D11C1 Descriptive assessment	DE, DK, FR	DE, FI	FR	
D11C2 Parameter achieved	PT (AMA-PT-SD-PCE)			
D11C2 Criterion status	PT (AMA-PT-SD-PCE)			
D11C2 GES achieved	PT (AMA-PT-SD-PCE)			

D11C2 Descriptive assessment	FR, ES	DE, FI	FR, ES	

2.5 Consistency, comparability, and adequacy of methodological standards

To check the consistency, comparability and adequacy of methodological standards, different aspects of the assessment provided by MS were considered, including the indications provided by MS regarding parameters and their sources, thresholds and their sources, and the consistence of values.

• **Parameters and sources**. The parameters indicated by MS for D11C1 were: duration (DUR) (DK, NL, PT, FI, PL, MT, IT), level of sound (LEV-N) (BE, PL, MT, IT); duration of licensed acoustic survey noise events carried out in 2016, 2017 and 2018 (IE), duration of noise events per year (IT), incidence (DE), and risk (PT -AMAPT-SD-PCE). FR reported several values for the parameter duration, assessing separately the duration per first, second, third and fourth quarter of the year, and the duration per year.

The parameters indicated by MS for D11C2 were underwater sound level (SPL) (BE, PT, ES, FR, DK, PL, MT, FR), sound level per unit of area (IT), risk (PT—AMA-PT-SD-PCE), evolution of underwater level (FR), and underwater sound level at 63, 125, and 2000 Hz (FI).

• **Threshold values**. MS were required to provide both lower and upper threshold values, or qualitative thresholds. No MS provided lower values for thresholds, while only BE provided an upper threshold (of 185 dB re 1 µPa2) for the parameter LEV-N of D11C1, and PL provided an upper threshold (of 30 D) for the parameter DUR.

As for qualitative thresholds, FI considered *Level and frequency are low enough not to cause adverse effects on sensitive species* for the parameter DUR of D11C1, and *Decline from the 2014-2016 baseline (mean)* for the parameters Underwater sound level at 63, 125 and 2000 Hz of D11C2. IE considered *Expert judgement and low risk based on low levels of impulsive noise inputs* as qualitative threshold for the parameters *Duration of licensed acoustic survey noise events carried out in 2016, 2017 and 2018* of D11C1. PT (AMA-PT-SD-PCE) indicated as a threshold. *The level of risk is low, given the absence of anthropogenic activities* for the parameter risk for both D11C1 and D11C2. BE considered as a threshold *No positive trend in annual mean* for the parameter SPL of D11C2. Finally, MT indicated as a threshold for parameters DUR and LEV-N of D11C1. *The spatial and temporal extent of marine waters exposed to impulsive sound sources, exceeding levels that may be set at EU level, are minimized*, and for the parameter SPL of D11C2. *The spatial and temporal extent of marine waters exposed to anthropogenic continuous low-frequency sound, exceeding levels that may be set at EU level, are minimized*.

• **Threshold value sources**. Most MS did not indicate a source for the threshold values provided. NL indicated OSPAR as source for the threshold value, while BE indicated it was a National source.

• **Presence of values achieved**. BE indicated the achievement of a lower and upper value for the parameter LEV-N; as did PT (AMA-PT-SD-AZO) for the parameter SPL. MT indicated the achievement of a lower and upper value for the parameters DUR (per year), and LEV-N. PL, IE, PT (ABI subregion) and FR provided upper values for the parameter DUR. No other MS assessed any value for the rest of parameters.

• **Trends and parameter achieved**. The only MS that assessed trends of values were IE, over the parameter *Duration of licensed acoustic survey noise events* carried out, indicating a deteriorating trend in 2017 with respect to 2016 and an improving trend in 2018, and PT (AMA-PT-SD-PCE), which indicated a stable trend for the parameter *Risk*, related to D11C1 and D11C2.

The MS that assessed the achievement of parameters were: BE, which did not achieve the parameter LEV-N, PL, which did not achieve the parameter DUR in the L2-SEA-007-POL MRU, while achieved it in the L2-SEA-008-POL MRU, and IE and PT (AMA-PT-SD-PCE), which both indicated the achievement of their set parameters *Duration of licensed acoustic survey noise events* and *Risk, based on low risk*.

2.6 Consistency of spatial coverage and assessment period

As described in Figure 1, several MS did not provide electronic reports, which resulted in the total lack of information regarding the Black Sea region, information from only 62.5% of the MS from the Baltic, 62.5% of the MS from the Mediterranean regions, and 88.9% of the North Atlantic region. Moreover, some of the MS that provided electronic reports did not perform any assessment, which resulted in even scarcer information (see Table 2 for detail).

The limited assessment provided was performed by MS mainly at MRU/sub-regional level. PT and PL were the only MS to provide separate assessments at criterion level (PL did so only for D11C1) within different MRU. DK provided a descriptive assessment for D11C1 in the NEA region, and a descriptive assessment for D11C2 in the BAL region. Most of the other MS provided similar information for their national MRU.

As for the temporal consistency, BE, DE (both in the NEA and BAL regions), FI and LV performed their assessment during the 6-year period 2011-2016; FR did it during the 5-year period 2012-2016, IT and SI during the 5-year period 2012-2017, PT and ML during the 7-year period 2012-2018. PL carried out its assessment on D11C1 and D11C2 over the two 6-year periods of 2012-2017 and 2011-2016, respectively. ES also assessed the two criteria over two different periods, spanning 2014-2018 for D11C1 and 2016 for D11C2. Shorter assessment periods were also considered by DK (2015 for D11C1 and 2014 for D11C2), IE (2016-2018), and NL (2015).

2.7 GES achievement or date when GES is expected to be achieved

Most MS did not define the unit for the assessment of GES extent, except NL, IE and PT, which considered it as the proportion of area in good status. However, apart from IE, which achieved GES for D11C1, and PT, which achieved GES for both D11 criteria in the MRU AMA-PT-SD-PCE, none of the MS could assess the extent of GES achieved nor indicate the date when GES is expected to be achieved. Only BE mentioned that, for D11C1, GES is expected to be achieved later than 2020, with no Article 14 exception reported.

