



Identified gaps on MSFD assessment elements

Deliverable Nr. 5.2



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EXECUTIVE SUMMARY / ABSTRACT

The main objective of WP5 is to identify, develop and promote tools and methods to assess environmental status across the Mediterranean and the Black Sea basins with emphasis on non- EU countries, in accordance with the principles and objectives of the Marine Strategy Framework Directive (MSFD).

The Subtask 5.1.1 of WP5 is dedicated to the identification and the analysis of the Environmental status assessment methodological elements used in the EU case study areas in the framework of the MSFD Initial Assessment (Articles 8, 9 and 10).

The target of this deliverable (D5.2) is to synthesize and analyze the elements provided in the Deliverable 5.1 “Compilation of reviewed EU marine environmental status assessments” and discussed during the PERSEUS Umbrella Workshop (Barcelona, 22-23 January 2013), aiming to identify main methodological approaches and eventual gaps in data availability and knowledge.

The first part of this deliverable presents for each the eleven MSFD descriptors the methodologies used in the Initial Assessments (IAs) and Good Environmental Status (GES) draft reports of the European Mediterranean and Black Sea countries, for which reports have been submitted. Following the outcome of the Umbrella Workshop, it presents discussion on gaps brought forward during the regional sessions and analyses it further. The second part of this deliverable aims to assess an indicative gap score for each descriptor, by considering the main kinds of gaps highlighted by the countries in their IAs and GES reports.



SCOPE

The five European countries in the Mediterranean Sea and Black Sea for which information has been collected in the framework of the PERSEUS Subtask 5.1.1 and reviewed in Deliverable 5.1 are Cyprus, France, Greece, Romania and Spain. The information has been collected by contributors from the PERSEUS partners involved in the Task 5.1., referring to the process followed by the countries in their Initial Assessments and Good Environmental Status reports. It has not been possible to include information from Italy, Malta and Bulgaria because their drafts Initial Assessments were not available. Slovenian information has not been included due to time constraints, but eventually it may be used in further steps.

The research undertaken aims at the identification of methodological approaches used for marine assessments under the MSFD implementation. Within the further development of PERSEUS WP5, they will then be compared with the approaches employed in the respective strategies of the Regional Sea Conventions for the Mediterranean Sea and the Black Sea. This will allow the identification of needs for harmonization and foster a close collaboration between these three environmental framework strategies.

Furthermore the present report aims to identify the main methodological, data and knowledge gaps, as brought forward by the review conducted in 5.1 and the outcomes of the Umbrella Workshop. PERSEUS experimental Work Packages (WP1, 2, 3 and 4) will tackle some of these gaps, but more widely, they can also be taken into account within the common implementation strategy for the MSFD, which is an iterative process allowing continuous improvement.



BACKGROUND ON THE MARINE STRATEGY FRAMEWORK DIRECTIVE

The Marine Strategy Framework Directive (MSFD) (2008/56/EC) came into force on the 15 July 2008. It aims to achieve or maintain a Good Environmental Status for the European Marine Waters in 2020 at the latest.

The implementation of the MSFD is composed by five successive steps, which follow a six-year iterative process:

- 1) Initial Assessment of the state of the marine waters -2012
- 2) Characterization of the Good Environmental Status - 2012**
- 3) Definition of Environmental Targets - 2012
- 4) Implementation of a Monitoring Program - 2014
- 5) Program of Measures – 2015 (elaboration) and 2016 (implementation)

The MSFD is organized under 11 descriptors, defined in Annex I of the MSDF:

- Descriptor 1: Biological diversity
- Descriptor 2: Non-indigenous species
- Descriptor 3: Population of commercial fish/shell fish
- Descriptor 4: Elements of marine food webs
- Descriptor 5: Eutrophication
- Descriptor 6: Sea floor integrity
- Descriptor 7: Alteration of hydrographical conditions
- Descriptor 8: Contaminants
- Descriptor 9: Contaminants in fish and seafood for human consumption
- Descriptor 10: Marine litter
- Descriptor 11: Introduction of energy, including underwater noise

Criteria and indicators, as well as generic methodological standards have been specified by the Commission Decision 2010/477/EU from 1st September 2010.

For the three first steps to be produced for 2012 (Initial Assessment, characterization of the Good Environmental Status, and definition of Environmental Target), the Member States have used existing assessment elements or have developed or adopted other ones that fit the specific requirements of the directive. Methodological procedures have been outlined in the framework of the MSFD task groups (JRC 2010), in the framework of the Regional Sea Conventions or of international commissions. These efforts have been considered by the countries and the methodologies they have used for each descriptor are presented in the following paragraphs, focusing on identified methodological, knowledge and data gaps.



PART I - GAPS ANALYSIS PER MSFD DESCRIPTOR

Methodology of the analysis

In this analysis, we have considered the information collected in the framework of the task 5.1 for the European and Mediterranean countries, which are: France, Spain, Greece, Romania and Cyprus. This information has been extracted by the task participants from the draft national reports on MSFD Articles 8, 9 and 10, produced in 2012 for the first step of the MSFD implementation (Initial Assessments and GES definition reports).

The analysis is organized per descriptor. For each of the eleven descriptors, the following elements are included:

- We present the list of the criteria and indicators specified by the Commission decision 2010/477/EU of the 1st September 2010.

- We provide the analysis produced in the framework of PERSEUS by JRC-IES and presented by the keynote speakers during the regional sessions of the PERSEUS Umbrella Workshop, which was held on 22 January 2013 in Barcelona: for each descriptor, the information available in the D5.1 was synthesized in one slide and organized in three blocks: main methodologies used by member countries, main gaps and criteria level gaps found in the review of the Initial Assessments. Each block includes specific information by countries: Spain (Sp), France (Fr), Greece (Gr), Cyprus (Cy) and Romania (Ro). Methodological elements and gaps reported by the countries are highlighted in green and red squares, respectively, allowing visual identification of the most common characteristics shared by the considered countries. Main findings are also represented in pie charts, including the percentage of countries sharing a specific issue.

- On the basis of available information within the task 5.1, we provide a general analysis of the descriptor scope, of the methodologies and of the data availability.

- We develop this analysis further by indicating the information available for each country at criteria and indicator level.

- Finally, we synthesize at the end of the chapter the main issues highlighted in the analysis of the descriptor.

An overall analysis is provided at the end of this chapter, underlining the main findings of this review among the 11 descriptors.



Descriptor 1

“Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.”

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 1.1 Species distribution

- indicator 1.1.1 “Distributional range”
- indicator 1.1.2 “Distributional pattern within the latter, where appropriate”
- indicator 1.1.3 “Area covered by the species (for sessile/benthic species)”

Criteria 1.2 Population size

- indicator 1.2.1 “Population abundance and/or biomass, as appropriate”

Criteria 1.3 Population condition

- indicator 1.3.1 “Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates)”
- indicator 1.3.2 “Population genetic structure, where appropriate”

Criteria 1.4 Habitat distribution

- indicator 1.4.1 “Habitat distributional range”
- indicator 1.4.2 “Habitat distributional pattern”

Criteria 1.5 Habitat extent

- indicator 1.5.1 “Habitat area”
- indicator 1.5.2 “Habitat volume, where relevant”

Criteria 1.6 Habitat condition

- indicator 1.6.1 “Condition of the typical species and communities”
- indicator 1.6.2 “Relative abundance and/or biomass, as appropriate”
- indicator 1.6.3 “Physical, hydrological and chemical conditions”

Criteria 1.7 Ecosystem structure

- indicator 1.7.1 “Composition and relative proportions of ecosystem components (habitats and species)”



Analysis presented during the Umbrella Workshop

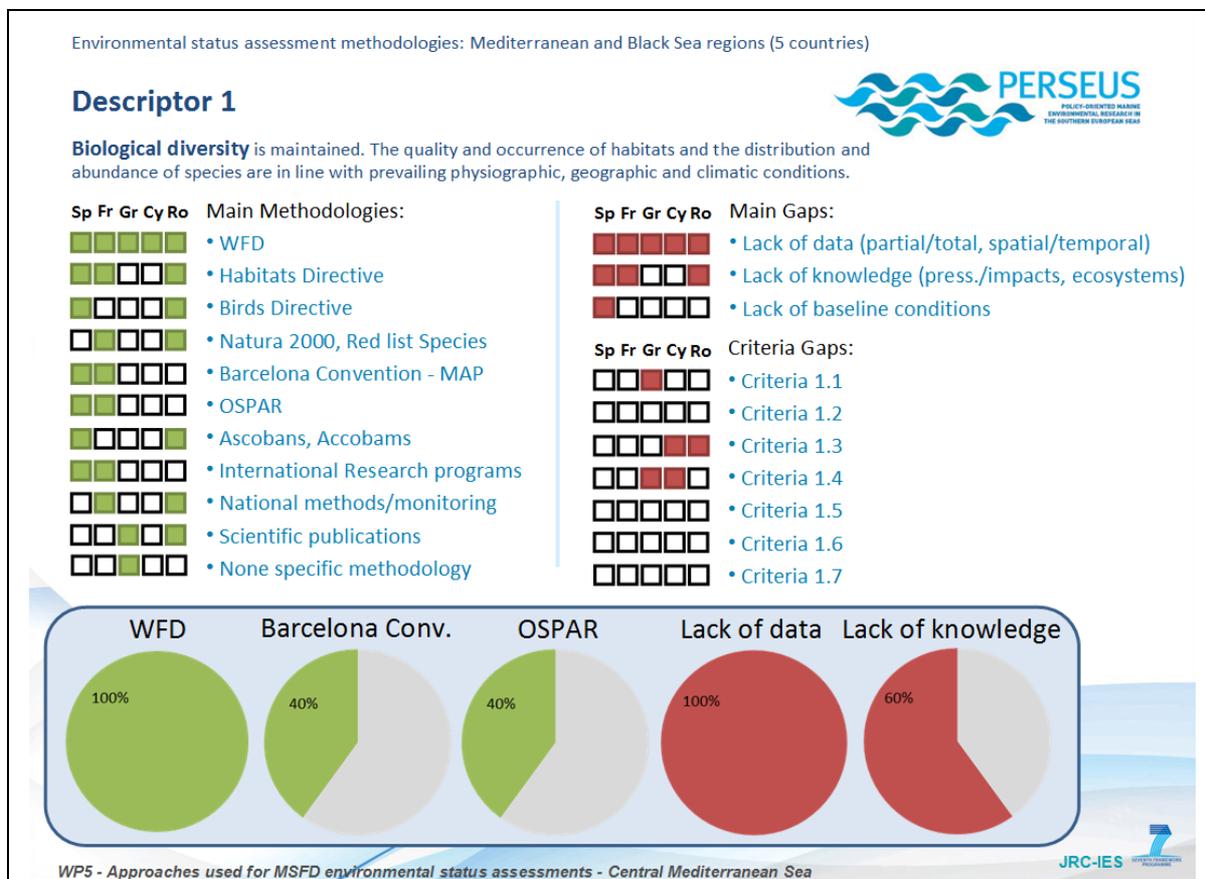


Figure 1: Umbrella Workshop D1 analysis

Descriptor scope

The Descriptor 1 is a very broad descriptor, interacting strongly with the other ten descriptors of the MSFD (JRC 2010). It has especially a strong overlap with the descriptors 3 (commercial fish and shellfish), 4 (food webs) and 6 (seafloor integrity), sharing some of the same habitats, populations or species. Some of the other descriptors, namely 5 (eutrophication), 7 (hydrographical conditions), 8 (contaminants), 9 (contaminants in seafood), 10 (litter) and 11 (energy) may be seen as causing pressure or having an impact on Descriptor 1 elements.

The biological characteristics covered by the MSFD are listed in Annex III, Table 1 of the Directive. The scale is very broad, covering zooplankton, phytoplankton, birds, mammals, reptiles, fish, zoobenthos, macroalgae, angiosperms and alien species.

Methodologies

For this descriptor, all the countries refer to the WFD methodologies. The approaches used are both quantitative and qualitative. However, the quantitative aspects are usually still under development. Furthermore, separate assessments on items and species prevails, while a more integrative and holistic analysis could be expected.



For example, Cyprus bases the estimation of the environmental status at descriptor level on the sum of differently weighted indicators values. Each Indicator is valued arbitrarily based on expert judgments by using criteria related to a conceptual model, metric responses, biological elements and data availability. Cyprus does not approach planktonic communities, populations of mammals and marine birds. Romania provides both a qualitative and quantitative assessment of the current status and an assessment of the trends for most of indicators in the coastal and transitional waters, while few data are available for offshore issues. The Romanian report considers the methodological works developed in the framework of the WFD and of the Habitat Directive, however, the state of marine birds is not considered. Spain reports a qualitative or quantitative approach, depending on the data availability. This approach is based on a non-integrative assessment at different level (species, functional group, habitat, ecosystem), including separated assessment of classified habitats. Greece follows a qualitative approach, and indicates that its evaluation is based on benthic habitats that host 90% of marine biodiversity, and on the condition of the most “charismatic” as well as sensitive species that are characterized as threatened or in need of conservation. This country did not specify further its methodological elements, but refers to overlapping methodologies in relation to D6. France also reports a qualitative approach, but mentions that a quantitative methodology is under development, in relation with monitoring programs. Finally, both France and Spain consider the methodological works developed in the framework of the Barcelona Convention.

Operational methodological elements are already available in the framework of the WFD and of the Habitat Directive. Thresholds are especially available for macroalgae, phytoplankton and benthic macroinvertebrates. However, the WFD methodological elements are only adapted to coastal waters. All countries highlight the need to adapt these methodologies to offshore issues, which constitutes a crucial gap for the MSFD.

Several countries, as France, Romania and Spain, also highlight the need to develop appropriate indicators. Romania especially indicates the need of indicators for specific regional levels (fishery related indices), and Spain for specific habitats.

Finally, there is a lack of reference levels, and a need to establish baseline conditions, using the available data.

Data

Most of the countries have data from national monitoring programs, developed in the framework of the WFD and of the Habitat Directive implementation. Other data comes from Regional Sea conventions (Barcelona Convention and MAP data bank) or from scientific publications, as reported by Greece. However, there are many data gaps for this descriptor. Firstly, there is an important lack of data concerning offshore issues. The available data is limited to coastal waters, but this data is furthermore scarce, disperse and heterogeneous. Time series datasets are missing, as well as data harmonized at spatial and temporal scale. Spain also mentions the lack of basic knowledge on marine ecosystems. France reports a lack of data on the extent, the intensity and the frequency of the pressures and on their impacts on biodiversity, as well as a lack of suitable monitoring network.



In consequence, several countries, as Spain, Romania and France, highlight that the habitats monitoring programs need to be improved.

Analysis at criteria and indicators levels

Regarding the **Criterion 1.1 “Species distribution”**, all the countries, except Greece, provided detailed information. However, several countries report a lack of data at indicator level. Cyprus and Romania present a general methodology using species number and diversity indices. Cyprus considers the spatial or spatio-temporal pattern of different diversity indices of macroalgae, benthic invertebrates and fishes as a proxy of species distribution changes. Romania considers macroalgae, zoobenthos and plankton, but reports for mammals a lack of data and the need for methodological development. We can also notice that Spain does not mention the planktonic and benthic populations for this criterion. France reports that the three indicators of this criterion are still under methodological development, as metrics, spatial and temporal resolution need to be specified.

Regarding the indicator **1.1.1 “Distributional range”** Spain mentions the distribution size and the number of breeding colonies for birds, and the demersal species presence or absence trends for fishes.

For the indicator **1.1.2 “Distributional pattern within the latter, where appropriate”** Spain considers different animal groups: reptiles (relative abundance), mammals (using modelling), birds (habitat suitability models, number and location of marine Important Birds Areas - IBAs) and demersal fishes (presence/absence by bathymetric stratus). Greece stated that this indicator was not considered for the determination of GES.

Regarding the indicator **1.1.3 “Area covered by the species (for sessile/benthic species)”**, France indicates that it is not pertinent for the cephalopods and the vertebrates and highlights, as these species are considered at community scale. France also highlights that a link should be made with the descriptors D6 and D2. Spain indicates that this indicator has not been considered and the other countries did not provide specific information. Greece stated that this indicator was not considered for the determination of GES.

The **Criterion 1.2 “Population size”** and its indicator **1.2.1 “Population abundance and/or biomass, as appropriate”** are generally well developed by all the countries. They take into consideration the detailed analyses by taxonomic structures: species number, abundance, coverage, diversity index, density and biomass of the populations. France indicates that this indicator is useful for mobile species, but that it needs further methodological development as metrics; spatial resolution and temporal resolution still need to be specified. Only Spain indicates that marine mammals are considered for this indicator (population abundance estimation, referring to OSPAR workshop, 2011). Spain considers also marine birds (census of colonies) and fishes, using demersal species average abundance (number/biomass stratified indices). However, they do not consider planktonic and benthic populations for this criterion. Regarding Greece, the assessment is based on *Monachus monachus* population and *Caretta caretta* spawning. Cyprus considers the abundance of macroalgae (% of coverage), of zoobenthos (individuals per sample) and of fishes



(individuals per km²), while Romania includes plankton; mammals could be considered for this indicator, but there is lack of data and methodological development is needed.

The **Criterion 1.3 deals with “Population condition”**. Cyprus and Romania report for this criterion a lack of data. Regarding indicator **1.3.1 “Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates)”**, information is provided by France, Greece and Spain. France considers information like size, age, fertility rates, mortality, and indicates that this indicator is highly pertinent for mobile species. However, this country highlights the need of important methodological development and the lack of data for many compartments or species which do not present any interest for fisheries. Greece reports only for this indicator the survival rate of *Posidonia oceanica*. Spain considers the demographic characteristics of reptiles (length, spawning rate, mortality rate), marine mammals (social structure, reproduction, growth, diet, predators, migrations and acoustic behaviour, referring to OSPAR workshop, 2011), marine birds (reproductive success, colony breeding general fail, survival rate, introduced predators, captures in fishing gears, light pollution and disorientation) and of fishes (percentile 95% size distribution, determination of base conditions using OSPAR methods).

Regarding the indicator **1.3.2 “Population genetic structure, where appropriate”** France reports that important methodological development is needed, in link with the indicator 1.3.1. They indicate that data acquisition process is in progress for marine birds and for some species of fishes and of marine mammals. Spain considers the genetic structure of reptiles and of marine mammals, and does not provide information for marine birds and fishes. Greece states that this indicator was not considered for the determination of GES.

Regarding the **Criterion 1.4 “Habitat distribution”** Cyprus reports a lack of data. For the indicator **1.4.1 “Habitat distributional range”**, Romania reports the distribution of habitat types within coastal SCI. They suggest considering vulnerable macrophytes species (*Phyllophora nevrova*, *Zostera nolti*, *Cystoseira sp.*) and vulnerable benthic species (*Mytilus galloprovincialis*, *Chamelea gallina*). Regarding the plankton, they suggest to use the ratio diatoms/Dynoflagellate and the ratio Copepods/phytoplankton. Spain considers for this indicator the distribution of EUNIS habitat types (number, spatial limits, depth limits). France indicates that this indicator needs further development to specify the metrics, the spatial resolution, as well as the temporal resolution. Greece underlines the need for extensive mapping.

Regarding the indicator **1.4.2 “Habitat distributional pattern”**. Spain uses typological spatial patterns, landscape indices, and follows the changes in communities. France indicates that this indicator is pertinent, but that methodological development is needed. The other countries did not provide any information for this indicator.

The **Criteria is 1.5 “Habitat extent”** and the indicator **1.5.1** concerns the “Habitat area”. France indicates that this indicator is pertinent for the descriptor D1, but also for the D6, and that indicators, which will be shared between the D1 and the D6, are



under development. In particular, the high spatio-temporal variability need to be considered. Cyprus uses for this indicator the extent and the distribution of marine angiosperm (area in ha), as well as Greece, who refers to the mapping of *Posidonia oceanica* meadows, but also of Maerl-type biogenic sediments. This country however mentions that these mappings are very fragmented. Romania uses the extent and the distribution of marine habitats within coastal SCI (area in ha), while Spain considers the extent of EUNIS habitat types and the areas with degradation risks. Generally there is a lack of knowledge offshore and in deep areas, as well as for the habitats which are not yet monitored in other directives framework.

The indicator **1.5.2** considers the “*Habitat volume, where relevant*”. Spain indicates that this indicator has not been considered, Greece suggests that this indicator make sense in shallow coastal areas subject to fluctuations, and France that this indicator is also interesting for the descriptor 6, but need further specifications.

Regarding the **Criterion 1.6 “Habitat condition”**, the indicator **1.6.1 “Condition of the typical species and communities”** is one of the best analyzed indicator as it refers directly to species or communities. France considers this indicator as highly pertinent for both pelagic and benthic habitats, but reports that important methodological development is needed. The link with the descriptors 6 and 4 is highlighted, but also with the indicator 1.6.3. France considers that the following elements need to be adapted to this indicator: the biotic index from WFD, the specific composition and the specific abundance parameters for benthic habitats. The other possible parameters could be biomass and specific trophic level. Greece considers benthic macrofauna communities, and refers to the WFD methodologies for the classification of benthic communities, in relation with the descriptor D6. Cyprus considers the abundance of perennial seaweeds. Romania suggests to consider benthic fauna species composition (Indices of diversity Shannon), benthic flora species (Ecological Index), AMBI and M-AMBI for the macrozoobenthos and finally the ratio trophic/non-trophic zooplankton Spain considers indicators depending on habitat type: composition (functional groups), abundance, biomass (key species), community’s identification, benthic invertebrate’s communities. They also use the following indices: CARLIT-BENTHOS, Shannon, MEDOCC, CYMOX, richness index, number of key species and communities. Regarding the *Posidonia oceanica* meadows, they consider spatio-temporal variation of structural descriptors. They use also multimetric indices (POMI).

Regarding the indicator **1.6.2 “Relative abundance and/or biomass, as appropriate”**. France mentions that metric, spatial and temporal resolution needs to be specified, in link with the development of the indicator 1.6.1 and of descriptors D2 and D4. Spain considers the abundance indices related to the indicator 1.6.1, as well as the BOPA (biotic index) and the MEDOCC. Romania mentions the opportunistic macroalgae, phytoplankton and zooplankton biomass. Cyprus considers the abundance of shade-adapted, slow growing calcareous species. Finally Greece -provides no information regarding this indicator.

The indicator **1.6.3** deals with “*Physical, hydrological and chemical conditions*”. France mentions for this indicator the need for further studies and for statistical validation, highlighting its pertinence for both pelagic and benthic habitats, as well as its link with the indicator 1.6.1 and with the criteria 6.2 (descriptor 6). Spain refers to the



abiotic and biotic parameters, depending on habitat types, while the other countries do not provide information for this indicator. Greece states that this indicator was not considered for the determination of GES. Finally, Cyprus takes into consideration the abundance of opportunistic macroalgae.

Finally, the **Criterion 1.7 “Ecosystem structure”** and its associated indicator **1.7.1 “Composition and relative proportions of ecosystem components (habitats and species)”** have been considered by all countries, but at different levels. France indicates that this indicator is pertinent and interesting but need important methodological development. Especially, the different scales and related evaluation areas are still to be specified. Greece considers for this indicator the structure of planktonic communities, however it mentions that this indicator was not considered for the determination of GES. Spain refers to the Mean Maximum Length (MML) for demersal species and to the Conservation Status of Fish species (CSF). Cyprus considers the Ecological Evaluation Index (EEI), the PREI (Posidonia) and the BENTIX index. Finally, Romania also mentions the Ecological Evaluation Index (EEI), as well as other indices of diversity (Menhinic, Sheldon, Integrated Biological Index – IBI, Pielou-Evenness, AMBI, M-AMBI indices).

Overall gap analysis for this descriptor

Overall, this descriptor is partly documented. Its scope is very wide and complex, and there is a data lack for some criteria of the descriptor 1, which explains, in a great measure, the lack of some methodological operational elements. Furthermore, separated assessments on items and species prevail, while a more integrative and holistic analysis could be expected.

The lack of thresholds is also mentioned, necessary in order to assess if an area is affected or not. Knowledge is still very heterogeneous regarding the countries. In some cases parameters from WFD must be adapted for offshore components.

The analysis of the methodological approaches observed in the Mediterranean and Black Sea countries showed predominance in the use of WFD. On the other hand, these countries use combinations of diverse methodologies, covering requirements of EU Directives and Regional Sea Conventions to national methods. We can notice that OSPAR methodologies are mentioned in the Mediterranean countries.

As a general observation, it could be said that the considered countries have some available methodological elements, according to the conventions or Directives adopted, but that no common or harmonized methodology appears.



Descriptor 2

“Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.”

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 2.1: Abundance and state characterisation of non-indigenous species, in particular invasive species

- indicator 2.1.1 Trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species

Criteria 2.2: Environmental impact of invasive non-indigenous species

- indicator 2.2.1 Ratio between invasive non-indigenous species and native species in some well studied taxonomic groups (e.g. fish, macroalgae, molluscs) that may provide a measure of change in species composition (e.g. further to the displacement of native species)
- indicator 2.2.2 Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible



Analysis presented during the Umbrella Workshop

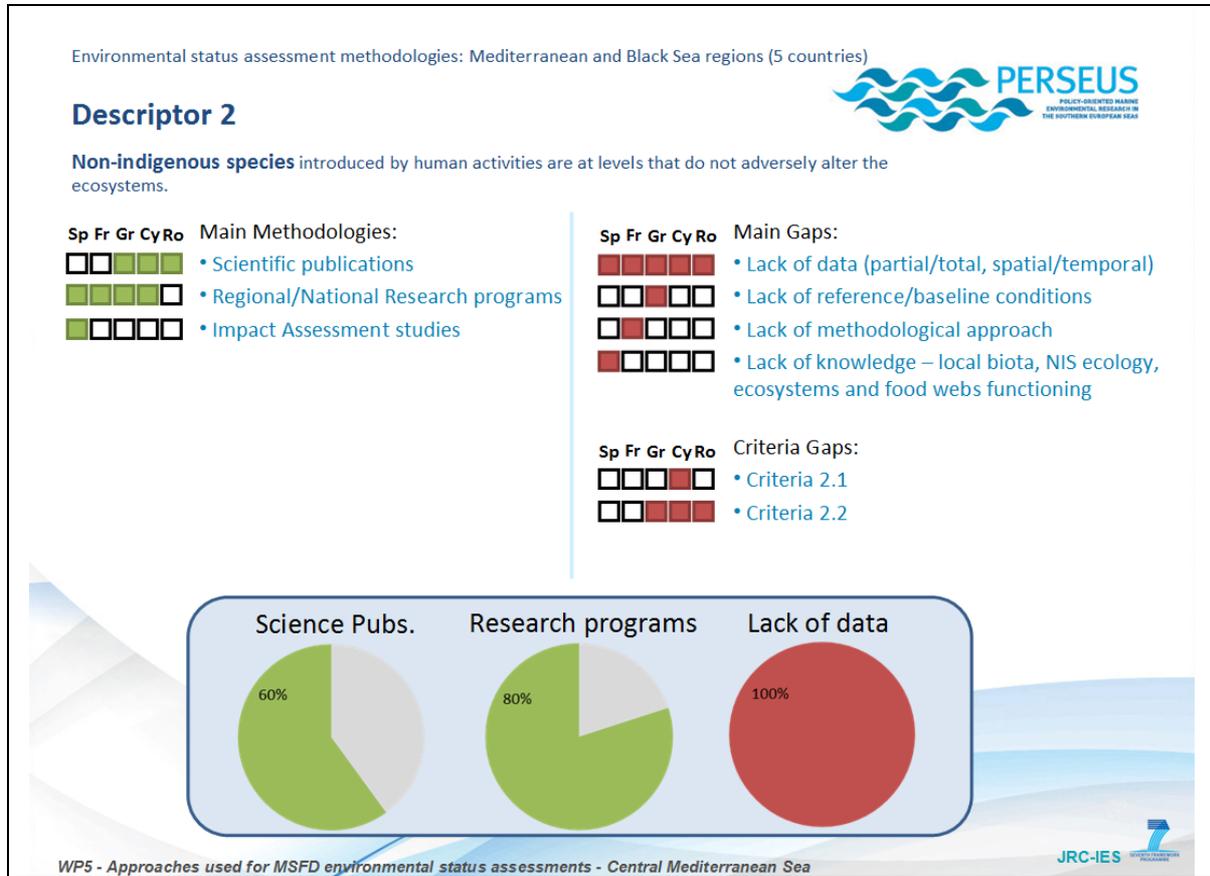


Figure 2: Umbrella Workshop D2 analysis

Descriptor scope and methodologies

Most of the considered countries implemented qualitative methodologies for the assessment of non-indigenous species. They based their works on scientific publications and data from regional or national research programs. A major issue for this descriptor is that all countries stated a lack of data. Spain suggest to consider the Good Environmental Status (GES) in relation to a decrease in impacts caused by non-indigenous species and to use biodiversity indexes in the monitoring of impacts. France indicates the lack of methodological approach on the NIS impacts and suggests focusing on the vectors of introduction. Greece, who is the only country to report a quantitative methodology, considers the species *Mnemiopsis leidyi*, *Lagocephalus sceleratus*, and *Caulerpa* and bases its analysis on trends and ratios according to scientific publications. However, no reference points or baseline/reference conditions were provided. Cyprus’s methodology demonstrated a qualitative approach focused on trends. For Romania, the assessment of NIS was based upon partial information, including both qualitative and quantitative approaches focusing on trends of new arrivals.



Data and Knowledge

Overall, a lack of data and knowledge concerning NIS is mentioned. Cyprus highlights the fragmentary nature of available information concerning the whole descriptor (for both criteria 2.1 and 2.2). For Spain, a lack of data is underlined, and more especially the data heterogeneity in terms of spatial and temporal coverage. Gaps in knowledge concerning local biota, ecology of allochthonous species and ecosystem along with food webs functioning, are also mentioned. The need for impact assessment studies and for specific monitoring programs is highlighted. France also identifies this need of monitoring network, and underlines the lack of knowledge about the NIS impacts. Greece refers to data from the Ellenic Network of Aquatic Invasive Species (ELNAIS), but underlines the lack of quantitative information. Finally, regarding Romania, data concerning spatial and temporal distributions of NIS is scarce. The lack of knowledge about non-indigenous species along with the need for NIS targeted monitoring programs is mentioned. The need for new indicators proposal and for impact assessment studies at regional level is underlined (e.g. impact of *Mnemiopsis*).

Analysis at criteria and indicators levels

The **Criterion 2.1: “Abundance and state characterisation of non-indigenous species, in particular invasive species”** and its associate indicator **2.1.1: “Trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species”**, was considered by all countries, still though the fragmentary nature of the available information is present in all Initial Assessments. For France, this indicator is still under methodological development while metrics, parameters, spatial and temporal resolution need to be specified. This country especially suggests following the vectors of introduction instead of the NIS themselves, as it is easier from a methodological point of view. However, this would require a better knowledge of introduction vectors. Greece also chose to focus on the identification of major vectors facilitating the spread of alien species, and proposed the development of a sampling network which would cover large spatial scales. The information provided concerns trends and ratios for a limited number of species. However, Greece underlines the need for further development of the GES status for indicator 2.1.1, which is expected to be operational by 2018 if adopted. Cyprus provides some comprehensive spatial and temporal distribution information for a few species, and suggests the identification of major vectors facilitating the spread of alien species, the development of policies to minimize their transport, along with a monitoring program. Romania provides information regarding the abundance of a very restricted number of species, and information on the biomass of one species. The necessity to develop a monitoring program in harbours is underlined by this country, especially in areas where ballast waters are unloaded – areas with a potential risk for invasive species penetration and the development of a sampling network which would cover large spatial scales. Finally, Spain considers the cumulative number of NIS, including date and location data.



Regarding the **Criterion 2.2: “Environmental impact of invasive non-indigenous species”**, information is provided by France, Greece and Spain. However, Greece did not consider this criterion for the determination of GES. The indicator **2.2.1: “Ratio between invasive non-indigenous species and native species in some well studied taxonomic groups that may provide a measure of change in species composition”** has been considered as not operational and not pertinent by France. Indeed, because of the lack of data for both NIS and indigenous species, the margin of error is too important. Spain considers an indirect indicator following the trends in ratio NIS/Native Species by taxonomic groups. Greece suggests the development of a sampling network which would cover large spatial scales for indicator 2.2.1. This country also underlines that the development of specific plans to address the management action for major alien species is of high importance.

The indicator **2.2.2: “Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible”** is considered by France as very interesting, however it would need further research and methodological development. For this indicator, Greece indicates that no information is available, and Spain that there is a lack of data.

Overall gap analysis for this descriptor

In the case of non-indigenous species, most of the countries followed a qualitative approach and based their works on scientific publications and data from regional or national research programs. Low availability of data is highlighted by all the five countries, along with the lack of legislative frameworks or international methodologies. Further development is needed in order to establish methodological approaches and reference conditions. The main considerations reported by the countries are the need for specific monitoring programs and for impact assessment studies, as well as the importance to identify the major vectors facilitating the spread of alien species.



Descriptor 3

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

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 3.1: Level of pressure of the fishing activity

- indicator 3.1.1. “Fishing mortality (F)”
- indicator 3.1.2. “Ratio between catch and biomass index (hereinafter ‘catch/biomass ratio’)”

Criteria 3.2: Reproductive capacity of the stock

- indicator 3.2.1. “Spawning Stock Biomass (SSB)”
- indicator 3.2.2. “Biomass indices”

Criteria 3.3: Population age and size distribution

- indicator 3.3.1. “Proportion of fish larger than the mean size of first sexual maturation”
- indicator 3.3.2. “Mean maximum length across all species found in research vessel surveys”
- indicator 3.3.3. “95 % percentile of the fish length distribution observed in research vessel surveys”
- indicator 3.3.4. “Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation”



Analysis presented during the Umbrella Workshop

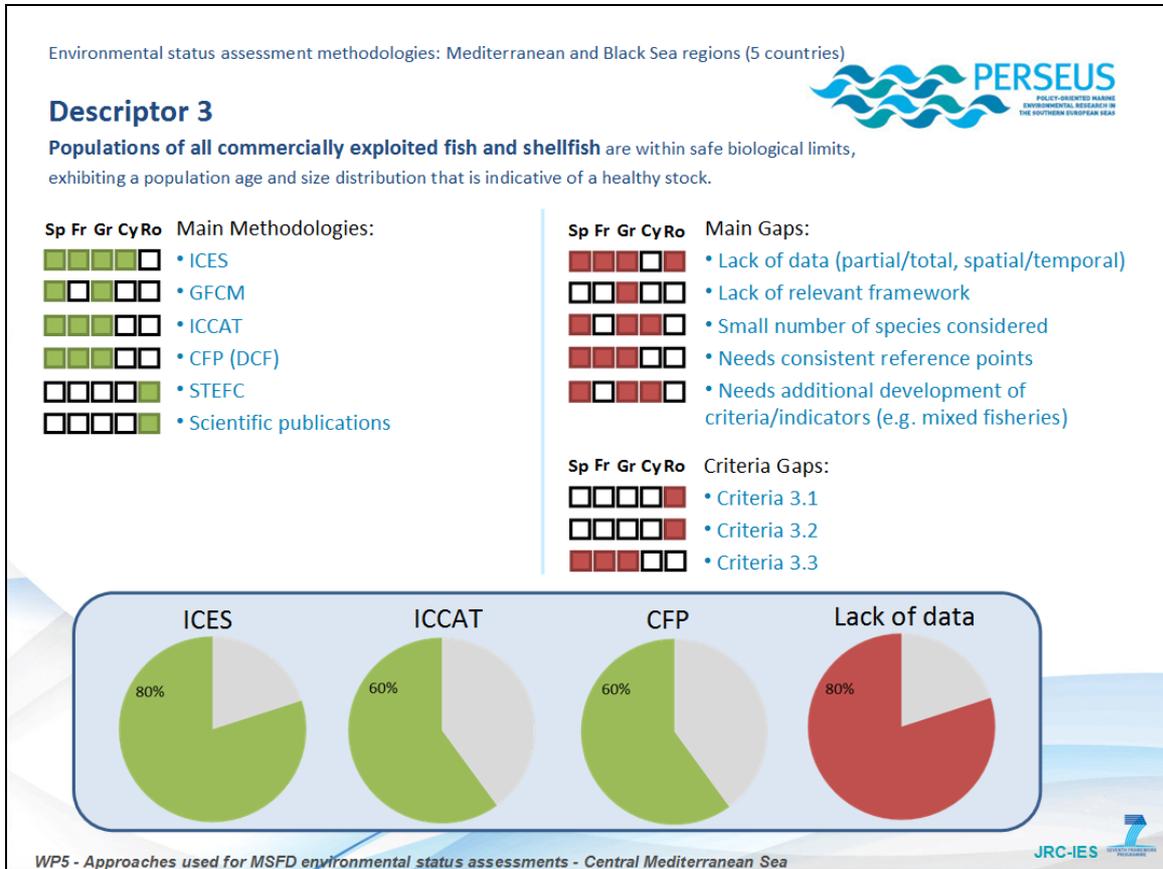


Figure 3: Umbrella Workshop D3 analysis

Descriptor scope and methodologies

All the five considered countries report for this descriptor a quantitative approach based on the methodologies used by intergovernmental organizations in charge of advices to fisheries managers (ICES, GFCM, ICCAT). However, Spain highlights the need to develop additional criteria and indicators, for example for complex situations like mixed fisheries. They mention also the lack of reference levels for Criteria 3.3 and, in conjunction with France, the need for development and establishment of consistent reference points. France follows a quantitative methodology including also qualitative elements; however it was stressed that it should be revised in order to allow European harmonization. Thresholds (F_{MSY} , $MSY-B-TRIGGER$) are used as proposed by the working groups of ICES and level or trends were calculated for each stock. Finally, an aggregation methodology at descriptor level is still to be developed. Greece and Cyprus implemented a quantitative approach. Stock assessments, wherever available, were used. However they exist for very few stocks (only for 4 species, concerning Cyprus). Regarding the reference points, Greece refers to the GFCM, ICES & ICCAT. When the reference values were not available, expert judgment was used by Cyprus. This country also used community indicators, as the lack of data on mixed fisheries did not allow always robust stock assessments. However community indicator seem rather relevant to D1, as D3 explicitly addresses



populations. Regarding Romania, their Initial Assessment report provides a quantitative and qualitative assessment of the current status and trends of the main commercial species (pelagic and demersal). Their methodology is based on JRC reports and scientific publications as well as on the approaches provided by international fisheries frameworks (GFCM and CFP).

Data

The countries used data from the Data Collection Framework (DCF) and the Data Collection Regulation (DCR). In particular the DCF funded MEDITS international trawl surveys, as well as other national or international data collection programs. However, a general lack of data is reported for commercially exploited fish and shellfish. Spain and France underline the lack of data for some populations, like molluscs or deep water fishes. Particularly for Greece, many gaps resulted by the cessation of the DCR collection framework from 2008. As for Cyprus, secondary community indicators from the MEDITS survey were calculated, because of the gaps. In the Romanian Initial Assessment, data are reported from regional or national research programs, but particularly for Criteria 3.2 data shortage was underlined. It should be mentioned that some information regarding criterion 3.1, 3.2 and 3.3 was further reported to European Commission under the MSFD electronic reporting database, even if it was not included initially in the IA/GES documents.

Analysis at criteria and indicators levels

The **Criterion 3.1: “Level of pressure of the fishing activity”** is included by all the considered countries. Romania used for this criterion a regional approach, based on common stocks.