ES reported that the Ministry for Ecological Transition would tender a contract in 2019 that would allow developing appropriate tools, filling in the data from March 2015 to date, calculating the indicators, generating illustrative maps, supporting the review of the initial assessment, reviewing the initial design of the monitoring programmes in light of the 2017/848/EU Commission Decision, and advising technicians and leaders on impulsive noise, including possible mitigation measures. Moreover, for D11C2, ES calculated the percentage of the surface area within the MED region in which the threshold values of 100, 110, 120 and 130 dB are reached for frequencies of 63 Hz and 125 Hz, so that it will be possible to assess the area reaching GES as soon as the threshold will be defined.

2.8 Analysis of the levels of integration by parameter and criteria reported

In the structure of the reporting, the GES achievement corresponds to the assessment of parameters, which are integrated at the level of criterion. MS should report the integration rules applied between parameters to inform the criterion level, and between criteria to inform the Descriptor level (Integration rule type parameter in column AK and Integration rule type criteria in column AM of the in the Art. 8 spreadsheet, respectively). Given the scarce number of MS providing any kind of assessment for D11C1, and that even less MS assessed D11C2, and the limited number of parameters used for the process, no information is reported by MS on the levels of integration for D11.

2.9 Differences between electronic and text reports

Beside from the information contained in the electronic reports, the information provided by MS in the text reports (free text reports provided as PDF's, separately from electronic reporting) was also analysed to assess the level of reporting for the three articles, the consistency between the information reported in the text and electronic reports, and to consider the information for MS that did not provided the electronic reports.

Overall, text reports were provided by 16 MS, but the level of information included was highly variable, and only in some cases they were detailed enough to extract useful data related to specific aspects for the three MSFD articles (see Table 3 for details).

Table 3. Level and format (electronic or text report) of the information provided by MS for Art. 8, 9 and 10.

	General[1]	Art.8		Art.9		Art.10	
	Text report	Electronic report	Text report	Electronic report	Text report	Electronic report	Text report
BE	X	X	X	X	X	X	X
BG	-	-	-	-	-	-	-

CY	X	-	X	X	X	-	X
DE	X	X	X	X	X	X	X
DK	X	X	X	X	X	X	X
EE	X	-	X	X	-	-	-
EL	X	-	X	-	X	-	X
ES	X	X	X	X	X	X	X
FI	X	X	X	X	-	X	-
FR	X	X	X	X	X	X	X
HR	-	-	-	X	-	X	-
IE	-	X	-	X	-	X	-
IT	X	X	X	X	X	X	X
LT	-	-	-	X	-	X	-
LV	X	X	X	X	-	X	-
MT	-	X	-	X	-	-	-
NL	X	X	X	X	X	X	X
PL	X	X	X	X	X	X	X
PT	-	X	-	X	-	X	-
RO	X	-	X	-	X	-	-
SE	X	-	X	X	X	X	-
SI	X	X	X	X	X	X	X

([1]) The column General refers to the delivery of text reports by MS, independently from the level of information contained in them.

Thus, among the eight MS that did not report any information in the electronic reports regarding the assessment of D11, it was possible to extract some information on this regard through the contents provided in the text reports for five MS (CY, EE, EL, RO, and SE).

CY declared that anthropogenic noise was monitored during acoustic cetacean surveys, and that GES was not achieved, both for what concerns the impulsive sound (D11C1) and continuous low-frequency sound (D11C2).

EL provided extensive information through the text report, at the criterion level, for both D11C1 and D11C2, describing the methods for their assessment and units of measurements, taking the guidelines provided by TG Noise into account. The information provided concerned the period 2012-2018 and related to all Greek MRUs. However, no final assessment of GES was provided, given that the threshold values at regional or sub-regional levels have not been defined yet. The major pressures related to D11C1 and D11C2 were identified to be seismic surveys and the ship traffic, respectively.

RO also provided extensive information regarding the GES definition and assessment at a criterion level, for both D11C1 and D11C2. Despite the report stated that for both criteria good environmental status and threshold levels for underwater noise have not been defined so far, it provided detailed description of monitoring and results obtained for both impulsive and continuous noise. It concluded that further studies focusing on a wider geographical and temporal area should be carried out to fill the data and legislative gaps in anthropogenic noise monitoring in Romanian territorial waters.

SE's text report, despite providing some general information on underwater noise, stated that no assessment regarding noise under descriptor 11 was possible, as threshold values have not been generated yet, either for impulsive or for continuous sound. A record of activities generating impulsive noise was compiled for 2015 and 2016, and information on continuous noise was collected mainly through the EU Life project *Baltic Sea Information on the Acoustic Soundscape* (BIAS); however, the report concluded that in the absence of assessment criteria, the national assessment of D11 was not possible.

With regard to the MS that did provide both electronic reporting and text report, the core of information was overall consistent across the two formats of reporting, with text reports generally providing a higher level of detail of the procedures, results, and geographical scale of the assessment for most of MS.

2.10 Improvements compared to 2012 assessment

As most of MS did not provide an assessment for D11, it was not possible to define if there has been any improvement as compared to 2012 assessment.

For the BAL region, no data from 2012 could be retrieved for the assessment of progress.

As for few of the MS that did provide any sort of assessment under Art. 8 (BE, DE, DK, FR, IE, PT), they all did report their assessment applying the latest GES determination as in the Commission Decision (EU) 2017/848.

PL did not consider in its assessment of D11C1 the three parameters (spatial distribution, temporal extent, and levels) that might be incorporated into the definition and assessment of GES as suggested in the Commission Decision (EU) 2017/848.

FI and ES reported the elements corresponding to the latest (2018) GES determination.

2.11 Gaps and recommendations for improved implementation

Several MS did not provide electronic reports and were not included in the analysis, preventing a comprehensive assessment of Art. 8. Moreover, some MS did not define parameters for either D11C1 or D11C2, and most MS, although indicating the parameters to be used for the assessment of criteria, did not define or use threshold values and thus could not assess any of the two criteria.