For the indicator **3.1.1: “Fishing mortality (F)**, France considers the fishing mortality for stocks with quantitative assessments available. As well as Spain, this country refers to the F_{MSY} . Greece indicates that for demersal species, estimations of F/F_{MSY} ratios for the main target species of the bottom trawl fishery were considered, while for pelagic species estimations of fishing over total mortality (exploitation rate, E) for the main target species of the purse-seine fishery were used. Cyprus provides information concerning the fishing mortality of a very restricted number of species, and reports that in the case of non-assessed stocks, the indicators related to the fishing pressure are provided for the last six available years, using the data provided by production models. Romania has considered this indicator by considering the ratio F/F_{MSY} at regional level.

The indicator **3.1.2: “Ratio between catch and biomass index”** has been estimated by Greece, but no threshold has been adopted. France considers that, on the long term, decreasing or stable trends are indicative of GES and increasing trends of non-GES. Spain indicates that this indicator has not been considered, while Romania refers to data on the ratio between catch and local agglomerations biomass.

The **Criterion 3.2 deals with “Reproductive capacity of the stock”**. Concerning indicator **3.2.1: “Spawning Stock Biomass (SSB)”**, Greece indicates that for demersal



species the ratio of total biomass over B_{MSY} has been used as a proxy for SSB trends, whereas for pelagic species SSB estimates have been obtained for a series of years through the analysis of fisheries and survey data. However, no reference point has been set due to the lack of a stock-recruitment relationship. France considers for this indicator $MSY-B_{TRIGGER}$, while Spain considers SSB_{MSY} .

For the indicator **3.2.2: "Biomass indices"**, time trends of biomass indices derived from the MEDITS experimental surveys have been used by Greece as indicators of changes in the reproductive capacity of the demersal and demersal elasmobranch stocks. Regarding pelagic species, total biomass indices for a series of years have been estimated from acoustic and plankton surveys. However no threshold values were adopted and the assessment of this indicator is based on expert judgment. Cyprus reports that the reproductive capacity of stocks can be assessed using the trend of the last six available years of the total biomass estimated by the production model. France considers that increasing or stable trend in this indicator, over the survey time-series, are associated with GES and decreasing trends are associated with non-GES. Spain does not provide further detailed information on the Biomass indices secondary indicators used.

Romania indicates that some data regarding these indicators (e.g. SSB) have been reported to the European Commission under the MSFD electronic reporting database.

The **Criterion 3.3 "Population age and size distribution"** has not been taken into account by Greece for the determination of GES. Cyprus mentions that both for assessed and non-assessed stocks, indicators related to the population age and size distribution provided by the MEDITS research survey were used, and whenever there was a lack of data, fishery dependent data were used for the assessment. Romania provides for this criterion information regarding several commercial species, including information on the age and size structure of *Psetta maxima maeotica*.

For the indicator **3.3.1. "Proportion of fish larger than the mean size of first sexual maturation"**, France reports that this indicator will be calculated as the percentage of the biomass formed by fish larger than the mean size at first maturity (L50). The L50 value used will be that estimated during the survey sampling for species for which these data are collected and a value from the literature in other cases, therefore assuming that this parameter is stable. France suggests that GES is reached when the indicator is stable or increasing over the survey time-series. Spain for this indicator uses a similar method based on L50. The other countries did not provide detailed information on this indicator.

The indicator **3.3.2. "Mean maximum length across all species found in research vessel surveys"** has not been considered by France as pertinent, as it reports more a possible modification of species composition than a possible variation of maximal size for each species, induced by fishing. However, France suggests that this indicator is relevant to D1 and D4. Spain indicates that this indicator has been considered, but does not provide further details. The other countries did not provide detailed information on this indicator.

Regarding the indicator **3.3.3. "95 % percentile of the fish length distribution observed in research vessel surveys"**, France reports that this indicator can be estimated for all stocks for which a length distribution is available. When several length distribution are available from different survey, the one which sample better large individual



should be selected. France did not define reference point and suggests a trend-based analysis: a stock is considered at GES if the indicator increases or is stable over the survey time-series. Spain indicates that this indicator has been considered, but does not provide further details. The other countries did not provide detailed information on this indicator.

For the indicator **3.3.4.** *“Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation”*, France indicates that relevant data are collected only since 2008 in application of DCF. This does not allow to assess trends in the short term. The estimation of the trend will become possible as soon as long enough time-series will be available. France however stressed that the interpretation of this indicator may not be straight forward because several natural and anthropogenic factors may affect it. Spain indicates that this indicator has not been considered, and the other countries did not provide detailed information on this indicator.

Overall gap analysis for this descriptor

Methodological approaches used for Descriptor 3 are mainly based on commercial stock assessments carried out under the umbrella of international organizations, such as ICES, GFCM, or ICCAT, and on data collected under the DCF. For stocks that are not reliably assessed, survey-derived indicators are used. Most of the countries are reporting a lack of data, especially regarding the small number of species considered in the assessments and the need to establish consistent reference points, as well as to develop additional indicators.



Descriptor 4

“All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.”

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 4.1: Productivity (production per unit biomass) of key species or trophic groups

- indicator 4.1.1. Performance of key predator species using their production per unit biomass (productivity)

Criteria 4.2: Proportion of selected species at the top of food webs

- indicator 4.2.1. Large fish (by weight)

Criteria 4.3: Abundance/distribution of key trophic groups/species

- indicator 4.3.1. Abundance trends of functionally important selected groups/species



Analysis presented during the Umbrella Workshop

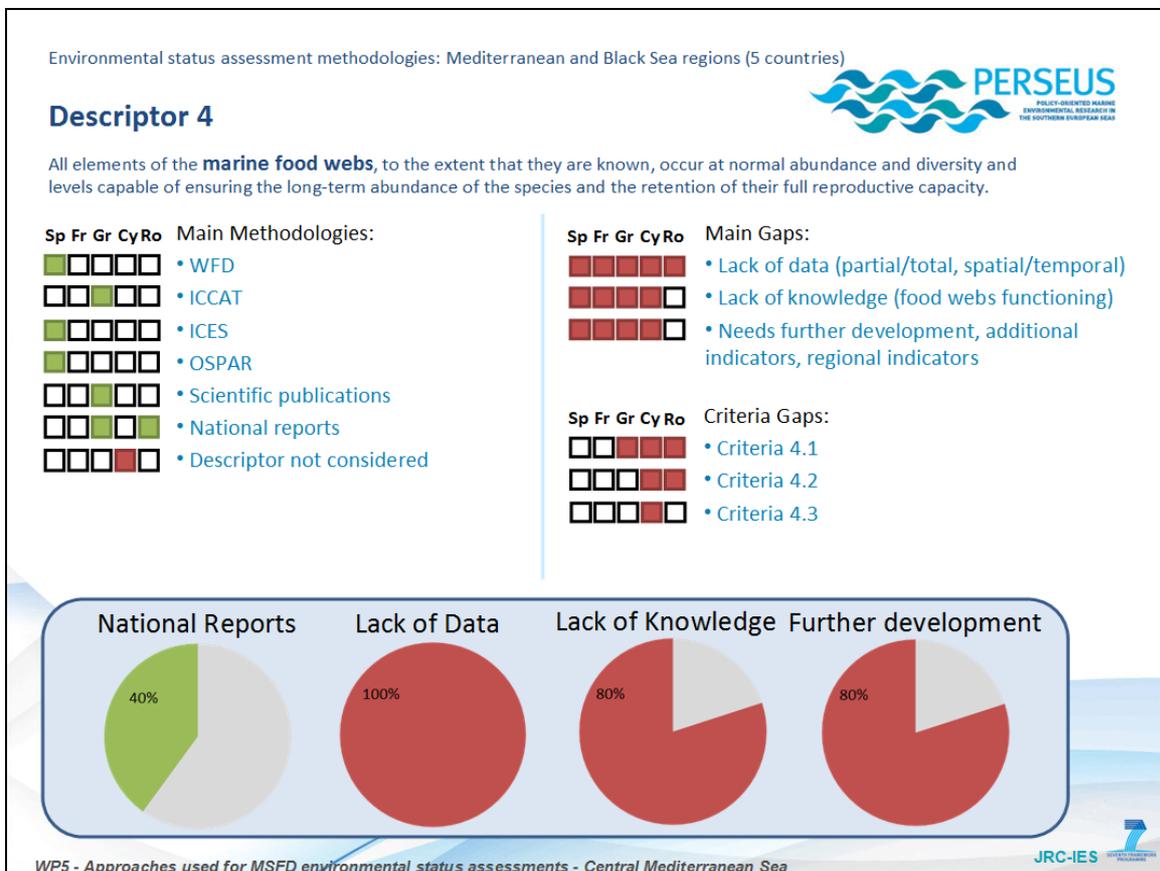


Figure 4: Umbrella Workshop D4 analysis

Descriptor scope and methodologies

For the assessment of the descriptor related to marine food webs, there is no predominance of a single approach. International methodologies, scientific publications and national reports have been considered by the countries. The lack of data and knowledge is underlined by most of the countries along with the necessity for further development of this descriptor.

More especially, Spain implemented a methodology based on OSPAR - ICES and WFD, focusing on large fish indicator and functional groups. The need for additional monitoring (e.g. plankton) and additional monitoring methodologies (diving, ROV, stable isotopes) is highlighted. The indicators were considered inappropriate for the study area, and the definition of metrics for GES is of high complexity. Indicators need to be developed for food web structure analysis, along with integrative indicators for trophic connections and energy fluxes. In the French works, a qualitative approach has been implemented based only on the key functional and structural components. It is also underlined that indicators are not operational yet. They need to be developed, tested and validated and to be adapted to the regional particularities. Complementary indicators need also to be developed. As thresholds are not yet operational for this descriptor, indicators assessments are based on trends. Greece follows a qualitative



and quantitative approach based on scientific publications and on ICCAT methodologies (ICCAT, 2011). The GES evaluation is made at indicators level, and is especially based on the 4.2.1 and the 4.3.1. According to the reporting sheets, temporal trends or biomass data are available. However, Greece mentions that further development is needed, and that the methodology is expected to be operational by 2014. Cyprus indicates that, because of the lack of data and knowledge, they did not assess this descriptor. In fact, the food web structure of the key habitats and ecosystem in Cyprus has not been explicitly studied to date. In the Romanian report, the assessment of marine food webs is based upon partial information. A qualitative approach has been implemented which considered only the key functional and structural components. The importance of additional monitoring methodologies (ROV, stable isotopes) and the need to develop indicators for food web structure analysis, but also integrative indicators for trophic connections and energy fluxes, is also highlighted by this country.

Data

Concerning the data used for the assessment of the Descriptor 4, the countries refer to the monitoring programs implemented under different EU and convention commitments (MEDITS, PELMED, ICCAT, WFD quality components, Natura 2000 species). France mentions a general lack of pertinent data for this descriptor. Spain and Romania indicate a lack of data for coastal areas, rocky bottoms and deep areas. The lack of data concerning experimental and functional ecology as well as energy fluxes is underlined in the Romanian report. This country especially highlights the lack of data for Criteria 4.1. & 4.2. and the lack of knowledge for the Criteria 4.3.

Analysis at criteria and indicators levels

Concerning the **Criterion 4.1: “Productivity (production per unit biomass) of key species or trophic groups”** and its associate indicator **4.1.1: “Performance of key predator species using their production per unit biomass (productivity)”**, information is provided only by France and Spain. Greece states that there is no such information for fish, while Cyprus indicates that the determination of this indicator is not currently feasible. Romania did not consider it in its Initial Assessment, because of the lack of data related to this criterion. Spain provides information regarding the reproductive success of marine birds, and refers to the indicator 1.3.1.. France indicates that additional methodological development is necessary. The metrics considered by this country are the reproductive success and productivity as well as the population size. France however indicates that this indicator is often linked with external variability (environment) rather than with trophic chain internal variability. In order to certify that variation in predator performance provides a measure of food web functioning, the predator–prey relationships involved need to be adequately understood. Therefore, this indicator should be linked with prey availability and individual predator’s body condition (e.g measured from biopsies and stranded marine mammals and seabirds) and growth. As it is not possible to use thresholds, France suggests considering trends for this indicator.



For the **Criterion 4.2: “Proportion of selected species at the top of food webs”** and its associate indicator **4.2.1: “Large fish (by weight)”**, Cyprus and Romania do not provide any information, because of the lack of data and of knowledge. Greece considers the proportion of biomass at higher trophic levels in the total catch of demersal fish. Spain included Large Fish Indicator in its Initial Assessments, but this indicator was not considered as appropriate to define GES in the Spanish subregions, as Large Fish Indicator was developed in the framework of fisheries for the northern seas and its application in Descriptor 4 has different limitations. France indicates that the indicator 4.2.1 is under methodological development. As currently defined, the Large Fish Indicator (LFI) acts as an indicator of the “health” of the demersal fish community in response to variation in fishing pressure and might therefore not appear to be particularly suited as a food web indicator. To better fulfill its food web role, the LFI clearly needs critical examination and validation. Firstly, the suite of species to which it is applied could be expanded to include some of the pelagic fish species which constitute such a high proportion of the diet of demersal piscivorous. Secondly, the length threshold might need adjustment to better reflect trophic structure. Also, additional information on trophic structure will be needed to interpret the LFI in a food web context. Information on the trophic structure of the fish community can be obtained by assigning fish species within a food web to their respective feeding or trophic guilds and monitor their relative changes in biomass. Finally, as it is not possible to use thresholds, France suggests considering trends.

Regarding the **Criterion 4.3: “Abundance/distribution of key trophic groups/species”** and its associate indicator **4.3.1: “Abundance trends of functionally important selected groups/species”**, all the countries, provide information, except Cyprus, which states that the determination of this indicator is currently not feasible. Greece considers the trends in populations of large pelagic fish. Romania refers to the tendencies of population’s evolution for key species of macrophytes and of macrozoobenthos. Regarding the plankton, they consider the proportion of diatoms in the total of phytoplankton biomass, the biomass of trophic zooplankton and the biomass of *Mnemiopsis leidyi*. For the latter, a threshold is defined at 4 g/m³. However, this country highlights a lack of knowledge regarding this criterion. Spain underlines that this indicator is not well defined in the framework of the MSFD. They consider trends in functional groups, like shelf and slope demersal ecosystem species and communities, planktonic systems, and marine birds (abundance). They suggest developing an additional indicator based on changes in diet composition for the main fish species (apical predators). Finally, France indicates that this indicator is still under methodological development. France stresses that attention should focus on the functional importance of abundance. In order to capture aspects of food web dynamics from these purely structural indicators, integrative approaches taking account multiple trophic levels, such as trophic biomass spectra, production, biomass ratios and predator/prey abundance ratios, should also be considered. In deriving metrics to support indicator 4.3.1, greater emphasis might be directed towards the lower trophic levels of pelagic and benthic components of marine food webs so that, in combination with indicators 4.1.1 and 4.2.1, a better whole-system view might be obtained. As for the two other indicators of the D4, France suggests to consider trends because of the lack of thresholds.



Overall gap analysis for this descriptor

The methodologies for marine food webs assessments showed diverse strategies regarding to the country. Countries are referring to international methodologies, but also to scientific publications and national reports. It should be highlighted that OSPAR is mentioned by Spain for the Mediterranean Sea. The analysis showed lack of knowledge for this descriptor, and that further development is required. It is remarkable that there are important Criteria gaps. Moreover, in one case (Cyprus), this Descriptor was not considered in the MSFD assessment due to the general lack of data and knowledge.



Descriptor 5

“Human-induced eutrophication is minimized, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.”

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 5.1 Nutrient levels

- indicator 5.1.1 Nutrient concentration in the water column
- indicator 5.1.2 Nutrient ratios

Criteria 5.2 Direct effects of nutrient enrichment

- indicator 5.2.1 Chlorophyll concentration in the water column
- indicator 5.2.2 Water transparency related to increase in suspended algae
- indicator 5.2.3 Abundance of opportunistic macroalgae
- indicator 5.2.4 Species shift in floristic composition such as diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms caused by human activities

Criteria 5.3 Indirect effects of nutrient enrichment

- indicator 5.3.1 Abundance of perennial seaweeds and seagrasses adversely impacted by decrease in water transparency
- indicator 5.3.2 Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned



Analysis presented during the Umbrella Workshop

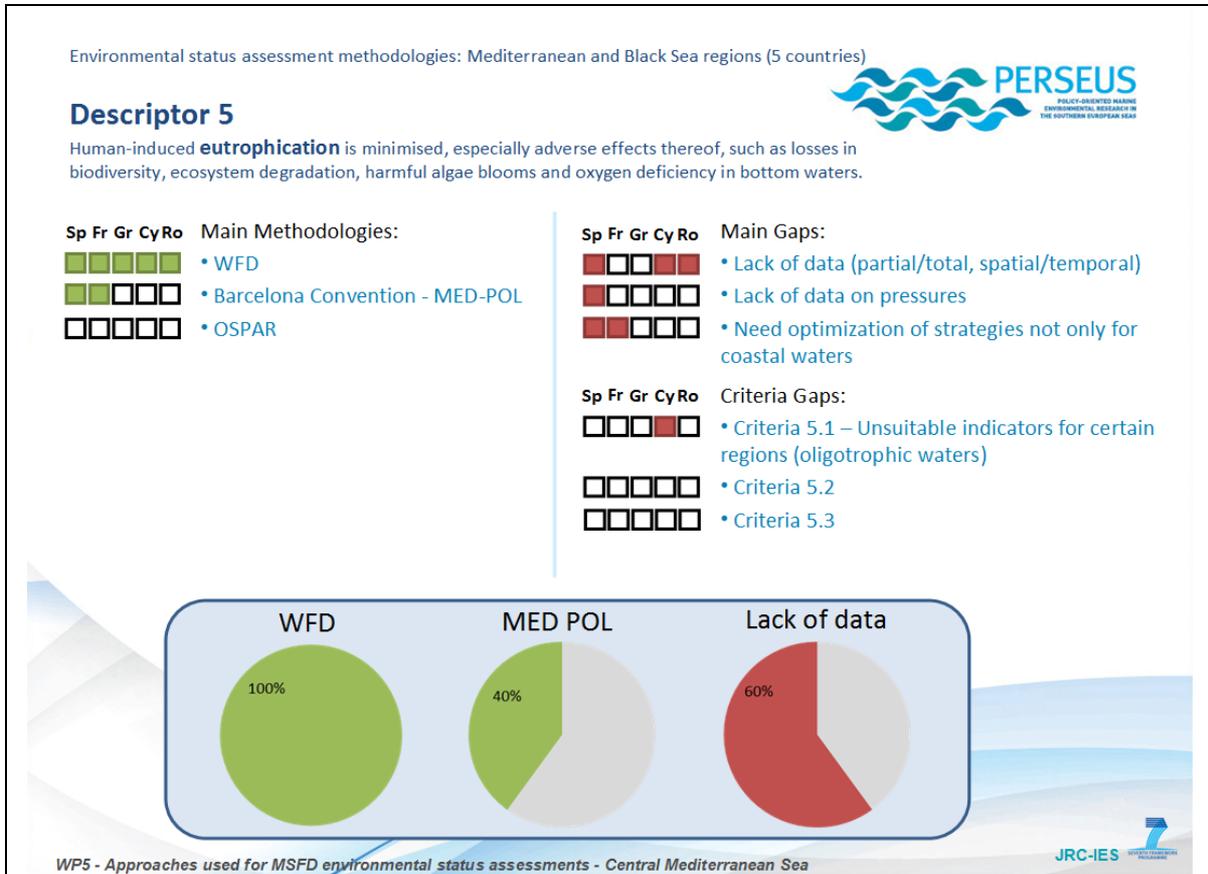


Figure 5: Umbrella Workshop D5 analysis

Descriptor scope and methodologies

For this descriptor, all the countries refer to the WFD methodologies. The approaches used are both quantitative and qualitative. For example, Cyprus based the estimation of the environmental status at descriptor level on the sum of differently weighted indicators values. Each Indicator was valued arbitrarily based on expert judgment by using criteria related to a conceptual model, metric responses, biological element and data availability. Greece states to have followed a quantitative approach, however no further information is provided. Spain reports a qualitative and integrative approach, based on the assessment of indicators groups (pressure indicators, direct effects and indirect effects). This country has established reference values, but has not been able to apply the TRIX index (MED POL) because of heterogeneity in data availability. Romania provided a quantitative assessment of the current status and of the trends for most of the indicators in the coastal and transitional waters. France used a both qualitative and quantitative approach, based on the WFD classification, which allow specifying the environmental status. However, this country indicates that for several indicators the parameters need to be specified by additional studies or that the exiting WFD parameters need to be adapted to offshore issues. Finally, both France and Spain report to have considered the methodological works developed in the framework of the Barcelona Convention.