The major issue reported by MS that provided an electronic report, was the lack of thresholds defined either at national, regional or EU level for any of the two criteria. According to the information reported by MS, the lack of consensus on temporal and spatial thresholds would make it impossible for MS to assess whether the parameters have been achieved.

The MS that provided an assessment did so mostly based on a qualitative description of the parameters and a low-risk approach. FR based its assessment on indicators characterising types of risk for marine mammals: acoustic disturbance (risk of disturbance) and excess of mortality by acoustic exposure (lethal risk) for D11C1 and masking of mysticete communications (risk of masking) for D11C2.

Some MS carried out D11 monitoring within the requirements of RSC and reported the results of their assessments in the corresponding reports: OSPAR and HELCOM contracting countries have notified impulse sound events for the first time in a sound registry established by them and hosted by ICES. The HELCOM State of the Baltic Sea Report (http://stateofthebalticsea.helcom.fi/pressures-and-their-status/underwater-sound/#impulsive-sound) gives an overview of the data available for 2013-2016. DE claimed that since data from contracting parties have so far been provided in varying quality and with gaps, and the assessment criteria are still in development, only a descriptive assessment could be provided.

Aside from the lack of defined thresholds, a few MS also claimed that the assessment was not possible due to a lack of data (e.g., DE), the limited monitoring activities carried out at a national level (e.g., SI, PT), or the lack of a sufficiently long data set to allow the detection of trends (e.g., FI, PL, BE).

The establishment of relevant thresholds is the most urgent gap that should be filled to allow the quantitative assessment of D11. A coordinated effort within marine regions is necessary for the definition of commonly agreed thresholds and methods that will bring consistency at all levels and facilitate the MSFD requirements. The MSFD TG Underwater Noise, OSPAR and HELCOM are jointly working to define such threshold values at union level that would allow the quantitative assessment of criteria.

Although the assessment of GES for D11 is a challenge due to the currently missing thresholds, MS should aim to define these provisionally and undertake a preliminary assessment based on existing pressures and available data.

The development of baselines, thus a set of comparable data across EU should be aimed at, in order to delineate problematic areas, support threshold development and enable compliance checking.

To cope with the limited amount of data, the development of scientific projects and the implementation of monitoring programmes such as those ongoing in the Atlantic and Baltic regions (e.g., BIAS project in the Baltic Sea, JOMOPANS in the North Sea, the BIOMOORE project in PT), or at national level, should be encouraged by regional and national governments. Such monitoring would contribute to the data collection necessary to allow the definition of standardized methods and thresholds and to the long-term assessment of trends.

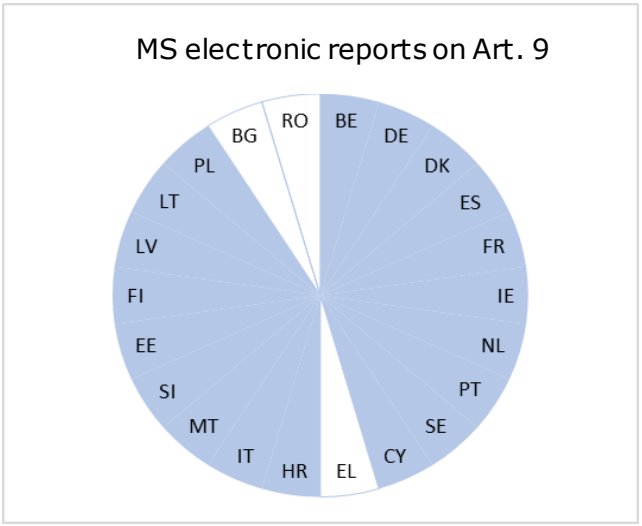
Alignment of data formats and monitoring protocols within EU and RSCs, but also at international level beyond EU should be aimed at in order to facilitate large scale application of the developed approaches.

MS should be encouraged to update their assessment in a consistent way using harmonized parameters and according to the standards provided and to cooperate at the regional level within the ongoing regional programmes. Cooperation should be encouraged in particular at the Black Sea, for which MS did not provide electronic reports to date, and only RO provided information through a text report.

The MSFD reporting system should enable harmonized reporting by providing, to the maximum extent possible, a common frame containing drop-down menus and text boxes in order to reduce reporting effort and to facilitate the overview and comparable analysis of the provided information.

3 Results of Art.9 analysis

The analysis of Art. 9 was performed over the electronic reports received from 19 MS.



NEA: 100 %

BAL: 100 %

MED: 87.5 %
- MWE 3/3
- MAD 3/3
- MAL 1/2
- MIC 2/3

BLK: 0%

Figure 2. Proportion of MS providing electronic reports (in blue).

3.1 GES determination levels

In order to provide an overview on the level of determination of GES by the MS and explore possibilities of harmonization, the level of detail of the "GES description" (column H in the Art. 9 spreadsheet) reported in the MS reports was considered.

According to the data extracted from the electronic reports, some MS did not provide a GES description; other MS determined GES either at the descriptor, or criterion level (Figure3, Table 4).

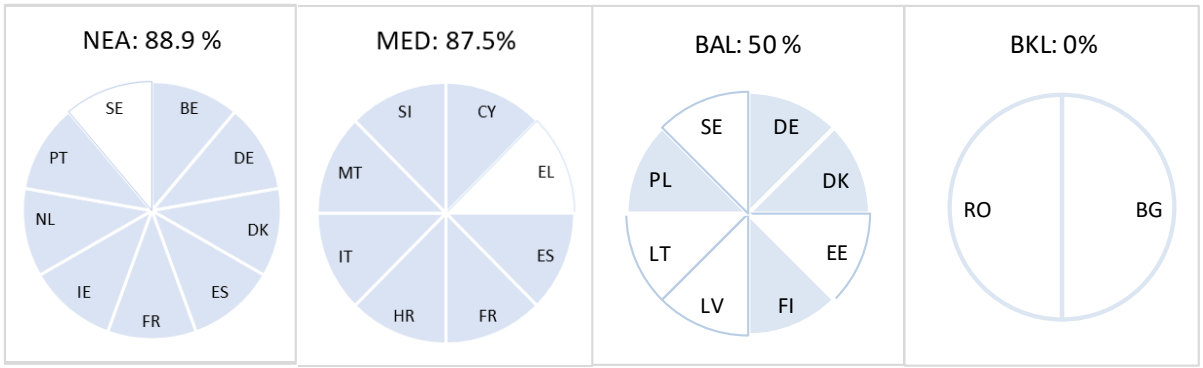


Figure 3. MS reporting a GES description at any level

Table 4. Level of detail (descriptor or criteria Level) attained by the GES description provided by MS, split by region.