Several countries are able to propose thresholds for this descriptor, as an operational methodology is already available in the framework of the WFD. However, the available methodologies (WFD and MEDPOL) are only adapted to coastal waters. All countries highlight the need to adapt these methodologies to offshore issues, which constitutes a crucial gap for the MSFD.

Data

Most of the countries have extensive datasets acquired by national monitoring programs in the framework of the WFD implementation. France and Spain report also that data have been acquired in the framework of the Regional Sea Conventions works. The other sources of data are national or international research programs, technical reports, scientific publications and satellite imagery (notably Spain). Greece assessment is based on extensive data, especially about coastal areas, collected from 1998 to 2008 in the framework of monitoring projects.

Regarding the data gaps, Cyprus reports a lack of data for criterion 5.1. The other countries mention mainly a lack of spatial coverage, and especially a lack of data offshore on nutrients, phytoplankton and oxygen.

Spain reports the heterogeneity of data availability depending to the regions. This country also mentions the lack of quantitative data on pressures (monthly/seasonal variation, natural/anthropogenic sources) and of appropriate monitoring programs to allow the use of multimetric indices.

Analysis at criteria and indicators levels

Regarding the **Criteria 5.1 “Nutrient levels”**, Cyprus reports a lack of data for both indicators and considers them as inadequate for the oligotrophic Cyprus waters, suggesting that biological criteria and indicators should be in this case more representative for eutrophication than nutrient concentrations.

The indicator **5.1.1. “Nutrient concentration in the water column”** was considered by the four other countries, and is well documented for nitrogen and phosphorus species. Spain also mentions silicate concentrations. France indicates to consider wintry concentrations, and refers to the WFD parameters but indicates that they need to be adapted to the offshore issues. Greece suggests for this indicator reference points ($\text{NO}_3 < 1 \mu\text{M}$ and $\text{PO}_4 < 0.5 \mu\text{M}$), however their seasonal and regional scales are not specified in the IA report. Romania suggests for PO_4 to maintain the actual concentration level $< 1 \mu\text{M}$ (the average for 2006-2011 was $0.31 \mu\text{M}$), and for DIN to decrease concentrations (the average for 2006-2011 was $10 \mu\text{M}$), in order to reach an optimum N/P ratio: 10-16. Cyprus assessment is based on nitrogen and reactive Phosphorus mean values and variance across differently impacted sites of Cyprus coastal waters, that were measured within the WFD monitoring program from 2007 to 2010.

The indicator **5.1.2. “Nutrient ratios”**, was considered by Spain, France and Romania. France mentions that the parameters for this indicators need to be specified by additional studies, Spain specifies the considered ratios (N/P, Si/P, and N/Si), while Romania suggest a reference point (N/P > 10). Cyprus assessment is based on nitrogen



and reactive Phosphorus mean values and variance across differently impacted sites of Cyprus coastal waters, that were measured within the WFD monitoring program from 2007 to 2010.

Regarding the **Criteria 5.2 “Direct effects of nutrient enrichment”**, several countries report a lack of data for some indicators.

For the indicator **5.2.1.**, which deals with “*Chlorophyll concentration in the water column*”, Romanian GES report provides data from 2011 and suggests a reference point (Chl a < 2.05 µg/l) proposed for all water bodies and all seasons. Greece also suggests a threshold, but based on a different value (Chl a < 4 µg/l), however its seasonal and regional scale is not specified in the IA report. Cyprus considers the Chlorophyll-a concentration, measured in winter and in early spring (November–March) when phytoplankton bloom occurs following the deep winter mixing, lower than 0.1 µg.L⁻¹. Spain considers data from a 25 meters top layer and /or surface data. They also use satellite imagery to identify hotspots (different productivity areas). France mentions that, for this indicator, the existing WFD parameters need to be adapted to offshore issues.

Regarding the indicator **5.2.2.** “*Water transparency related to increase in suspended algae*”, both Spain and Cyprus refer to the Secchi disk, and Romania suggests a reference point, proposed for all water bodies and all seasons (transparency > 3 m). France mentions that the parameters need to be specified by additional studies, and Greece refers to water transparency related to increase in suspended algae.

The indicator **5.2.3.**, which deals with “*Abundance of opportunistic macroalgae*”.

Cyprus and Greece consider the percentage of coverage of opportunistic macroalgae. Spain refers for this descriptor to the data from the descriptor 6. Romania considered this indicator, and indicates that the GES could be expressed as a diminution of the algal biomass and its effects nearby the land based sources. France mentions that the parameters which exist for this indicator in the framework of WFD need to be adapted to offshore issues.

Finally, the indicator **5.2.4** deals with species shift in floristic composition (“*Species shift in floristic composition such as diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms caused by human activities*”). Greece refers to diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms (e.g. cyanobacteria) caused by human activities. Cyprus considers the *Cladophora* blooms. Romania considers the ratio diatoms biomass /dinoflagellates biomass in the spring. The Romanian Initial Assessment contains detailed information in terms of diatoms and dinoflagellates which was resumed in the GES document. The latter contains data until 2011 and suggests as GES to maintain the actual ratio diatoms/dinoflagellates in the land based source neighbourhood. Spain reports a lack of data for this indicator, and France mentions that the parameters need to be specified by additional studies.

The **Criteria 5.3 deals with the “Indirect effects of nutrient enrichment”**. For its first indicator, the indicator **5.3.1** “*Abundance of perennial seaweeds and seagrasses adversely impacted by decrease in water transparency*”, information is provided by all countries. Spain refers to the data from the descriptor 6, Romania considers the biomass of *Cystoseira barbata*. Cyprus and Romania mentions the Ecological Evaluation Index (EEI), and Cyprus also refers to the PREI (*Posidonia*). France



indicates that the WFD parameters can be used, but need to be adapted to the offshore issues. Greece refers to the abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency.

The indicator **5.3.2** deals with dissolved oxygen (*“Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned”*). Cyprus refers to the percentage of saturation and France reports for this indicator that the parameters from WFD should be adapted for offshore issues, while Spain reports a lack of data. In its GES Description, Romania considers for this indicator the GES as 75% of the measurements of DO higher than 8.8 mg/L (proposal for all water bodies and all seasons), but specifies however that this reference point would need revision after another assessment. Greece refers to dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned and considers that there should be no occurrence of toxic algal blooms.

Overall gap analysis for this descriptor

In general, this descriptor is well documented, and many data are available, as similar indicators are already operational in the framework of the WFD. Several countries are able to propose thresholds, and overall, the D5 is one of the descriptor for which the environmental status can be determined. The methodological and data gaps mainly refer to offshore issues, as only coastal marine waters are considered under the WFD. To fill these gaps, the parameters from the WFD need to be adapted for offshore issues. France also highlighted the need to coordinate the methodological approach on this descriptor with other MSFD descriptors (D1, D6, D4 and D7).



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.”

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 6.1 Physical damage, having regard to substrate characteristics

- indicator 6.1.1 “Type, abundance, biomass and areal extent of relevant biogenic substrate”
- indicator 6.1.2 “Extent of the seabed significantly affected by human activities for the different substrate types”

Criteria 6.2 Condition of benthic community

- indicator 6.2.1 “Presence of particularly sensitive and/or tolerant species”
- indicator 6.2.2 “Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species”
- indicator 6.2.3 “Proportion of biomass or numbers of individuals in the macrobenthos above some specified length/size”
- indicator 6.2.4 “Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community”



Analysis presented during the Umbrella Workshop

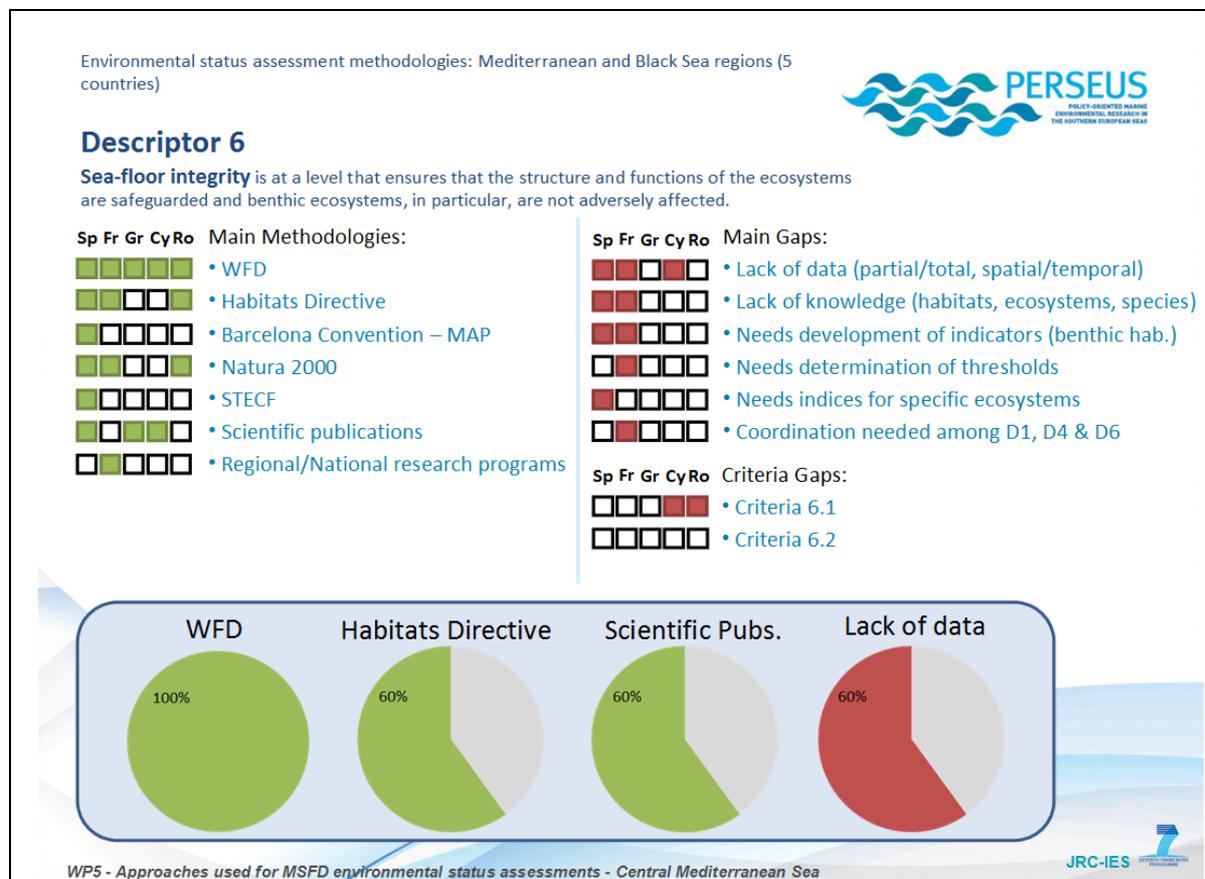


Figure 6: Umbrella Workshop D6 analysis

Descriptor scope and methodologies

The main methodological sources for this descriptor are the WFD, but also Natura 2000 and the Habitats Directive (as reported by France, Romania and Spain).

Cyprus, Greece and Spain have a quantitative approach. Cyprus uses benthic multimetric and biotic indices (ESG IC, ESG IIA, EEI, PREI, BENTIX). Greece considers benthic habitats condition in depths superior to 50m and refers to the Water Framework Directive, but also to methodologies developed by Simboura et al. (2012) including BENTIX index of WFD, and Lampadariou et al. (2008). Spain refers to methodologies related to the WFD, the Habitats Directive, the Barcelona Convention (MAP), Natura 2000 and STECF. This country also used EUNIS habitat classification, Favourable Reference Values (FRV) and multimetric indicators, and considered only biogenic habitats.

France has a qualitative approach, based on the WFD, on Natura 2000 and on the Habitats Directive and reports that additional work is required for the determination of thresholds for the different indicators.

A lack of methodological standards is reported for several indicators (especially 6.1.2., 6.2.3. and 6.2.4). For the other indicators, when some methodological elements are available, they have a limited applicability. For example, the WFD parameters are



only coastal and concern mostly soft bottoms. However, some of the WFD indices such as BENTIX applied by Greece for WFD refer not only to coastal but to all marine soft bottom habitats and a boundary modification is only applied for certain habitats such as purely muddy sediments usually found in bathyal zones.

The determination of thresholds is still needed for the different indicators, as reported by Spain, France and Romania. Spain and Romania also report the need to develop indicators for different ecosystems, and Spain highlights the need to develop for benthic communities some quantitative indicators on the ecological state, in relation to the pressures in circalittoral and bathyal areas. Greece also reports some thresholds for Shannon and Species richness suggested in Simboura et al., 2012 applying for different ecotypes following a statistical categorization and analysis of variance.

Finally, we can notice that France considers some indicators (the 6.2.1. and the 6.2.3.) as non pertinent for this descriptor, and highlights the need to have a coordinated approach with the D1 and the D4. France is working on the development of new indicators, which will be shared with the D1 and the D4.

Data

For most of the countries, the data have been acquired by national monitoring programs, in the framework of the implementation of the WFD (as reported by Cyprus, France, and Romania), of NATURA 2000 and of the Habitat Directive. International data sources, such as Regional Sea Conventions, EUNIS and MEDITS are reported by Spain and Romania. Additional data sources are sedimentology database and maps database, reported by France, and scientific publications, reported by Spain and Greece.

Regarding the data gaps, a lack of knowledge is reported, especially by Spain, on habitats modeling, on size distribution, on ecosystem structure, on species response to impacts, and on sensitive or opportunistic species. All datasets are subjected to many gaps for specific indicators, notably for the indicators 6.1.2, 6.2.3. and 6.2.4 (see details below).

Analysis at criteria and indicators levels

The **Criteria 6.1** which deals with physical damage (***“Physical damage, having regard to substrate characteristics”***).

Its first indicator **6.1.1**, which is *“Type, abundance, biomass and areal extent of relevant biogenic substrate”*, has been considered by Romania Spain and France. For this indicator, existing methodological standards are available; however they have a limited applicability (only suitable for coastal areas, in specific regions). Especially, the Habitat Directive provides elements for this indicator, but their applicability on biogenic substrates need to be evaluated. France indicates that this indicator is still under development, and that it should be linked with D1 and D4 work. For this country, "biogenic substrates" are considered as "engineer species". Spain also mentions the link with the D1 (criteria 1.4 and 1.5) and refers to the EUNIS habitats classification. Greece considers that the mapping of sensitive benthic habitats is



needed. This country also indicates that this indicator has not been taken into consideration for the determination of GES. Romania identified for this indicator 8 types with 28 subtypes of habitats as defined by the Directive 92/43/EEC, and used the mapping of habitats in the NATURA 2000 sites. Cyprus states that the areal coverage of most relevant habitats, let along abundance, biomass, and other metrics of the key species are currently not known.

Regarding the indicator **6.1.2**, which is “*Extent of the seabed significantly affected by human activities for the different substrate types*”, a lack of methodological standards and of data is reported. Greece reports that this indicator has not been taken into consideration for the determination of GES. Romania reports a lack of data. France indicates that the indicator is under development, and reports a lack of data, including data on pressure extent. Spain provided more detailed information. They consider for this indicator the area of *Posidonia oceanica* meadows loss, using an estimation of area of dead algae. They consider also the percentage of squared grids (5x5 miles) of biogenic or vulnerable habitats affected by significant impacts, considering specific pressures. Cyprus states that the effects on distinct biogenic substrates/habitats cannot be estimated at this point.

The Criteria 6.2 deals with the “Condition of benthic community”.

The indicator **6.2.1** “*Presence of particularly sensitive and/or tolerant species*” was considered by Greece and Spain. For this indicator also, existing methodological standards are available, however they have a limited applicability (coastal areas, specific regions...). Greece considers for this indicator that the percentage of resistant/opportunist species does not exceed 25% of the total abundance in 90% of sampling stations, referring to Rosenberg et al, 2004 and Dimitriou et al, 2012. Spain refers to the disturbance state of *Posidonia oceanica* meadows, by considering its structure and population dynamics, but also multimetric indices (POMI). We notice that this indicator, as well as the 6.2.2 and the 6.2.6, have been considered as non pertinent by France, because of the lack of knowledge on the relation pressure-impacts. This country is working on new indicators in link with D1 and D4, that could be relevant with pressures to consider within MSFD implementation. Cyprus considers the presence of particularly sensitive and/or tolerant species.

For the indicator **6.2.2**, which deals with benthic multi-metric indexes (“*Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species*”), information is provided by Cyprus, Greece, Spain and Romania. Existing methodologies are also available, but still with a limited applicability. Spain consider the richness and biodiversity indices (per habitat types) referring to Species Richness and Shannon. Spain also uses WFD multimetric indicators such as CARLIT-BENTHOS, POMI, MEDOCC and BOPA. Greece refers for this indicator to the paper of Simboura et al. (2012), which presents a combined use of BENTIX, Shannon and Species richness indicators also suggesting thresholds for diversity indices. Greece also suggests this methodology as an overlapping indicator to be used also for D1 (macroinvertebrates condition) based on WFD data. Romania considers Shannon for macrozoobenthos, AMBI and M-AMBI Index 1 (WFD) and the Ecological Evaluation Index (EEI) (WFD). For the same reason than for the 6.2.1, France did not consider this indicator as pertinent. Greece refers to multi-metric indexes assessing benthic community



condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species (90% of the stations within the limits outlined by the paper of Simboura et al., 2012.), while Cyprus considers the abundance of shade-adapted, slow growing calcareous species.

The indicator **6.2.3** deals with “*Proportion of biomass or numbers of individuals in the macrobenthos above some specified length/size*”. A lack of methodological standards and of data is reported on it. Only Greece provided detailed information: they mention the BFI index, referring to Lampadariou et al. (2008). Spain reports a lack of data, Romania did not provide any information because of the lack of data and methodological standards, and France, as above, considered this indicator as non pertinent. Cyprus refers to the abundance of opportunistic macroalgae.

The indicator **6.2.4** concerns the “*Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community*”. A lack of methodological standards and of data is also reported on it, especially by Spain, while Greece provided no information.

Regarding Cyprus, this country provided information concerning multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive (EEI, PREI, BENTIX) species.

Overall gap analysis for this descriptor

Overall, we notice that there are significant data and methodological gaps for this descriptor. Existing methodological standards are available only for some indicators; furthermore they have a limited applicability, as they are adapted only to regional specificities and only to coastal waters. Further work is needed to adapt these elements to the MSFD scope, as well as to develop new methodologies for other indicators. We also notice that France did not consider the indicators of the criteria 6.2. as pertinent, because of the lack of knowledge on the relation pressure-impacts, and decided to develop new ones in link with the D1 and the D4.