	REGION			
GES components	**NEA**	**BAL**	**MED**	**BLK**
D11	ES, DE, PT (ABI)	DE, PL	HR, SI, ES	
D11C1	BE, DK, FR, IE, NL, PT (AMA)	DK, FI	FR, IT, MT	
D11C2	BE, DK, FR, NL, PT (AMA)	DK, FI	CY, FR, IT, MT	

The lack of GES determination by several MS, combined with the different level of detail to which GES have been described by the other MS, is the main factor hampering the comparison of GES achievement across MS.

3.2 Comparability with legislation related to D11 at different scales

Most MS that determined GES referred to the Com. Dec. 2017/848/EU or the previous Com. Dec. 2010/477/EU.

DE stated that it has been working with the North Seas countries in the framework of EU MSFD and OSPAR, and with the Baltic Sea countries in the framework of EU MSC CIS process and HELCOM to contribute to the assessment of GES, as reported also in Art.8_GES. FI referred to the use of a HELCOM register and suggested the development of thresholds through HELCOM cooperation. SE claimed that all Swedish determinations of GES are implemented in a regulation (HVMFS 2012:18) issued from the Swedish Agency for Marine and Water Management and that from the update made in 2018 only criteria supported with at least one indicator and only indicators underpinned with a regular monitoring programme are included in the regulation, which is not the case for D11.

3.3 Analysis of adequacy of GES

Most MS referred their GES description to the definition provided in the Decision 2017/848/EU (e.g., DK, FR). However, several MS did not update their description of GES, reporting the same as in the last determination (e.g., ES, IT, CY), or modifying the last reported determination (e.g., BE, MT) (Table 5). Most MS determined GES at the criterion level, consistently with the Decision 2017/848/EU and using the same determination across the marine subregions. However, several MS did not update their definition of GES or even provide one, due to the lack of a general agreement on GES indicators and thresholds. Only PT provided different GES determinations between marine subregions, while FI was the only MS to define specific GES descriptions at D11C2 level, by considering 125 Hz noise, 63 Hz noise, and 2000 Hz noise, and including in its GES description the amount of heat within D11 and at D11C1 level.

Table 5. Analysis of the type of update provided by the MS in the GES determination, split by region.

	REGION			
GES update type	**NEA**	**BAL**	**MED**	**BLK**
Same as last reported	DE, ES	DE, PL	CY (C11.2), IT, ES	
Modified from reported	BE, PT (ABI)	FI	MT, SI	
New determination	DK, FR, IE (C11.1), NL, PT (AMA)	DK	HR, FR	

3.4 Consistency and adequacy of reported GES spatial coverage

As described in Figure 3, several MS did not provide electronic reports or determined GES, which resulted in the total lack of information regarding the Black Sea region, and information from only 50 % of the MS from the Baltic region.

Most GES determinations were done at larger scale, MRU/sub-regional or national waters. PT was the only MS to provide separate GES determinations at criterion level for different MRUs within the same subregion (i.e., providing new GES determination only for the national waters around the Madeira archipelago). Most of the MS provided the same GES determinations for all their national MRU.

3.5 Justifications for delays in setting EU/regional thresholds and non-using of criteria

EE, LV, LT mentioned lack of nationally or regionally agreed GES indicators, lack of sufficient knowledge to set GES threshold values, and lack of defined GES thresholds or known effect on species, as justifications for not using D11 criteria in their GES assessment. IE also mentioned the lack of agreed methodologies for the assessment of continuous noise and its impact on marine mammals for not defining GES under criterion D11C2.

Similar justifications were provided by MS for the delays in setting EU/regional thresholds, including:

- Lack of thresholds for which levels of underwater noise (both impulse and continuous) are compatible with GES (DK, PT, ES, LT, HR); specifically, lack of threshold associated with anthropogenic impulsive sound (IE)

- Lack of knowledge on the impacts of noise on ecosystems, lack of consensus on thresholds at both national and EU level (FR), and at OSPAR regional level (DE)

- Variability of indicators and necessity for further development and testing (DE)

- Lack of data and not yet established methodological standards (HR, CY)

- Lack of established threshold implemented in the national regulation (SE)

- Confidentiality of certain information including the use of low frequency sonar, data on sonar and seismic equipment used (LT).

3.6 Inconsistencies between Art. 8 and Art. 9

The majority of MS did not provide any assessment for Art. 8, and specified the reasons, at different extents, in the Art. 9 report, under the *Justifications for delays in setting EU/regional thresholds* and *non-using of criteria* columns.

From this perspective, there is no inconsistency in reporting the two articles by MS, as some of the MS that did not deliver electronic reports for Art. 8 claimed it was due to the lack of national or regionally agreed GES indicators (EE, SE), agreed thresholds (LT, SE, HR), and methodological standards for performing the assessment (HR, CY).

Other MS that provided electronic reports but did not perform an assessment under Art. 8 also declared that this was due to the lack of sufficient information and knowledge (LV, NL). MS that provided an assessment at some level of either D11C1 or D11C2, also justified the non-use of parameters and thresholds with the lack of agreed thresholds (DK, FR, IE, PT, ES, FI), and the lack of sufficient data (FR, ES).

Some MS, as FI, ES, did not provide much information on some variables to check whether the assessment under Art. 8 was consistent with the GES definition under Art. 9. However, some inconsistencies in the parameters used by both MS were present in the two articles.

Further inconsistencies in the GES determination and assessment were detected, mainly caused by:

- use of the last reported GES determination, not updating the information according to the details provided in the new GES Decision 2017/848/EU

- use of different levels of determination both by MS across regions and by the same MS within different subregions

- qualitative determination of GES

- lack of regional coordination for the common GES determination at regional or subdivision level.

3.7 Recommendations to improve harmonization and GES development

The major gaps reported by MS that prevented a harmonized definition of GES across regions and criteria were identified as the lack of commonly agreed methodological standards, including thresholds for both D11C1 and D11C2. Moreover, the lack of sufficient data also prevented a proper assessment of D11 by several MS.

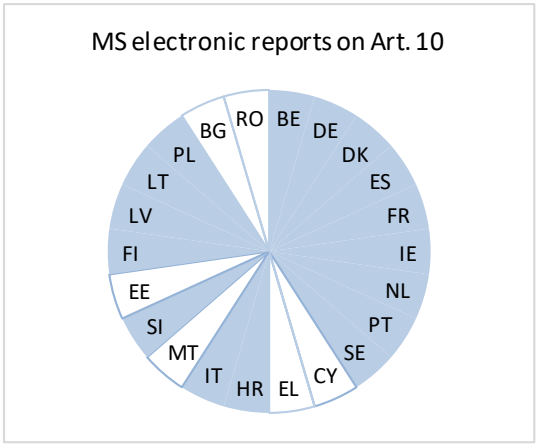
There is an ongoing effort within the MSFD TG Underwater Noise and by RSC like OSPAR and HELCOM to define at EU level such threshold values that would allow the quantitative assessment of the D11 criteria. A coordinated effort at Union level, taking into account regional specificities, for the definition of commonly agreed thresholds and methods will bring consistency at all levels and support the MSFD implementtaion.

The development of scientific projects and the implementation of monitoring programmes such as the ones ongoing in the North Sea region (Jomopans, led by NL and involving DE, DK, SE, BE; https://northsearegion.eu/jomopans/), in the Black Sea region (CeNoBS project, involving RO and BG in close collaboration with non-EU countries Turkey and Ukraine; https://www.cenobs.eu/), in the Mediterranean Region (QUIETMED I and II, covering the marine regions and sub-regions shared by ES, IT, MT, EL, CY, HR, and SI; https://quietmed2.eu/) or at subregional level between PT, FR and ES (RAGES, Jonas, Life IP projects) should allow the collection of sufficient data to allow the definition of standardized methods and thresholds.

The MS should be encouraged to update their GES determination in a consistent way according to the standards provided and to cooperate at the regional level within the ongoing programmes. Cooperation should be encouraged in the Black Sea, for which MS did not provide any electronic report and only RO provided some information through a text report.

4 Results of Art. 10 analysis

The analysis of Art. 10 was performed considering the electronic reports provided by 16 MS.



NEA: 100 %

BAL: 100 %

MED: 62.5 %

- MWE 3/3
- MAD 3/3
- MAL 0/2
- MIC 1/3

BLK: 0%

Figure 4. Proportion of MS providing electronic reports (in blue).

4.1 Spatial consistency of Environmental targets at EU and regional levels

In order to provide an overview on the spatial consistency on the target determination provided by MS, the "Description target" (column F in the Art. 10 spreadsheet) was considered in relation to regions and subregions.

According to the data extracted from the electronic reports, some MS did not provide any target; others determined their targets at the descriptor level, and others at the criterion level (Figure 5, Table 5), resulting in some heterogeneity within marine regions.

MS from the BLK region did not file electronic reports and were not considered for the analysis.

Within the NEA region, all MS defined targets, either at descriptor (44.5%) or criterion (55%) level. Except for PT, which defined targets at the descriptor level for the AMA subregion and at the criterion level for the ABI subregion, and IE, which defined targets at the criterion level only for D11C1, all MS defined targets consistently within their marine subregions.

Within the BAL region, 87.5% MS defined targets, of which 62.5 % did so at the descriptor level, and 25% at the criterion level.

Finally, within the MED region, 62.5% MS provided electronic reports and defined targets, 25% of which did their definition at the descriptor level, while 37.5% of them did so at the criterion level.

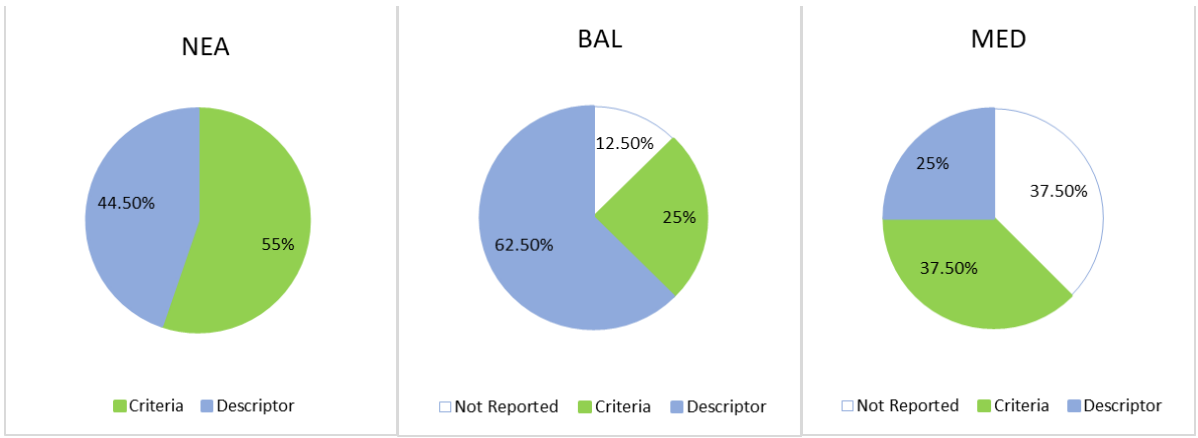


Figure 5. Level of detail (descriptor or criteria level) for the target descriptions provided within each marine region.

4.2 Adequacy of pressures and impacts by regions and subregions

The pressures and impacts identified by the MS that addressed the GES definition at a criterion level were mostly adequate and pertinent with the indications provided within the 2017 Com. Dec. 848.