Descriptor 7

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

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 7.1 “Spatial characterization of permanent alterations”

- indicator 7.1.1 “Extent of area affected by permanent alterations”

Criteria 7.2” Impact of permanent hydrographical changes”

- indicator 7.2.1 “Spatial extent of habitats affected by the permanent alteration”
- indicator 7.2.2 “Changes in habitats, in particular the functions provided, due to altered hydrographical conditions”



Analysis presented during the Umbrella Workshop

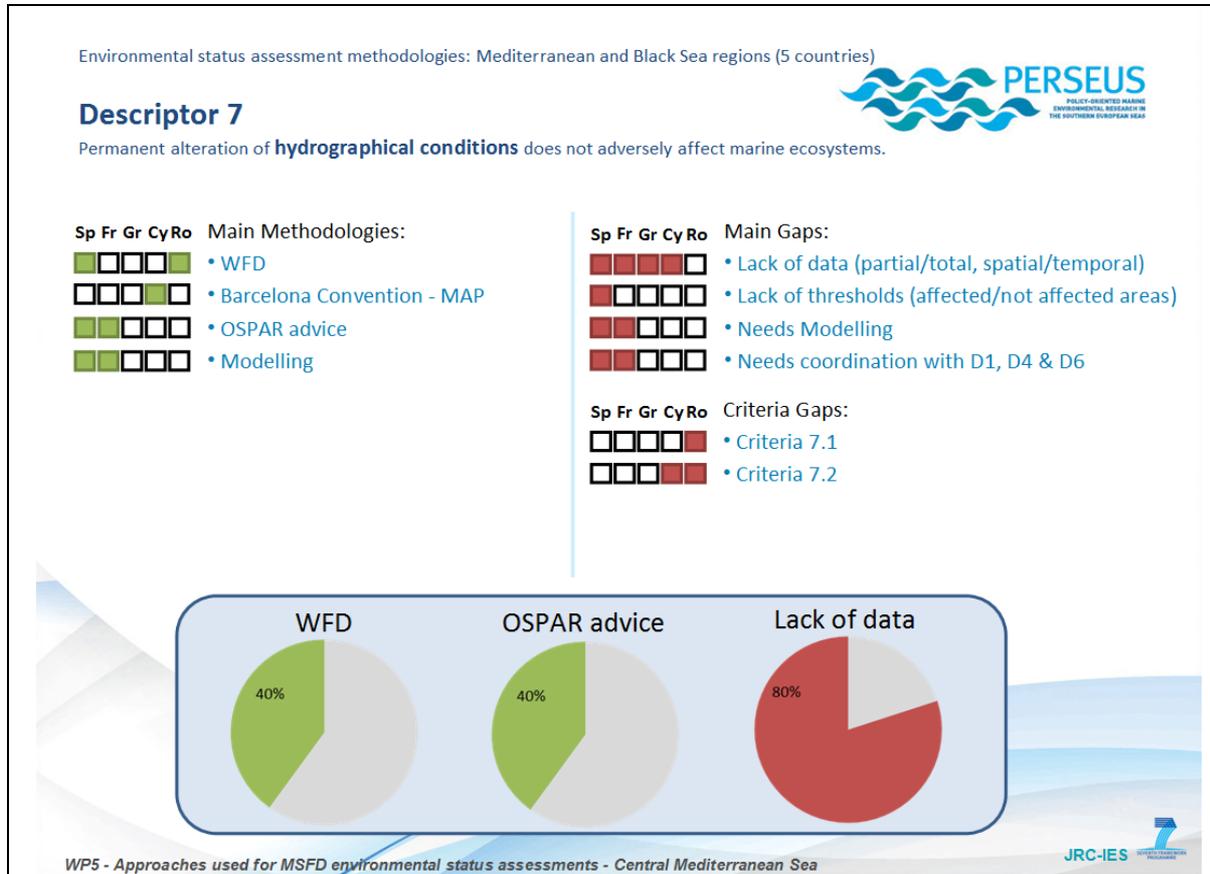


Figure 7: Umbrella Workshop D7 analysis

Descriptor scope and methodologies

For this descriptor, the five countries report a qualitative methodology, mostly based on expert judgments.

An important point is that the different countries have not the same interpretation of the scope of this descriptor and especially of the definition of “permanent alteration of hydrographical conditions”.

For example Cyprus considers the coastline artificialization and its impacts on the habitats, while Greece and Romania focus on hydrologic condition data (temperature, salinity, currents), on their variations regarding a pristine period and on the induced modification of water stratification.

France considers physical pressures on the marine environment (for example constructions, aquaculture cages or wind turbines), and, as Spain, consider also hydrological modifications of coastal rivers inputs.

Regarding the methodologies, France and Spain report that they are working on OSPAR methodological elements, which are still under development. Cyprus mentions methodological elements from the EUROSION project and from the UNEP/MAP assessments.



Spain and Romania report also that they use WFD elements, as for example the WFD quality descriptor “dissolved oxygen”, or other hydrological quality elements from the WFD.

Overall, there is a lack of methodological operational elements. The lack of thresholds to assess whether an area is affected or not is also mentioned. In fact, the definition of quality thresholds seems to be very complicated for this descriptor.

Data

The data considered comes from monitoring programs, research projects, but also modelling, as highlighted by France and Spain.

However, gaps on these data are reported by almost all the countries. The lack of long time-series datasets is especially identified, and in consequence monitoring programs need to be optimized. The need to develop further operational models on hydrographical conditions is also reported by both France and Spain.

Analysis at criteria and indicators levels

If we look at the information provided at indicator level, specific information is only available for France, Spain and Cyprus. Romania did not use any of the criteria and indicators recommended by the MSFD, because of the lack of a deep enough analysis. Greece did not provide any information at criteria and indicator level. Cyprus only considered for this descriptor the criteria 7.1.

For this **criteria 7.1 “Spatial characterization of permanent alterations”** and its associate indicator **7.1.1 “Extent of area affected by permanent alterations”**, Cyprus considered two kind of information: the percentage of coastal length that has infrastructure, referring to methodological elements from the EUROSION project (2004) and from the UNEP/MAP assessment (2006), and also the area covered by coastal structures (for example the area within a port, or the area under coastal structures such as breakwaters, groins etc).

For this indicator, both France and Spain report the problematic of the analysis scale. Spain considers two different scales: a “big scale”, including climate change considerations, and a “small scale” considering both non point alterations (coastal modification degree, river basin regulation degree) and point alterations (civil works, thermal or haline effluents). France chose to consider the regional scale, and to use modelling or semi-quantitative estimate. However, France report a gap for this indicator, as modelling still need to be developed and as data and knowledge are missing to allow a robust assessment.

The second criterion for this descriptor is the **criteria 7.2 “Impact of permanent hydrographical changes”**. Cyprus reports a gap on this criteria, because of the lack of data. Both France and Spain highlight that the affected areas (resulting from indicator 7.1.1) would need to be crossed with the indicators considered for the biological descriptors D1, D4 and especially D6, which deals with seafloor integrity.



This crossing of information would allow the assessment of the impacts of considered modifications. For this reason, Spain considers that the indicator **7.2.1** “*Spatial extent of habitats affected by the permanent alteration*” is unnecessary and redundant with the 7.1.1. France plans to use modelling, but indicates that the models are still to be developed.

For the indicator **7.2.2** “*Changes in habitats, in particular the functions provided, due to altered hydrographical conditions*”, Spain reports a lack of knowledge on the cause/effects relationship. The other countries did not provide further information.

Overall gap analysis for this descriptor

Overall, we notice that the understanding of the scope of this descriptor is still vague and heterogeneous regarding the countries. Some methodological elements from OSPAR and UNEP/MAP efforts are considered, but they are still under development.

The scale at which the assessment should be made is also quite imprecise. This descriptor also illustrates the difficulty to differentiate the impacts of direct anthropogenic pressures and the global change consequences. To stay in the MSFD tracks, the indicators should be pragmatics and quantify metrics, which could be positively impacted by the program of measure.



Descriptor 8

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

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 8.1 “Concentration of contaminants”

- indicator 8.1.1 “Concentration of the contaminants mentioned above, measured in the relevant matrix in a way that ensures comparability with the assessments under Directive 2000/60/EC”

Criteria 8.2 “Effects of contaminants”

- indicator 8.2.1 “Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored”
- indicator 8.2.2 “Occurrence, origin (where possible), extent of significant acute pollution events and their impact on biota physically affected by this pollution”



Analysis presented during the Umbrella Workshop

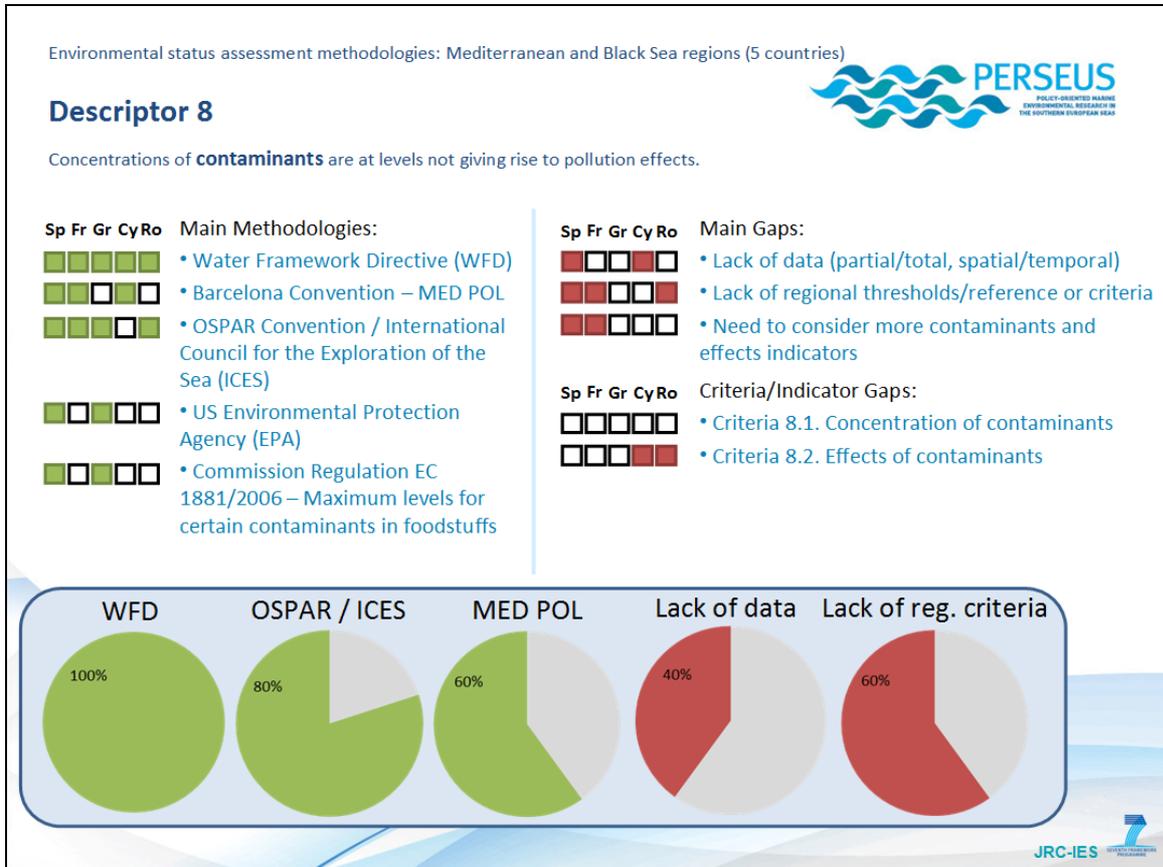


Figure 8: Umbrella Workshop D8 analysis

Descriptor scope and methodologies

For this descriptor, the five considered countries follow a quantitative methodology. Contamination quantification methodologies are available for several pollutant families, and can measure the contamination in several matrices, such as water, sediment or biota. In the water, different methods could be used: the concentrations can be measured in the water after pumping and filtration, or using passive samplers. The methods used by the different countries are not specified in the table of the deliverable 5.1.

Only for contaminants for which relevant Environmental Quality Standards are not yet established through European or national legislation, further research and methodologies are needed in order to establish thresholds, considering natural variability of non-synthetic contaminants (background levels), historical data (trends) and relevant reference sites, where available.

Regarding the contaminants effects assessments, some ecotoxicological tests exist on mussels or on *Mullus barbatus*. They are based on OSPAR/ICES and MED-POL methodologies, and are mostly implemented by Spain and in a lesser extent by France.



Thresholds

The concentrations in the water can be compared with the EQS (Environmental Quality Standards) from the WFD, if a threshold is available for the considered contaminant, and if the data acquisition methodology is compatible with the WFD.

For the biota, few international thresholds exist. Each country defines its own quality classes, referring to statistical processing of the data, extracted from the bibliography or from international methodologies (OSPAR, MED-POL, US-EPA).

For t sediments and biota, the EAC (Environmental Assessment Criteria) and the BAC (Background Assessment Criteria) from OSPAR have been used.

There is a lack of thresholds for some contaminants. When no threshold is available within a regulatory framework, the countries consider the trends (as specified for France and Spain). The methodologies and the statistical processing of data which allows determining the trends differ regarding the country, because different recommendations are available. This difference does not allow the comparison of the trends between the countries.

Some other methods are not built on recommendations, but on diverse bibliography, which make the comparison still more difficult.

Data

Many data are available on several contaminants families, like heavy metals, PAH, or organic compounds. Some countries have also data on specific contaminants, like TBT, pesticides, detergents, or other pollutant specified in the Annexes IX and X of the WFD. Greece specifies to have considered synthetic and non-synthetic substances, petroleum hydrocarbons and radionuclides in water, sediment and organisms. Cyprus refers to heavy metals, synthetic (organic) compounds, petroleum hydrocarbons, radionuclides and organotin compounds. The other countries may also have this kind of data, but do not consider them in the framework of the MSFD.

All the considered countries report to have contaminants concentration data in the water, in the sediments and in the biota. Regarding the biota, most of the countries have mussel data. Some countries also use fish data. Only France mentions data in top predators. In the framework of the MYTILOS/ MYTIMED/ MYTIAD/ MYTIOR programs using transplanted mussels, harmonized data have been acquired for Cyprus, Greece, France, Spain, Slovenia and Italy (but also for non European countries like Morocco, Algeria, Tunisia, Libya, Turkey, Albania, Montenegro and Croatia).

Despite the availability of an important amount of data, there is still lack of data fore some contaminants. The monitored contaminants are often historical contaminants monitored for a long time, and they represent only a small fraction of the overall contaminants present in the marine environment. In particular, emergent pollutants such as pharmaceuticals, fire retardants or some pesticides are not considered by sustained monitoring programs, and are often tackled by local or punctual research programs.

Additionally, most of the existing data have been acquired in coastal environment, in relation with methodological and logistic constraints. In the framework of the MSFD,



which considers both coastal and offshore environment, there is an important gap of data offshore, which should be filled by the development of appropriate monitoring programs.

Analysis at criteria and indicators levels

Cyprus, Greece, France, Romania and Spain provided specific information at criteria and indicator level.

Most of the methodologies and of the available data, detailed above, refers to the **criteria 8.1 “Concentration of contaminants”** and its associate indicator **8.1.1 “Concentration of the contaminants mentioned above, measured in the relevant matrix in a way that ensures comparability with the assessments under Directive 2000/60/EC”**. The information reported by Cyprus for this descriptor concerns the kind of pollutant considered, which are heavy metals and petroleum hydrocarbons. Greece specifies that 3 groups of contaminants have been examined in water, sediment and biota: Synthetic contaminants (PAHs, PCBs, DDTs and Drins), non -synthetic: pollutants (Cd, Pb, Cu, Zn, Hg) and petroleum hydrocarbons and radionuclides: (137 Cs), which allow comparability with the assessments under Directive 2000/60/EC. Romania considered metals (Cu, Cd, Pb, Ni, Cr), TPH, PAH and organochlorine pesticides, in the water and sediment matrixes. They considers also metals and pesticides data in biota (molluscs) and took into account national legislation, as well as OSPAR methodologies. France mentions the matrix used (biota and sediments, top predators and passive samplers for the water matrix), the use of reference level in the water if available (EQS, EAC or BAC), and the use of trends if no threshold is available. France highlights the difficulty to compare measurements in biota or in sediments with thresholds expressed as a concentration in water.

Spain reports that the contaminants included in the EQS directive have been considered. They mention also the OSPAR/ICES methodologies (transition points, BAC), the Effect Low Range (ELR - US EPA), the maximum levels of certain contaminants in foodstuffs (Commission Regulation EC 1881/2006) and the Environmental Assessment Criteria (EAC - OSPAR/ICES) in sediment and biota.

Regarding the **criteria 8.2 “Effects of contaminants”**, Cyprus and Romania report a gap, because of the lack of data. The indicator **8.2.1** focus on the level of pollution effect (“Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored”). To assess the effects of contaminants, some ecotoxicological tests exist and are mostly used by Spain and in a lesser extent by France. France mentions the "gastropods imposex" (OSPAR), but explains that tests have shown that it is not suitable for the French Mediterranean Sea, and is furthermore operational only in coastal areas. Other "biological effects methods", from OSPAR/ICES works, are under implementation in the French Mediterranean Sea, but only on mussels. Spain already uses these methods on *Mullus barbatus* and on mussels (*Mytilus edulis*). These methods consider the following



biomarkers: EROD activity, lysosomal membrane stability, stress on stress, acetylcholinesterase activity, metallothionein content, frequency of micronuclei.

Regarding the second indicator **8.2.2** *“Occurrence, origin (where possible), extent of significant acute pollution events and their impacts on biota physically affected by this pollution”*, Spain mentions that it has been considered, but that there is not enough information to allow assessment. France is working on the frequency and the extent of accidental spillage, but the study areas as well as the reference areas are still to be determined. For the impacts on biota, France suggests to monitor the percentages of oiled or dying birds. However, the associated monitoring, involving NGO, is much localized and does not constitute a robust monitoring network, which does not allow a robust assessment.

Overall gap analysis for this descriptor

For this descriptor, substantial data on contaminants concentrations exist and several well established international methodologies are used by EU members. However, there are partial data gaps (e.g. spatial data limited to coastal areas) and a restricted number of contaminants is considered. Emerging pollutants need to be included in monitoring programs. Further, countries are using regulatory thresholds from extra-Mediterranean regions in their assessments, including OSPAR Convention and US Environmental Protection Agency, indicating the lack of regional thresholds or reference levels, particularly in sediment and biota matrices. Regarding effects indicators, some countries were not able to consider Criteria 8.2 in the assessment because of lack of data, but indicators are available to be used in the assessment, as mentioned by other EU members.