Thus, general pressures and impacts related to the temporal and spatial occurrence of impulsive and continuous low-frequency sounds in the sea were associated with negative effects on the populations of marine animals and acoustic harm to marine species and their habitats. More specifically, these included the permanent hearing loss (PTS) caused by impulsive sounds, physiological disturbance to the species and to their ability to detect prey and communicate, physical harm (e.g., temporary hearing threshold shift in harbour porpoises) and negative spatial and temporal effects, such as expulsion from habitats, masking of biologically relevant signals, etc. and physical damage to marine species caused by noise inputs due to continuous, especially low-frequency broadband noises.

MS having defined GES, with the addition of a few more, also defined the targets at the criterion level and addressed in a consistent way the main impacts related with the two criteria of D11. Thus, on the NEA region, 5 MS and 4 MS did provide specific and pertinent definitions of targets related to desired levels or reduction of pressures and impacts for D11C1 and D11C2, respectively. In the BAL region, only 2 MS did it, and 3 did so in the MED region.

However, also MS that did not consider the two criteria and only provided GES and target definition at the descriptor level did identify the main impacts related with underwater noise and provided adequate descriptions of GES. For some of these MS, however, the definition of targets was in some cases very broad and not directly related with D11 (e.g., structure and function of food webs and marine habitats, effects of climate change, aggregation of agricultural plastics), and the large amount of information provided made the assessment of its adequacy difficult.

4.3 Analysis of the levels of details of reported targets

As mentioned in 3.1, MS did report targets at different levels of detail, with most of them reporting general targets at the descriptor level, and a lower proportion of MS defining targets related to specific parameters at the criterion level (Figure5, Table 6).

Table 6. Level of detail (descriptor or criteria level) attained by the target definition provided by MS, split by region.

	REGION			
GES components	**NEA**	**BAL**	**MED**	**BLK**
D11	DE, FR, ES, IE, PT (AMA), SE	DE, FI, LV, LT, PL, SE	FR, SI, ES	
D11C1	BE, DK, IE, NL, PT (ABI)	DK, PL	HR, IT, SI	
D11C2	BE, DK, NL, PT (ABI)	DK, PL	HR, IT, SI	

Most of the targets defined by MS at the criterion level were related to specific aspects of the GES definition provided for D11, such as the levels and duration of impulsive anthropogenic sound (D11C1) and the trends in ambient noise (D11C2). On the other hand, targets defined at the descriptor level were less specific, and referred to disturbance of marine mammals, adverse, negative, or undesirable effects, and other related general aspects, among others, to the maintenance of habitats, the increase of knowledge and the implementation of marine spatial planning.

4.4 Integration with other pieces of legislation or RSC agreements

Some MS provided reference to the TG Noise Monitoring Guidance for Underwater Noise in European Seas when defining their targets (e.g., PT, HR) and in general to the MSFD guidelines reported in the Com. Dec. (IE).

However, a few MS also integrated their target definition with RSC agreements or other regional or local legislation, especially when definition was provided at the criterion level. Thus, reference was made by MS to OSPAR, the Habitat Directive, ICES, and NATO standards for activities under the Danish Ministry of Defence.

4.5 Completeness and comparability of targets by criteria

As mentioned in 3.1 and 3.3, targets were not defined at the criterion level by the majority of MS, preventing an assessment of their completeness and hampering their comparison across regions.

However, the 9 MS that provided targets at the criterion level for D11C1 did consistently address the issue of establishing a register for recording impulsive sound at national or regional level (4 MS), and defined targets related to the parameters level and duration of impulsive sounds, indicating related limits at different levels of specificity (6 MS).

As for the 8 MS that provided targets at the criterion level for D11C2, they were also consistent in addressing the parameter of sound level, indicating as main target the reduction/decreasing trend in ambient noise level (4 MS) and an increase in monitoring for this parameter (2 MS), to identify risk areas for marine mammals (1 MS) and develop limits on the number of days of disturbance (1 MS).

4.6 Progress since 2012 targets and setting of new targets

The targets defined by MS were a combination of new targets, targets modified from 2012 definition, targets defined in 2012, and targets no longer needed (see Table 7 for detail), thus the timeframe for their definition was ranging between 2012 and June 2020.

Table 7. Type of target update performed by MS, split by region.

	REGION			
Target update type	**NEA**	**BAL**	**MED**	**BLK**
No longer needed	FR*, IE, ES*		FR*, ES*, SI	
Same as last reported	BE, DE, NL, PT*	DE, FI*, LT*	HR	
Modified from last reported	DK*, PT, ES*	DK*, LT*	IT, SI, ES*	
New determination	DK*, FR*, ES*, IE, PT, SE	DK*, PL, FI*, LT, SE	ES*, FR*	

(*) Asterisks indicate that only a subset of the targets indicated by the MS were of this type.

Out of the 9 MS providing targets for D11C1, three did not modify those defined in 2012, two did modify their definition, three provided newly defined targets, and one provided a combination of newly defined and modified targets.

Out of the 8 MS providing targets for D11C2, three did not modify those defined in 2012, three did modify their definition, and two provided newly defined targets.

Finally, out of the 11 MS that provided general targets at the descriptor level, two included in their list no longer needed targets, one MS did not modify the targets defined in 2012, three MS defined new targets, and the other four MS provided a combination of newly defined and not modified targets (2), of unmodified and modified targets (1), and no longer needed targets with new ones (1) and newly defined plus modified ones (1).

Overall, the majority of MS providing targets at the criterion level did show some progress by updating the definition provided in 2012 or setting new targets. For MS that defined targets at the descriptor level there was a high heterogeneity in the progress since the 2012 definition, but in general most MS did provide at least some newly defined or modified target description.

4.7 Methodology proposed consistency across criteria

Most MS identified specific parameters for the definition of targets at the criterion level, while the parameters used for the definition of targets at the descriptor level were heterogeneous and generic, and most of them referred to elements other than those specifically related to D11.

Thus, within D11C1, the only elements defined by MS were marine mammals, hearing loss (DK) and pulse block days (IE), and the parameters indicated included: DUR, LEV-N, SPL. Only DK indicated more specific parameters, such as the record of impulse noise generating activities, the exposure of marine mammals, planning of anthropogenic activities and of remedial actions, as well as the establishment or thresholds.

Within D11C2, the elements defined by MS were again marine mammals (PT), and pulse block days (NL), and the parameters listed were SPL and LEV-N, while DK also included increased monitoring.

As for the elements and parameters listed at the descriptor level, these were a combination of the above with several other generic elements, such as: habitat, knowledge, MPAs, species, and parameters, such as, among others: conservation of the species, coordination of actions, impact, surveillance systems, marine spatial planning, social participation initiatives.

Except for FR and PT, which indicated target values for three of the targets they had defined, the rest of MS did not provide any threshold value for the proposed target, and thus also failed to indicate the values achieved (upper and lower).

4.8 Is the timescale appropriate and comparable across regions and (sub)regions?

The assessment periods and the timescales listed by MS were highly variable, given that both 'old' and newly defined targets were listed.

Thus, for D11C1, most MS indicated assessment periods ranging 2012-2017 (PL, IT, SI), 2012-2018 (BE), 2013-2018 (HR), or shorter periods such 2016-2018 (IE) and 2015 (NL). On the other hand, PT and DK indicated later assessment periods such as 2018-2024 and 2020-2024.

The same pattern was found for D11C1, with the exception of IE, which did not report for this criterion, and PL, which indicated that the assessment for this criterion was done during the period 2011-2016, consistently with the information provided for Art. 8.

The assessment periods reported by MS that defined targets at the descriptor level were more heterogeneous, with some of the assessments done during earlier periods ranging 2011-2016 (DE, SE), 2011-2017 (PL), other foreseen during a later period, ranging 2018-2024 (FI), and some MS reporting different assessments periods for the several targets indicated (e.g., 2012-2018 and 2015-2021 for FR, and similar patterns for ES and PT).

As for the timescales indicated by MS, they ranged from 2018-2030 (IE indicated a 2050 date only to allow inserting in the scheme a target no longer in use), with most of the timescales indicated falling within 2020, and another set of them within 2024 (Table 8).

Table 8. Time scales indicated by MS for their targets assessment, split by region.

	REGION				TOT MS[1]
Time scale	**NEA**	**BAL**	**MED**	**BLK**	
201812	2				2
201912	1				1
202001			1		1
202007	1				1
202012	5	3	3		7
202112	1				1
202212		1			1
202407	1				1
202410	2	1			1
202412	2	1	3		5
202610	1				1
202612			1		1
203012		1			1

(1) The column TOT MS indicates the total number of MS that indicated a given timescale, without splitting by marine region.

4.9 Assessment of target adequacy to progress towards GES

While most MS did provide a definition for one or more of the targets that should be achieved to progress toward GES, most of them did not define the relative target values, which hampers their assessment.

Thus, within each region, only a limited proportion of MS performed an assessment of targets either at descriptor or criterion level.

Within the NEA region, 4 MS assessed their targets either at descriptor level or for D11C1, and 3 did so for D11C2. Of these, only IE could achieve its target for D11C1, and ES achieved three of the several targets defined for D11.

Within the BAL region, only 1 MS assessed the targets defined for the two criteria; two MS assessed the targets defined at the descriptor level, and none of the MS achieved them.

Within the MED region, only 2 MS assessed the targets defined at the criterion level for D11C1 and D11C2, not achieving them, and two MS assessed the targets defined at the descriptor level, with only one, ES, achieving three of the several targets defined (see Figure 6 for details).

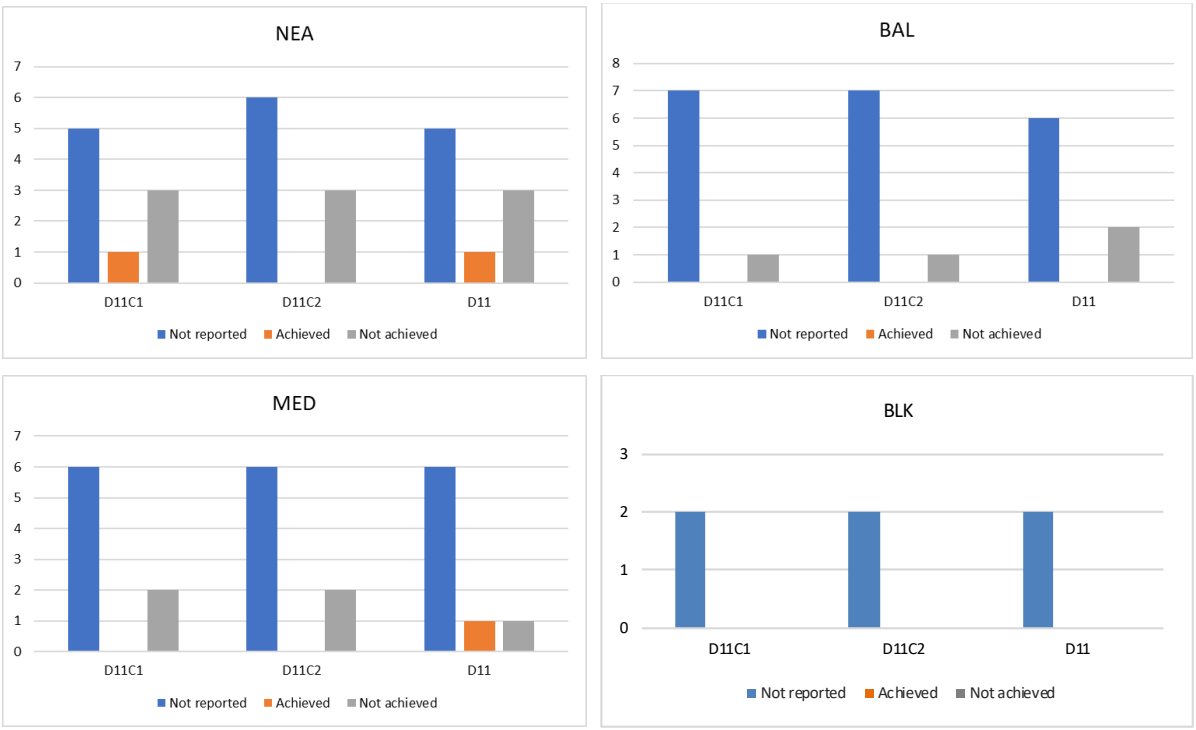


Figure 6. Level of achievement (at descriptor or criteria level) of the target defined by MS within each marine region.