Descriptor 9

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

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 9.1 “Levels, number and frequency of contaminants”

- indicator 9.1.1 “Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels”
- indicator 9.1.2 “Frequency of regulatory levels being exceeded”



Analysis presented during the Umbrella Workshop

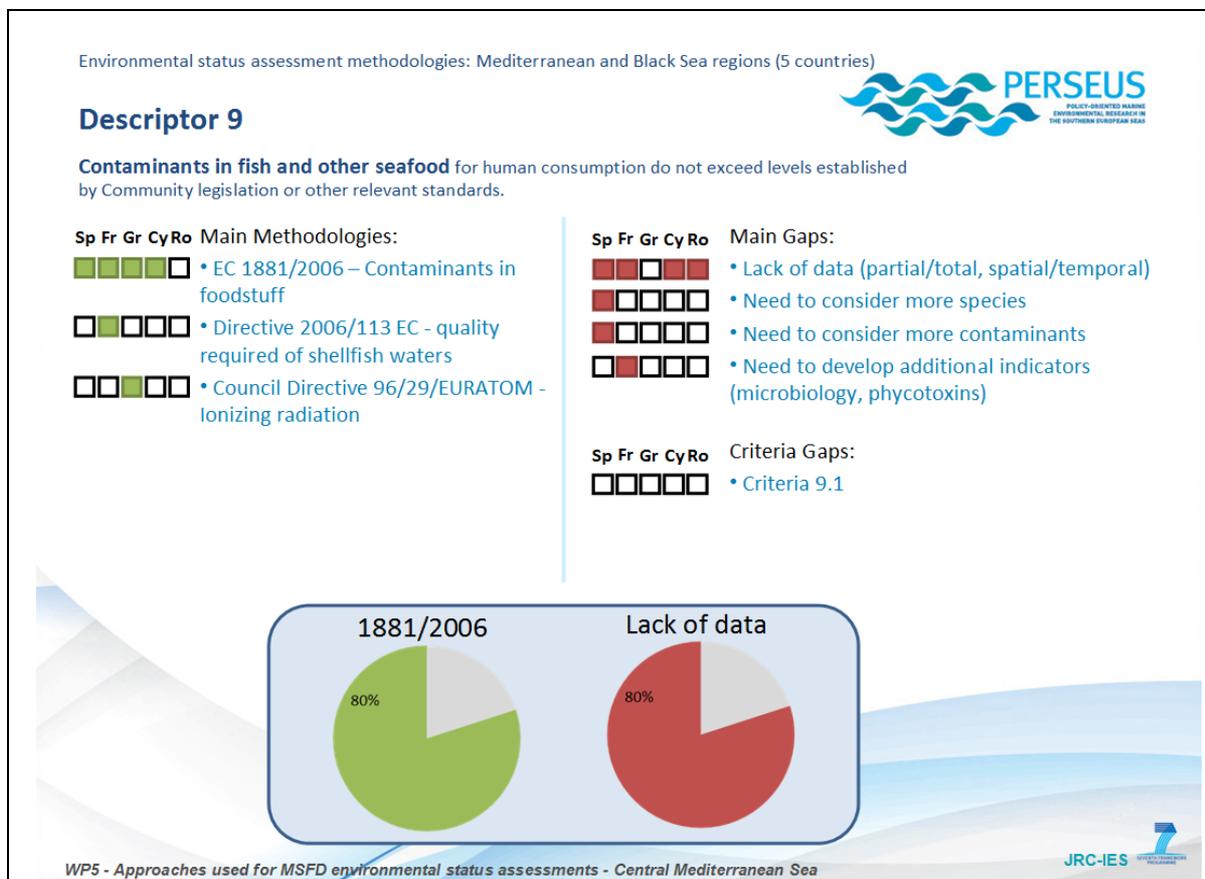


Figure 9 : Umbrella Workshop D9 analysis

Descriptor scope and methodologies

All countries considered in the analysis followed a quantitative approach. The methodology for Descriptor 9 is mostly based on Commission Regulation EC 1881/2006, which sets up maximum levels for certain contaminants in foodstuffs (including fish and seafood). Other regulations mentioned by member countries were: Directive 2006/113 EC on the quality required of shellfish waters; and Council Directive 96/29/EURATOM on basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation. Romania follows a quantitative approach but no reference to European regulation frameworks is made.

Some countries also consider in the assessment the analysis of trends in number of contaminants exceeding thresholds and trends in bioaccumulation in biota/functional groups used as bio-indicators.

France indicates the need to include microbiological indicators and to develop phycotoxin indicator, and suggest an additional criteria 9.2 on microbiological contamination defined as follow: "The GES is reached when the quality criteria defined by the national and Community regulations regarding microbiological



contaminants in water and sea products intended for human consumption are respected."

Thresholds

Thresholds for different contaminants are included in the European regulations mentioned above. However, development of new thresholds will be needed since some countries remarked the importance of including additional contaminants and sampling in further representative commercial species to improve the assessment.

France considers that thresholds from regulations regarding microbiological contaminants in water and sea products might be taken into account.

Data

In general, a frequent lack of data is reported by most of the countries. It is important to mention that this lack of data also include the need to increase the number of contaminants analyzed and the number of species considered in the assessment.

Data sources include monitoring programs at different levels: national/subregional and European monitoring nets, such as MYTILOS project and MED POL monitoring. It should however be noticed that these monitoring networks do not aim to monitor the contaminant levels of the produces put on the market.

Analysis at criteria and indicators levels

All considered countries included **Criteria 9.1** ("*Levels, number and frequency of contaminants*") in their Initial Assessments documents. Indicator **9.1.1** ("*Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels*") is considered by all countries, but its coverage is subjected to data availability. Cyprus considers concentrations of heavy metals (Pb, Cd and Hg) in fish tissues at three sampling stations. The other countries consider heavy metals and different persistent organic pollutants according to EU regulations, but availability of data for regulated substances is reported as partial. In the case of Romania, heavy metals and organochlorine pesticides are analyzed in four species of molluscs (*Mytilus galloprovincialis*, *Mya arenaria*, *Rapana venosa* and *Scapharca inequivalvis*). Spain includes contaminants data on a wide variety of marine commercial species but monitoring programs still need improvements to provide an appropriate assessment. France includes the possibility of assessing trends within Indicator 9.1.1 (e.g. number of contaminants exceeding regulatory thresholds is stable or decreasing). Greece considers trends of bioaccumulation in the biota and functional groups used as bioindicators (*Mytilus Galloprovincialis* and *Mullus Barbatulus/ Boops Boops*, respectively).

The indicator **9.1.2** ("*Frequency of regulatory levels being exceeded*") is also considered in all cases. France includes the possibility to establish a threshold within Indicator 9.1.2 to determine annual maximum frequency of regulatory levels being exceeded. The value of this threshold is still to be determined. Romania also will take



into consideration the possibility to establish a threshold within Indicator 9.1.2 to determine annual maximum frequency of regulatory levels being exceeded, as all not all contaminants have thresholds established by EU and/or national legislation yet.

Overall gap analysis for this descriptor

Methodology for Descriptor 9 is fairly harmonized and mostly based on Commission Regulation EC 1881/2006. However, in the Initial Assessment documents there are frequent data gaps and some improvements would be needed to provide an appropriate assessment. Some considerations from EU countries include the analysis of additional contaminants, sampling in a wider range of marine commercial species and development of new criteria regarding microbiological indicators. Regulatory thresholds are available for several substances, but further development is advisable if EU member's considerations are taken into account.



Descriptor 10

“Properties and quantities of marine litter do not cause harm to the coastal and marine environment.”

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 10.1 “Characteristics of litter in the marine and coastal environment”

- indicator 10.1.1 “Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source.
- indicator 10.1.2 “Trends in the amount of litter in the water column (including floating at the surface) and deposited on the seafloor, including analysis of its composition, spatial distribution and, where possible, source”
- indicator 10.1.3 “Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro- plastics)”

Criteria 10.2 “Impacts of litter on marine life”

- indicator 10.2.1 “Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis)”



Analysis presented during the Umbrella Workshop

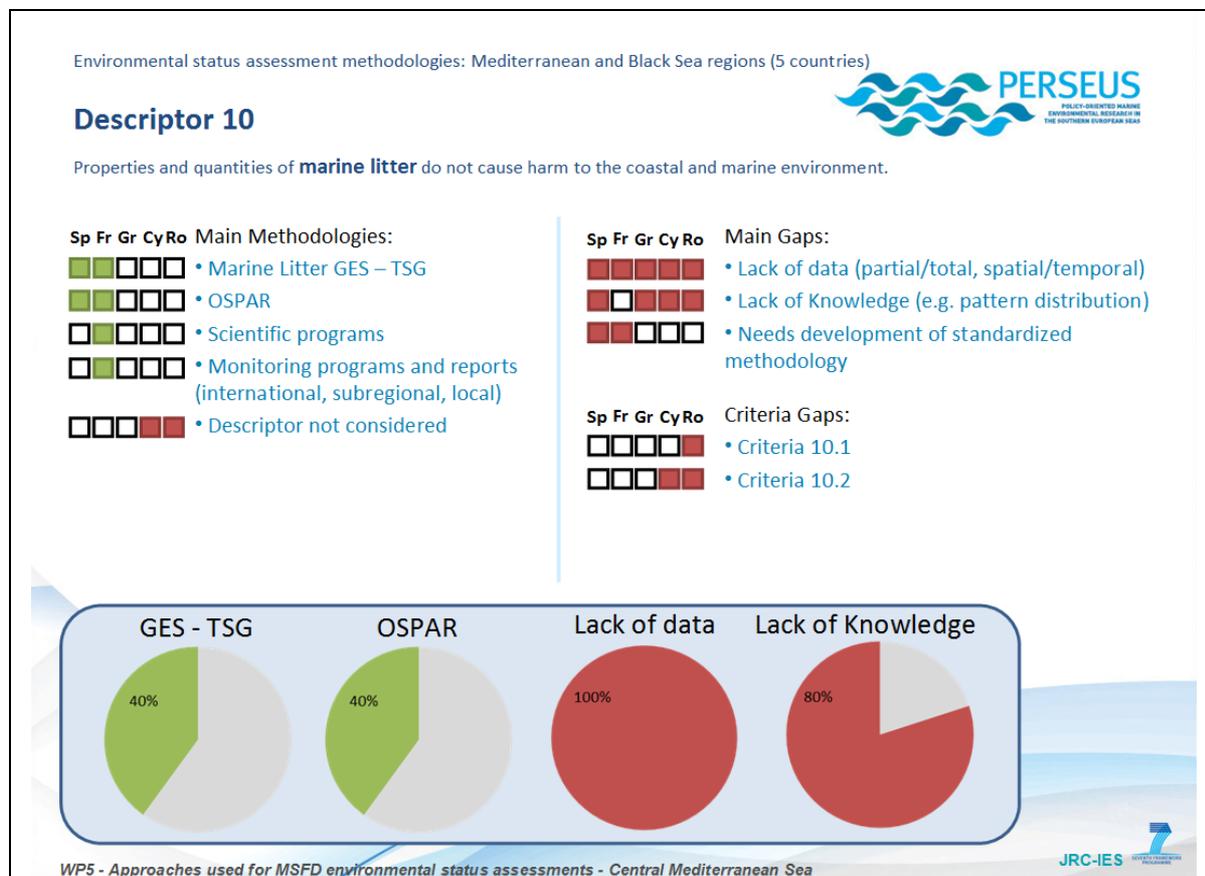


Figure 10: Umbrella Workshop D10 analysis

Descriptor scope and methodologies

Marine litter is one of the descriptors where, despite the fact that there are some elements about methodological approaches, the general lack of data and knowledge makes it quite difficult to assess it. Very few data and methodological elements are available for Greece, Cyprus and Romania and the two latter did not consider this descriptor at all. Information provided by Romania underlines that there is for this country a lack of common monitoring and assessment approach based on standardized methodologies and assessment criteria, as well as a technological lag in respect to contemporary methods and devices for collection, processing, recycling and disposal of solid wastes and marine litter. However, Romania is involved in research projects (PERSEUS and CleanSea), which will enable this country to enhance its data and methodologies related to the marine litter. Greece reports for this descriptor a qualitative methodology based on expert judgment, which does not allow determining the disturbance level. Greece however highlights the crucial importance of this issue for the subregion.

France and Spain both refer to the works of the European group GES-TSG as well as to OSPAR methodologies. France suggests for several indicators methodologies and protocols, however, they are not totally finalized.



The indicators of the criteria 10.1 are trends indicators expressed as a percentage of decrease. These percentage values are still under discussion. For the indicators of the criteria 10.2, thresholds are still to be specified. Regarding inter-indicators and inter-criteria aggregation methodologies, they are still to be defined.

Data

Data on marine litter is presented as scarce and often incoherent. When some data exist, they concern mostly coastal environment. The lack of data for deep areas is reported by Greece, and is a gap for the assessment of the environmental state regarding this descriptor. This country also reports limited data on floating litter.

Spain also mentions data and knowledge gaps for this descriptor, while France does not report any important gap (only an exhaustive inventory of beach litter is missing for the French Mediterranean Sea).

Romania indicates that the most extensive publication written on this subject is the report “Marine Litter in the Black Sea Region 2009”, which evaluates existing data, policies, activities, and institutional arrangements concerning the Marine Litter in the Black Sea region and proposes several actions to deal with the problem.

Data, when they are available, come from few monitoring programs (as reported by France), from specific research projects (as reported by Spain), from programs led by NGO (as reported by Spain, France, Greece and Romania), or from MEDITS campaigns which allow data collection on seafloor litter (as reported by Spain and France).

It should be noticed that some field studies are planned on the D10 methodologies in the framework of PERSEUS WP2, which will enable further methodological development and data collection.

Analysis at criteria and indicators levels

Spain, Cyprus, France and Romania provided for this descriptor information at indicator level.

Regarding the **criteria 10.1 “Characteristics of litter in the marine and coastal environment”**, the first indicator, 10.1.1, deals with litter deposited on coastline (“Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source”). Cyprus and Romania only mention information regarding this indicator for all the D10. Cyprus states a gap of data. Romania considers the characteristics of marine litter (plastic, paper, metal, rubber, etc), the amount, the sources and the composition of the litter. Spain reports for the 10.1.1 that adequate information is not available. France refers to OSPAR protocol and to MED-POL recommendations. OSPAR protocol is already implemented in the French Channel and North Sea, while in the French Mediterranean Sea; initiatives are only local and punctual. They report that sampling method is available for litter over 2.5 cm, but that the conversion factors number/weight/volume are still to be developed. The protocol for litter



between 5mm and 2,5cm is also still under development (the discussions concern the size of the sampling areas).

The indicator 10.1.2 deals with floating litter, water columns and seafloor litter (“Trends in the amount of litter in the water column (including floating at the surface) and deposited on the seafloor, including analysis of its composition, spatial distribution and, where possible, source”). Spain reports a lack of information and a lack of spatial and temporal coverage for floating or water column litter, not enough information for bottom litter in shallow water areas, and no information for bottom litter in the slope. Only bottom litter in the shelf area seems to be well characterized, due to the MEDITS campaigns and other trawling surveys.

Regarding this indicator, France mentions for the water column some protocols under development (to be harmonized), like quantification using visual observation, with a possibility to automate it. For the seafloor, France mentions trawling surveys, for which harmonized protocols are available, but also diving observations (efficient only for localized concerns). For deep areas and canyon, where the cost of data acquisition is very important, France suggests opportunistic data acquisition, allowing a long term monitoring.

The indicator 10.1.3 deals with micro-particles (“Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro-plastics)”). Spain mentions a lack of knowledge, when France highlights that inter-calibration and harmonization protocols are necessary. France reports that protocols and quantification methodologies are under development for sand beach and are already available for surface sampling.

The **criteria 10.2” Impacts of litter on marine life”** and its associated indicator 10.2.1 “Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis)” have been considered by both France and Spain. Romania reports a lack of information, and Spain reports a lack of data and knowledge to assess litter impacts (there are only scarce data on fish or birds stomach contents, plastic entangles...). In France, data are available on turtle stomach contents, however the information collection network need some rationalization. Greece states that this criteria was not taken into consideration for the determination of GES, while Cyprus underlines a general lack of knowledge and data.

Overall gap analysis for this descriptor

Marine litter is an emerging issue with few data available, which is the reason why this descriptor has not been considered by some countries. However, coordination is existing at the European level that may facilitate the implementation process. Methodologies for the indicators of criteria 10.1 (litter characterization) have been developed, and tested in some locations. Available data were however obtained only in few selected sites, confirming gaps for most of the countries. Regarding the impact indicators, the information collection network still needs to be optimized. Descriptor



10 will require further development of harmonized methodologies and support to establish appropriate and coherent monitoring programs at EU level.



Descriptor 11

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

Criteria and indicators defined by the Commission decision 2010/477/EU

Criteria 11.1 “Distribution in time and place of loud, low and mid frequency impulsive sounds”

- indicator 11.1.1 “Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as Sound Exposure Level (in dB re 1 μ Pa 2 .s) or as peak sound pressure level (in dB re 1 μ Pa peak) at one meter, measured over the frequency band 10 Hz to 10 kHz”

Criteria 11.2 “Continuous low frequency sound”

- indicator 11.2.1 “Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1 μ Pa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate”



Analysis presented during the Umbrella Workshop

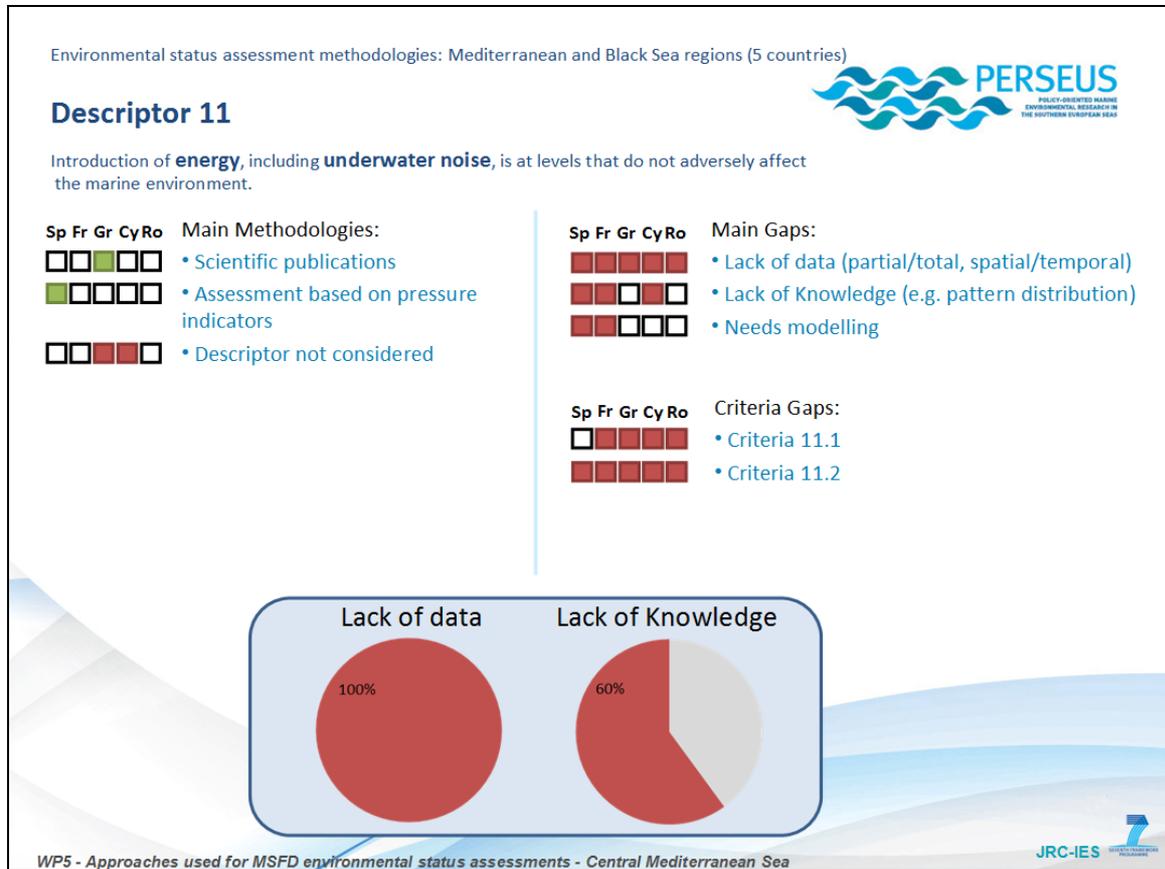


Figure 11: Umbrella Workshop D11 analysis

Descriptor scope and methodologies

Regarding the Descriptor 11, no international frameworks for methodologies is reported by the considered countries. Methodological sources are scarce and based on scientific publications or assessment using pressure indicators data. No quantitative approaches are reported due to the lack of data and knowledge. Furthermore, some countries were not able to assess this descriptor.

France split the descriptor 11 in two parts: 11a for noise introduction, and 11b for introduction of other sources of energy. The latter has not been considered so far.

It is necessary to develop methodological standards and to establish appropriate monitoring programs.

Thresholds

No thresholds are reported in the IAs documents. Therefore, establishment of thresholds will be necessary.



Data

A mayor lack of data and knowledge is present for the Descriptor 11. For that reason, several countries were not able to include it in their assessment.

Data sources refer to scientific publications, impact assessment studies and registry of activities from pressure indicators data.

Analysis at criteria and indicators levels

For the **criteria 11.1 (“Distribution in time and place of loud, low and mid frequency impulsive sounds”)**, only France and Spain report information about the indicator **11.1.1.** (*“Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as Sound Exposure Level (in dB re 1 μ Pa 2.s) or as peak sound pressure level (in dB re 1 μ Pa peak) at one meter, measured over the frequency band 10 Hz to 10 kHz”*).

This indicator is still under development. Estimations based on potential sources of noise have been made by using the listing of concerned acoustic equipments and days of use and the registry of potential activities and sources (pressure indicators data).

For the **criteria 11.2 (“Continuous low frequency sound”)**, only France and Greece provide information about the indicator **11.2.1.** (*“Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1 μ Pa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate”*). Once again, this indicator is still under development. According to France, it is necessary to establish monitoring grids (at least fixed observatories) to obtain data time-series, to complete these data with modelling (sound mapping) and to homogenize the measures by using the percentiles methods. It is also necessary to implement modelling capabilities to allow annual assessment. Greece reports for this indicator sampling in a grid of stations to monitor ambient noise level in within the 1/3 octave bands 63 and 125Hz.

Overall gap analysis for this descriptor

Descriptor 11 is subjected to a major lack of data and knowledge. For this reason, some countries were not able to assess this descriptor. Development of methodological standards and thresholds is necessary, along with establishment of appropriate monitoring programs to allow assessment.



Synthesis of the main findings per descriptor

If we consider **Descriptor 1**, which deals with Biological diversity, the analysis of the methodological approaches adopted by the Mediterranean and Black Sea countries showed predominance in the use of WFD. On the other hand, these countries used combinations of diverse methodologies, covering requirements from EU Directives and Regional Sea Conventions to national methods. Some important methodological frameworks were: Habitats Directive, Natura 2000 or Mediterranean Action Plan (Barcelona Convention). We notice also that OSPAR methodologies (North East Atlantic Ocean region) are mentioned in the Mediterranean region, indicating the existence of methodological gaps to assess this descriptor within the MSFD in the Mediterranean Sea and Black Sea regions for EU countries.

In general, the considered countries have some available methodological elements, according to the conventions or Directives adopted, but this descriptor is very complex and included the use of a great variety of parameters in the assessment, with no common or harmonized methodologies being adopted. A lack of methodologies adapted to offshore components was also highlighted.

Regarding **Descriptor 2**, on Non-indigenous species, most of the countries have followed a qualitative approach. The lack of international frameworks and corresponding methodologies was significant. Further development is needed in order to establish methodological approaches and reference conditions.

For **Descriptor 3** on Fisheries, all five considered countries reported the application of a quantitative approach based on the methodologies used by intergovernmental organizations in charge of providing advice to fisheries management (ICES, GFCM, ICCAT, CFP). However, the need for further development and for harmonization at European level must be highlighted, along with the need to increase the number of species considered and to establish consistent reference points.

If we consider **Descriptor 4**, the methodologies for marine food webs assessments showed diverse strategies with no predominance of one single approach. Countries referred to international methodologies, but also to scientific publications and national reports. It should be highlighted that OSPAR was mentioned by Spain for the Mediterranean Sea. The analysis showed lack of knowledge for this descriptor, and that further development is required.

For **Descriptor 5** on Eutrophication, operational methodologies are already available in the framework of the WFD, as mentioned by all countries considered in the analysis. However, existing WFD parameters need to be adapted to conditions beyond 1 nautical mile subjected to MSFD assessments. MEDPOL methodologies are also available and have been considered by some countries (France and Spain).

Regarding **Descriptor 6** on Sea floor integrity, the main methodological source was the WFD. Approaches pertinent to requirements of the Habitats Directive and Natura



2000 were also reported by France, Romania and Spain. Other international frameworks, such as MAP and STECF were rarely mentioned (only by Spain). On the other hand, scientific publications were used quite often. The use of diverse methodological approaches indicates that harmonization is needed. Methodological standards were available only for some indicators; furthermore, they have a limited applicability, as they are only adapted to regional specificities and to coastal waters.

If **Descriptor 7** on hydrographical conditions is considered, we notice that the understanding of its scope is still vague and heterogeneous according to the information provided by the considered countries. Regarding the existence of international frameworks, WFD was mentioned. In addition, some methodological elements from OSPAR and UNEP/MAP efforts were also considered, but they are still under development. Further development is needed to define quantitative metrics in order to allow an appropriate assessment.

For **Descriptor 8** on Contaminants, several well established international assessment frameworks were used by EU members, including: WFD, MEDPOL program, OSPAR, US EPA thresholds and Commission Regulation EC 1881/2006. The combination of different methodological approaches indicates that harmonization efforts are needed. Besides, there are partial data gaps, such as spatial limitation to coastal areas, and a restricted number of contaminants being considered so far. Countries referred to methodologies adopted in regions outside the Mediterranean Sea and the Black Sea (OSPAR Convention and US EPA), indicating the lack of regional thresholds or reference levels, particularly in sediment and biota matrices. Regarding contaminants effects assessment, ecotoxicological tests were already available (mainly on OSPAR/ICES and MED-POL methodologies) but not included by all countries due to lack of data. They were mostly used by Spain and in a lesser extent by France.

Regarding **Descriptor 9** on fish and seafood contamination, the methodology is mostly based on Commission Regulation EC 1881/2006 (setting maximum levels for certain contaminants in foodstuffs), giving the impression that it is fairly harmonized. However, in the Initial Assessment documents there are frequent data gaps and improvements are needed to provide an appropriate assessment. Some considerations from EU countries include the analysis of additional contaminants, sampling in a wider range of marine commercial species, and development of new criteria regarding microbiological indicators.

If **Descriptor 10** is considered, Marine litter is an emerging issue with few data available, which is the reason why this descriptor has not been considered by some countries. Lack of knowledge is also a major issue. On the other hand, coordination efforts exist at European or regional levels, which may facilitate the implementation process of a harmonized assessment. Methodological approaches mentioned in the Initial Assessment reports include those recommended by the Marine Litter GES Technical Subgroup and OSPAR protocols. Some methodologies are under development or have already been tested in some locations by France, but overall there are major gaps in all of the considered countries to allow an assessment.



Descriptor 10 will require further development of harmonized methodologies and support to establish appropriate and coherent monitoring programs.

Finally, **Descriptor 11** on Noise is subjected to a major lack of data and knowledge. For this reason, some countries were not able to assess this descriptor. Development of methodological standards and thresholds is necessary, along with establishment of appropriate monitoring programs to allow assessment.



PART II - ASSESSMENT OF A GAP SCORE PER DESCRIPTOR

Concept and methodology

In order to provide a synthetic and illustrative representation of the main gaps underlined for each descriptor, we decided to introduce a ranking system and a gap score based on each descriptor analysis, on the basis of the information reported in the MSFD reports of the considered countries.

A qualitative assessment of 8 semi-quantitative criteria based on a matrix aiming to assess the methodological gaps per descriptor has been followed, taking into account the methodology developed by Van der Sluijs et al. (2001). In order to minimize arbitrariness and subjectivity already included in the assessment of the matrix, each criterion has been evaluated according to a discrete numerical scale: 0 (MINOR GAP), 1 (PARTIAL GAP) & 2 (MAJOR GAP). Further information on the description of each level per each criterion is provided in the gap score assessment matrix presented below (table 1).

The following criteria have been considered:

- Criterion A - Common understanding
- Criterion B - Operational methodologies available
- Criterion C - Methodologies under development
- Criterion D - Harmonized methodologies
- Criterion E - Thresholds available
- Criterion F - Trends available
- Criterion G - Sufficient data
- Criterion H - Sufficient knowledge

The assessment matrix, which constitutes the assessment guideline, has been validated by several participants of the assessment, in order to minimize subjectivity. This process enables to avoid misinterpretations among the participants and to reduce arbitrariness in the assessment.

**Table 1: Gap score assessment matrix**

Criteria	Interpretation of the criteria	MINOR GAP (0)	PARTIAL GAP (1)	MAJOR GAP (2)
A - Common understanding	<i>Do the countries consider the same kind of parameters for this descriptor? Is there any misunderstanding / different interpretation of requirements posed by the MSFD documents?</i>	The countries share the same understanding for requirements pertinent to the evaluation of this descriptor, criteria, and indicators. They consider the same kind of parameters, even if detailed methodologies may differ.	- At descriptor level, a common understanding is shared. However, there are differences of interpretation at criteria level. - Partial gap also applies in case only one country has a divergent understanding of the descriptor scope.	More than one country has interpreted the descriptor in a very different way. There's no coherence in the process followed by the different countries and outcomes can not be compared.
B - Operational methodologies available	<i>Are methodologies already identified in the countries IA reports, which allow the assessment of the environmental status according to each of the criteria and the respective indicators (even if these methodologies are not optimal and can be further improved)?</i>	Operational methodologies are already available (even if they are not optimal and can be further improved) for all the criteria and indicators of the descriptor, and are reported in most of the countries IA reports.	- There are some criteria and indicators for which there are no operational methodologies available. - Partial gap also applies in case only one country has identified operational methodologies within its IA.	There are no operational methodologies for any indicator, in any country.
C - Methodologies under development	<i>Are the countries working to develop methodologies more adapted to this descriptor?</i>	Works are engaged or considered by several countries or by the European groups, what will allow developing operational methodologies for all indicators within a close future.	The methodologies under development do not concern all the indicators or all the countries.	There are not enough possibilities to develop methodologies. The methodological gap is severe and will not be tackled in a close future.
D - Harmonized methodologies	<i>Do the available methodologies allow a harmonization and a comparison at indicator, criteria and descriptor level between the different member states?</i>	The countries follow mainly the same protocols, and their assessments at indicator, criteria and descriptor level are inter-comparable.	- For some criteria and indicators, the methodologies are harmonized, but for other they are not. - 1 could also mean that only one or two countries use a methodology which is not harmonized with the other.	The considered countries use different methodologies, which do not allow the harmonisation requested by the MSFD.



PERSEUS Deliverable Nr. 5.2

Criteria	Interpretation of the criteria	MINOR GAP (0)	PARTIAL GAP (1)	MAJOR GAP (2)
E - Thresholds available	<i>Do reference levels exist, which allow to determine if the GES is reached or not at indicator level?</i>	Reference levels exist for all the indicators of this descriptor, for at least one country, and can be adapted to the other countries.	- Reference levels exist for only some indicators - Available reference levels are not adapted to all the considered countries.	Reference level is missing for most of the indicators and most of the countries.
F - Trends available	<i>Are the countries able to determine trends for this descriptor, where pertinent?</i>	Trends can be evaluated in all countries, for all the indicators for which trends assessment is pertinent.	Trends can be evaluated only for some countries, or some indicators for which trends assessment is pertinent.	Trends can not be evaluated for any country, or any indicators for which trends assessment is pertinent.
G - Sufficient data	<i>Are the available data sufficient to allow a robust assessment?</i>	Enough data is available and provides information for all the indicators, in all the considered countries.	The lack of data concerns only some indicators or some areas.	The lack of data concerns most of the indicators and most of the areas.
H - Sufficient knowledge	<i>Is the available knowledge sufficient to allow a robust assessment?</i>	The knowledge is sufficient, and allows the assessment of all indicators in all countries.	The lack of knowledge concerns only some indicators or some areas.	The lack of knowledge concerns most of the indicators and most of the areas.



On the basis of this assessment matrix and of the information available in the above analysis per descriptor and in the Deliverable 5.1, each of the six organisms contributing to this deliverable (JRC-IES, HCMR, GEOECOMAR, NIMRD, IO-BAS and IFREMER) has been asked to produce its own assessment of the gap scores per descriptor. The basic idea was that people already involved in the reviewing of the Initial Assessments would communicate the methodological gaps reported by the countries, as objectively as possible.

In order to ensure a common understanding of the assessment scope among the evaluators, the following guidelines have been provided to each of them:

- Each assessment should consider information pertinent to the five countries' considered in this deliverable.
- The assessment should be based on the content of the MSFD reports (IAs and GES definition reports) included in D5.1, considering as many details as possible. This would allow addressing the actual methodological gaps.
- For each of the 11 descriptors and each of the 8 criteria, a score should be assigned according to the assessment matrix: 0 (MINOR GAP), 1 (PARTIAL GAP) & 2 (MAJOR GAP).

After the collection of the assessments, the pedigree scores have been aggregated per descriptor, and the scores have been averaged, and normalized on the scale of 0-1.

This process enables the analysis of the results and the visualization of gap issues. It aims to provide a broad comparison between descriptors. It is, however, based on expert judgment and should not be considered as exhaustive but rather as indicative. Indeed, the assessment is based on the PERSEUS partners' appreciation of the elements extracted by the team from each country MSFD drafts reports. The list of the considered criteria is not exhaustive, and the underlying data is based on qualitative information.



Results and data processing

For each descriptor and each criterion we aggregated the six organisms scores to a single score by averaging them, and normalizing them on the scale 0-1. The averaged normalized scores obtained are presented in the table below.

Then for each descriptor, we calculated a single score for methodological gap by averaging the scores for all of the eight criteria for which scores were specified.

An aggregated score per criterion was also obtained by averaging the scores for all of the eleven descriptors for which scores were specified.

Table 2: Averaged normalized scores for each descriptor and each criteria

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	Aggregated scores per criteria
A - Common understanding	0,333	0,417	0,000	0,667	0,000	0,417	0,917	0,000	0,000	0,500	0,583	0,348
B - Operational methodologies available	0,500	0,667	0,083	0,667	0,083	0,583	0,750	0,083	0,000	0,500	1,000	0,447
C - Methodologies under development	0,500	0,333	0,333	0,500	0,250	0,583	0,333	0,250	0,333	0,500	0,583	0,409
D - Harmonized methodologies	0,833	0,667	0,417	0,917	0,333	0,667	0,917	0,500	0,250	0,667	1,000	0,652
E - Thresholds available	0,833	0,833	0,667	1,000	0,500	0,917	1,000	0,583	0,500	0,917	1,000	0,795
F - Trends available	0,583	0,583	0,417	0,667	0,250	0,750	0,833	0,500	0,583	0,750	0,833	0,614
G - Sufficient data	0,583	0,750	0,583	0,750	0,333	0,583	0,833	0,500	0,667	1,000	1,000	0,689
H - Sufficient knowledge	0,583	0,583	0,333	0,667	0,333	0,583	0,667	0,417	0,417	1,000	1,000	0,598
Aggregated scores per descriptor	0,594	0,604	0,354	0,729	0,260	0,635	0,781	0,354	0,344	0,729	0,875	

	minor gap: averaged normalized score comprised between 0 and 0,333 (included)
	partial gap: averaged normalized score comprised between 0,333 and 0,667 (included)
	major gap: averaged normalized score comprised between 0,666 and 1 (included)



Analysis of the most important gaps

The comparison of the aggregated scores per criteria, calculated in table 2, are presented bellow. They allow identifying the most common gaps found in the analysis, all descriptors considered together, according to the assessment of the information reported.

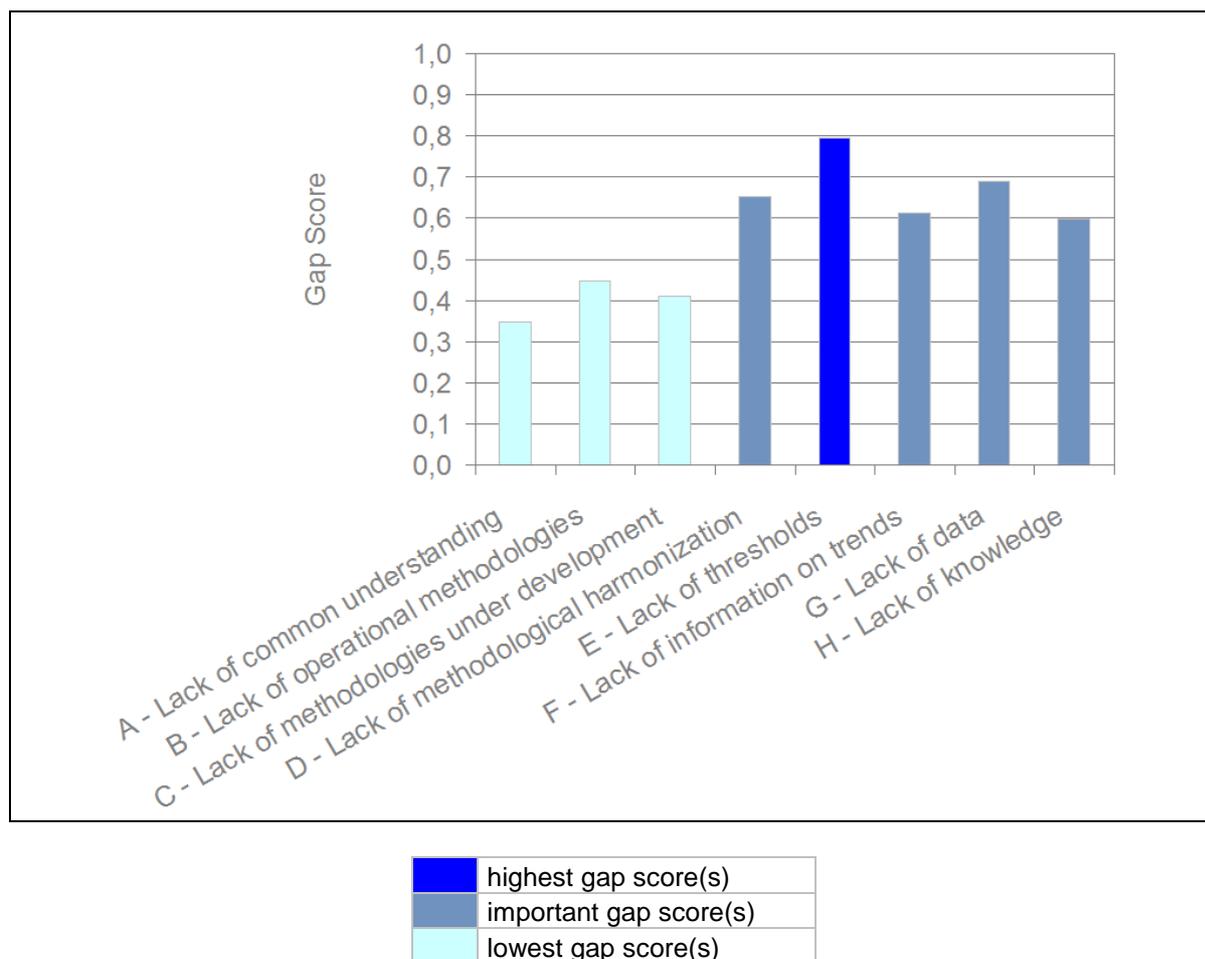


Figure 12: Representation of the most important gaps, all descriptor together (aggregated scores per criteria)

We notice that, among the eleven descriptors, the most important gap is the general lack of thresholds, represented in dark blue in the above figure.

The lack of data, the lack of harmonized methodologies, the lack of information on trends, as well as the insufficient knowledge are also important and are represented in grey-blue in the figure.

Finally, the lack of operational methodologies, the lack of further methodological development and the lack of common understanding present lower gap scores and are represented in light blue. This implies that for many of the MSFD indicators, operational methodologies are already available or are under development.



Overall, this analysis highlights that the main MSFD stakes concerns more the harmonization and the optimisation of the methodologies (identification of relevant thresholds) than the existence of methodologies.

Comparison of the aggregated gap scores per descriptor

The comparison of the eleven aggregated scores per descriptor is represented below. However, it should be noticed that the gap score value of a descriptor prejudice neither the importance of the descriptor nor the priority to focus the efforts on it. Due to the diverse nature, content and importance of the 11 descriptors, this inter-comparison should be carefully considered.