As mentioned in 1.7 and 2.5, most MS did not define the unit for the assessment of GES and justified this with the lack of agreed GES indicators and thresholds, and of sufficient knowledge to set them.

While the definition of targets by several MS was adequate, the lack of defined threshold values and the limited data available to perform the assessment impeded the progress towards GES of the majority of MS.

4.10 Consistency across Regions by MS for criteria and features (GES, assessment, targets)

As mentioned in 3.2, in general, all MS that defined GES at the criteria level also provided a definition of targets within the same criteria. However, the rest of MS presented different levels of inconsistency across articles regarding the criteria and features used.

Thus, within the NEA region, the 5 MS defining GES within D11C1 also defined targets; as for D11C2, the same MS defining GES at the criterion level did provide relative targets. It should be noted that one MS provided a definition of GES at the criteria level but defined targets at the descriptor level, and PT provided separate GES and target definitions for the AMA and ABI subregions. Moreover, SE, which did not provide GES definition or assessment at any level, did indicate some targets at the descriptor level.

Within the BAL region, only 1 MS did consistently define GES and targets at the criterion level, for both D11C1 and D11C2. One MS did provide a GES definition at the criterion level, but defined general targets at the descriptor level, and on the contrary, PL lacked to define GES at the criterion level, but did define targets at the criterion level and performed their assessment for D11C1. SE, LV and LT did not provide GES definition or assessment at any level, but they did indicate targets at the descriptor level.

Within the MED region, only 1 MS defined both GES and targets at the criterion level, while two MS did define GES at the descriptor level and targets at the criterion level. Two MS defined GES but did not define targets, and one MS did define GES at the criterion level but provided general targets at the descriptor level.

4.11 Gaps and recommendations

As previously mentioned, only a limited number of MS did consistently inform regarding GES and relative targets referring them to the criterion level, with only 5 the MS that did so for both criteria and considering all marine

regions. However, a slightly higher number of MS did list targets referred to specific parameters and related them to the adequate feature of the descriptor.

Apart from the lacking information from the MS that did not provide electronic reports and were not included in the analysis, the heterogeneity in the definition of targets and in their level of specificity were the major issues interfering with a comprehensive assessment of Art. 10.

As already discussed in reference to Art. 8 and Art. 9, the lack of commonly agreed thresholds was the cause identified by several MS for unspecific definitions of GES and thus for the difficulties related with the definition of quantitative targets.

For this reason, some MS indicated targets that were more referred to a desired level of an impact or pressure rather than to the reduction of the level of the pressure or impact, which is not considered adequate to achieve GES.

On the other hand, several of the targets listed by MS at the descriptor level, were either quite broad, addressing the pressure only indirectly, or directly referred to other topics (research studies, monitoring, awareness raising), slightly related with D11, or totally irrelevant for the descriptor.

In almost no case MS provided target values or indicators, making the targets not measurable and thus not clear whether the defined targets would contribute to address the gap between current state and GES.

Finally, some MS did not indicate the measures linked to the targets to make them operational, and some of the measures indicated did not address the targets in a specific way.

MS are therefore recommended to review the reported targets and focus on the definition of specific operational targets that directly aim at a reduction in the level of a pressure or impact that are preventing the achievement of GES.

Noting that progress on advice from TG Noise on thresholds is pending, the defined targets should address the achievement of GES by focusing on reducing relevant pressures, tackling specific activities and sources of the pressure so that the progress towards their achievement can be measured as well as their contribution to the achievement of GES.

Where needed, MS should update the list of targets provided, removing those no longer needed or not directly linked to D11 and rationalizing the large number of targets reported. They should provide a precise and comprehensive target description that indicates the essential information to understand in detail their exact scope (i.e., reduction of pressure, impact), their value and their assessment.

All targets provided by MS should be linked to the relative measures that directly aim to reduce the pressure(s) preventing the achievement of GES.

On a broader scale, MS are recommended to share best practices and knowledge within their marine regions to overcome the general lack of data regarding underwater noise that hampers the progress toward the definition of thresholds for the two criteria and thus of the relative targets.

References

Dekeling, R.P.A., Tasker, M.L., Van der Graaf, A.J., Ainslie, M.A, Andersson, M.H., André, M., Borsani, J.F., Brensing, K., Castellote, M., Cronin, D., Dalen, J., Folegot, T., Leaper, R., Pajala, J., Redman, P., Robinson, S.P., Sigray, P., Sutton, G., Thomsen, F., Werner, S., Wittekind, D., Young, J.V., 'Monitoring Guidance for Underwater Noise in European Seas, Part II: Monitoring Guidance Specifications', *JRC Scientific and Policy Report* EUR 26555 EN, Publications Office of the European Union, Luxembourg, 2014, doi: 10.2788/27158.

EU, 'Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU (Text with EEA relevance.)', *Official Journal of the European Union*, Volume L 125, No 43, 2017, pp: 1-32.

HELCOM (2018), 'State of the Baltic Sea – Second HELCOM holistic assessment 2011-2016', *Baltic Sea Environment Proceedings* 155. ISSN 0357-2994.

List of abbreviations and definitions

ABI	Atlantic - Bay of Biscay and Iberian Coast
ACS	Atlantic - Celtic Seas
AMA	Atlantic - Macaronesia
ANS	Atlantic – Greater North Sea
BAL	Baltic Sea
BLK	Black Sea
EC	European Commission
GES	Good Environmental Status
HELCOM	Convention on the Protection of the Marine Environment of the Baltic Sea Area
ICES	International Council for the Exploration of the Sea
MAD	Mediterranean - Adriatic Sea
MIC	Mediterranean - Ionian Sea and Central Mediterranean Sea
MRU	Marine Reporting Unit
MS	Member State
MSFD	Marine Strategy Framework Directive
MWE	Mediterranean - Western Mediterranean Sea
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
RSC	Regional Sea Convention
USA NOAA	United States of America National Oceanographic and Atmospheric Administration

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doi:10.2760/20326

ISBN 978-92-76-36186-2