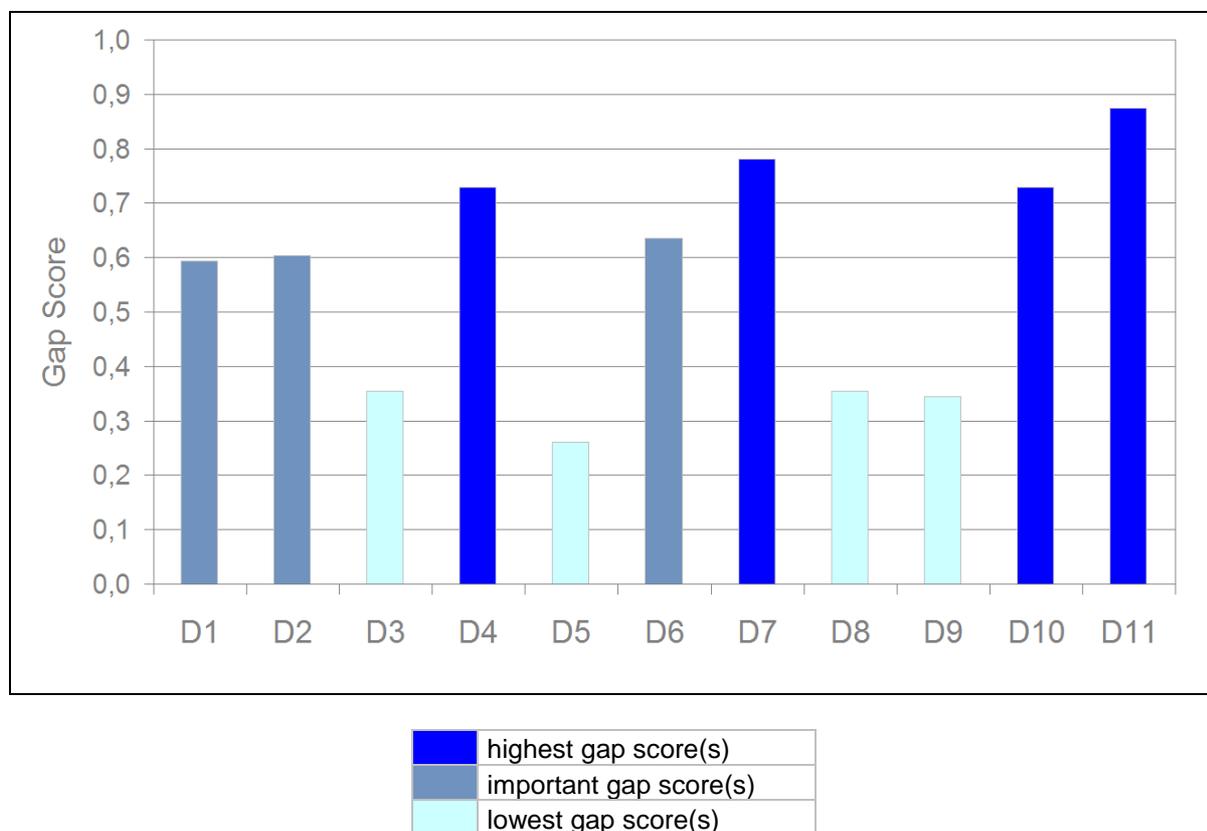


Figure 13: Representation of the eleven aggregated scores per descriptor

If we compare these scores, D11 (noise), D10 (litter), D7 (hydrological condition) and D4 (food webs) exhibit the highest gap values, represented in dark blue in the above figure. D6 (seafloor integrity), D2 (NIS) and D1 (biological diversity) present also important gap scores. They are represented in grey-blue in the figure.

D10 and D11 are mainly characterized by few data available, and some countries have not been able to consider them for this reason. The importance of litter issue is however highlighted by several countries, and coordination exists at the European level that may in the future facilitate the implementation process. Concerning D7, the



lack of common understanding among countries has been particularly highlighted. Concerning the biological descriptors, D1, D2, D4 and D6, they are complex and integrative, which explain their important gap scores.

D3 (fisheries), D8 (contaminants and environment), D9 (contaminants and human health) and D5 (eutrophication) present lower gap scores and are represented in light blue in the figure. International frameworks are already available for these descriptors and they are already substantially assessed in compliance with the requirements of other European regulations.

Some of these results fit with the main conclusions of the first part of this deliverable, however some nuances need to be added to this gap score analysis. Indeed, it is necessary to mention that “low gap score descriptors” (D3, D5, D8 and D9) still need harmonization efforts, further development and establishment of consistent regional thresholds/reference values. As an example, regarding D8, there are only few chemical substances being considered, which is an issue at EU scale, and needs efforts for correction. Likewise the availability of harmonized thresholds is a gap within the assessment process. There is also overall agreement that the processes of contaminant pathways and in particular in the marine environment have not yet been well understood (c.f. TG8 report) and there are obvious gaps, which need to be filled. As an additional illustration, Descriptor 9 has not really been considered by Member State for environmental versus human health monitoring. The discussions are at their beginning, and just a few chemicals are being considered currently.

Inversely, gaps could appear as over-estimated for some descriptors like D7, D10 or D11. There are for these descriptors methodologies applicable and applied, (e.g. for noise in the context of environmental impact assessments), but they have not yet been applied by Member States in their MSFD Initial Assessments.



Relative composition of the aggregated gap scores per descriptor

In an attempt to visualize the knowledge gained from the implementation of the pedigree matrix, radar diagrams were used to represent the values from table 2. These diagrams use polygons to present, in our case, the aggregated scores per descriptor, while each axis represents each criterion score, having 0 in the center of the polygon and 1 on each corner point.

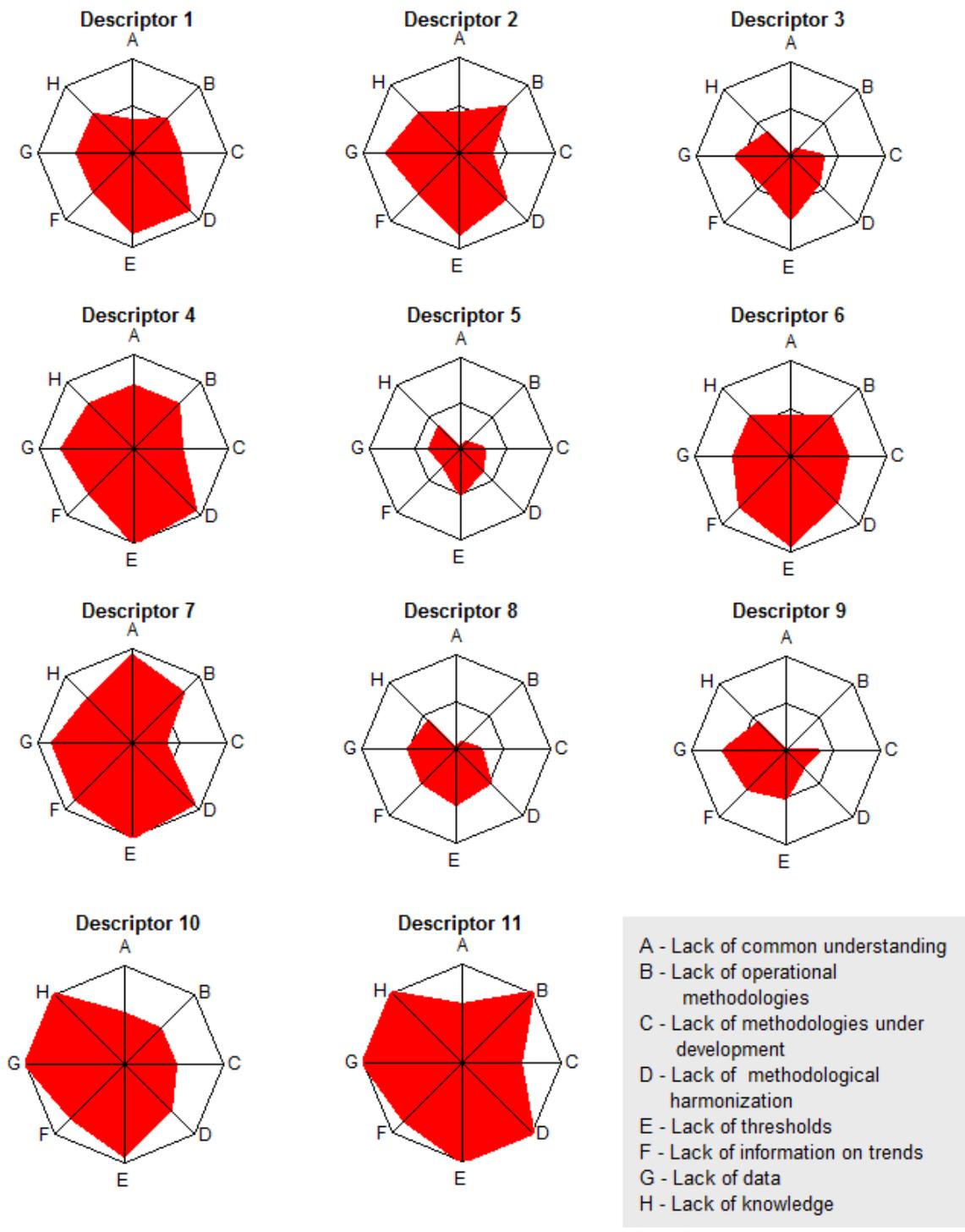


Figure 14: Gap score composition for each descriptor of each criteria



According to these radar graphs, we notice that the lack of common understanding (criterion A) appears to be an important issue for descriptors 4, 7, 10 and 11.

The lack of operational methodologies (criterion B) appears to be a concern for descriptors 2, 4, 6, 7, 10 and 11.

The lack of further methodological development (criterion C) appears to be a concern for descriptors 1, 4, 6, 10 and 11.

The lack of harmonized methodologies (criterion D) appears to be an important issue for descriptors 1, 2, 4, 6, 7, 8, 10 and 11.

The lack of thresholds (criterion E) appears to be a concern for descriptors 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11.

The lack of information on trends (criterion F) appears to be an important issue for 9 descriptors 1, 2, 4, 6, 7, 8, 9, 10 and 11.

The lack of data (criterion G) appears to be an important issue for descriptors 1, 2, 3, 4, 6, 7, 8, 9, 10 and 11.

The lack of knowledge (criterion H) appears to be an important issue for descriptors 1, 2, 4, 6, 7, 10 and 11.



CONCLUSION

This review and analysis of the methodological elements reported by the European Mediterranean and Black Sea countries in their draft IA and GES reports highlighted gaps for most of the MSFD descriptors. Indeed, methodologies for environmental status assessment need to be further developed and harmonized. Review of indicators is necessary, as well as establishment of appropriate monitoring programs. In some cases, countries referred to methodologies from other regions, outside the Mediterranean Sea and Black Sea, indicating possible inconsistencies and the need for adaptations to regional conditions.

If we consider the Biology group (D1, D2, D3, D4, D6 and D7), we notice that there is predominance of International Frameworks depending on the specific descriptor. Methodologies are diverse and different combinations are used by countries on each descriptor. Therefore, harmonization efforts are needed. Further development is necessary at the criteria and indicator level, along with the establishment of appropriate reference levels.

Regarding the Contamination group (D5, D8 and D9), further development is needed for establishment of regional thresholds and reference levels. For some indicators, the available methodologies need to be adapted to offshore issues/conditions. The need to consider additional contaminants and additional indicators is also reported by the countries.

For the Disturbances group (D10 and D11), a general lack of Data and Knowledge is highlighted. There is a need to develop Methodological Standards and to establish appropriate Monitoring Programs. It should be noted that the disturbances group has not been considered by some countries due to the aforementioned gaps.

In the second part of this deliverable, we suggested a scoring methodology to enable the visualization and the comparison of the gaps issues among descriptors. The comparison of the overall scores showed the highest gap levels for descriptors 11, 7, 4 and 10. However, due to the diverse nature, content and importance of the eleven descriptors, the inter-comparison exercise should be considered only as indicative, aiming to provide a general overview of the reported methodological gaps. In addition, it has been highlighted that even the descriptors which present the lowest gap scores (D8, D3, D9 and D5) still need harmonization efforts, further development and establishment of consistent regional thresholds/reference values.

Furthermore, the gap score assessment allowed the identification of the most important gap issues among the whole MSFD process, all descriptors considered together. Overall, the gap issue estimated as the most prominent was the general lack of thresholds. Lack of data, lack of harmonized methodologies, lack of information on trends, as well as the insufficient knowledge have been also identified as frequent. Gaps in data and knowledge have been especially pointed out concerning the relation between the pressures and their impacts. In consequence, most of the impact indicators still need further development. On the other hand, the existence of available methodologies and the perspective for further methodological development have not been underlined as a major problem. This highlights that the main MSFD stakes concern more the harmonization and the optimisation of the methodologies



(identification of relevant thresholds, extension of the spatial and temporal resolution) than the methodologies availability in itself.

The methodological gaps identified should be filled to facilitate the implementation of the MSFD, which is an iterative process based on continuous improvement. The implementation of the monitoring programs will provide additional data acquisition and experience, which will be useful to improve the methodological elements for the next MSFD iteration.

Furthermore, a point of major attention is the harmonization of the approaches among the MSFD process and the Regional Sea Conventions. In the framework of the next deliverable D5.3 “Draft report on assessment elements for MSFD descriptors”, the degree of harmonization for methodological elements reported by the EU Member States will be determined. In the next WP5 steps, the Black Sea Commission and Mediterranean Action Plan approaches will be analysed and compared with the ones reported by the European Member States for MFSD implementation. This comparison will allow identifying the needs for further harmonization and collaboration with non-EU countries in order to support the development of common Environmental Status Assessments in the Southern European Seas.



REFERENCES

- BSC, 2009. Marine Litter in the Black Sea Region. Black Sea Commission Publications 2009, Istanbul, Turkey.
- Dimitriou, P.D., Apostolaki, E.T., Papageorgiou, N., Reizopoulou, S., Simboura, N., Arvanitidis, C., Karakassis, I. (2012) Meta-analysis of a large data set with Water Framework Directive indicators and calibration of a Benthic Quality Index at the family level Ecological Indicators 20:101-107.
- EUROSION. (2004) The EUROSION Portal - A European initiative for sustainable coastal erosion management [WWW Document]. EUROSION. URL: <http://www.euroasion.org/index.html>
- Jeroen van der Sluijs, James Risbey, Serafin Corral Quintana , Jerry Ravetz, José Potting, Arthur Petersen, Detlef van Vuuren, ASSESSMENT OF PARAMETER STRENGTH, in: Jeroen P. van der Sluijs, Jose Potting, James Risbey, Detlef van Vuuren, Bert de Vries, Serafin Corral Quintana, Jerry Ravetz (eds.) 2001. Uncertainty assessment of the IMAGE/TIMER B1 CO2 emissions scenario, using the NUSAP method Dutch National Research Program on Climate Change, Report no: 410 200 104 (2002), 225 pp.
- JRC (2010) Cardoso A, Cochrane S, Doerner H, Ferreira J, Galgani F, Hagebro C, Hanke G, Hoepffner N, Keizer P, Law R, Olenin S, Piet G, Rice J, Rogers S, Swartenbroux F, Tasker M, Van De Bund W, authors Piha H, editor. Scientific Support to the European Commission on the Marine Strategy Framework Directive - Management Group Report. EUR 24336 EN. Luxembourg (Luxembourg): Publications Office of the European Union; 2010. JRC58097
- Lampadariou, N., Akoumianaki, I., Karakassis, I. (2008) Use of the size fractionation of the macrobenthic biomass for the rapid assessment of benthic organic enrichment. Ecological Indicators 8: 729-742
- MSFD Initial Assessments and Good Environmental Status draft reports (Cyprus, France, Greece, Romania, Spain):
http://ec.europa.eu/environment/marine/public-consultation/index_en.htm
- MSFD Initial Assessments and Good Environmental Status Final documents:
http://cdr.eionet.europa.eu/recent_etc?RA_ID=608
- Rosenberg, R., Blomqvist, M., Nilsson, H.C., Cederwall, H., Dimming, A. (2004) Marine quality assessment by use of benthic species-abundance distributions: A proposed new protocol within the European Union Water Framework Directive. Marine Pollution Bulletin, 49:728-739.
- Simboura, N., Zenetos, A., Pancucci-Papadopoulou, M.A., Reizopoulou, S., Streftaris N. (2012) Indicators for the Sea-floor Integrity of the Hellenic Seas under the European Marine Strategy Framework Directive: establishing the thresholds and standards for Good Environmental Status. Medit. Mar. Sci., 13/1, 2012, 140-152



ACRONYMS TABLE

AMBI	AZTI's Marine Biotic Index
AZTI	Basque Technological Centre specialized in Marine and Food Research
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B	Biomass
BAC	Background Assessment Criteria (OSPAR)
BENTIX	Biological Benthic Index
BOPA	Benthic Opportunistic Polychaeta Amphipoda Index
B _{PA}	Biomass Precautionary Reference Points
CARLIT-BENTHOS	Littoral Cartography BENTHOS index
Cd	Cadmium
CFP	Common Fisheries Policy
Chl a	Chlorophyll a
Cr	Chromium
Cs	Caesium
CSF	Conservation Status of Fish species
Cu	Copper
CYMOX	<i>Cymodocea nodosa</i> biotic index
D1	MSFD Descriptor 1: Biological diversity
D2	MSFD Descriptor 2: Non-indigenous species
D3	MSFD Descriptor 3: Population of commercial fish / shell fish
D4	MSFD Descriptor 4: Elements of marine food webs
D5	MSFD Descriptor 5: Eutrophication
D6	MSFD Descriptor 6: Sea floor integrity
D7	MSFD Descriptor 7: Alteration of hydrographical conditions
D8	MSFD Descriptor 8: Contaminants
D9	MSFD Descriptor 9: Contaminants in fish and seafood for human consumption
D10	MSFD Descriptor 10: Marine litter
D11	MSFD Descriptor 11: Introduction of energy, including underwater noise
DCF	Data Collection Framework
DCR	Data Collection Regulation
DDT	DichloroDiphenylTrichloroethane
DIN	Dissolved Inorganic Nitrogen
Directive 2000/60/EC	WFD - Water Framework Directive - European Directive establishing a framework for Community action in the field of water policy
Directive 2006/113/EC	European Directive on the quality required of shellfish waters



Directive 2008/56/EC	MSFD - Marine Strategy Framework Directive - European Directive establishing a framework for community action in the field of marine environmental policy
Directive 92/43/EEC	European Council Directive on the conservation of natural habitats and of wild fauna and flora
Directive 96/29/EURATOM	European Council Directive laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation
DO	Dissolved Oxygen
E	Exploitation rate
EAC	Environmental Assessment Criteria (OSPAR)
EC 1881/2006	European Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs
EEI	Ecological Evaluation Index
EI	Ecological Index
ELNAIS	Ellenic Network of Aquatic Invasive Species
EQS	Environmental Quality Standards (WFD)
ERL	Effect Low Range (US-EPA)
EROD	Ethoxyresorufin-O-deethylase
ESG IA	Ecological State Group - Group of conservative, slow-growing, perennial species
ESG IC	Ecological State Group - Group of shade-adapted, slow growing species
ESG IIA	Ecological State Group - Group of fast growing, fleshy opportunistic species
ESG IIB	Ecological State Group - Group of fast-growing, sun-adapted filamentous and sheet-like species
EU	European Union
EUNIS	European Nature Information System
EURATOM	European Atomic Energy Community
EUROSION	European initiative for sustainable coastal erosion management
F	Fishing mortality
FRV	Favourable Reference Values
GES	MSFD Good Environmental Status
GES-TSG	MSFD Good Environmental Status Technical Sub-Group
GFCM	General Fisheries Commission for the Mediterranean
Hg	Mercury
IA	MSFD Initial Assessment
IBA	Important Birds Areas
IBI	Integrated Biological Index
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
JRC	Joint Research Centre - European Commission



L50	Mean size at first maturity
LFI	Large Fish Indicator
M-AMBI	Multivariate AZTI's Marine Biotic Index
MAP	Mediterranean Action Plan
MEDITS	International bottom trawl survey in the Mediterranean
MEDOCC	Western Mediterranean biotic index for zoobenthos
MED-POL	Programme for the Assessment and Control of Pollution in the Mediterranean Region
MML	Mean Maximum Length
MSFD	European Marine Strategy Framework Directive (2008/56/CE)
MSY	Maximum Sustainable Yield
MSY-B _{TRIGGER}	Reference point under which the stock is considered as out of the biomass range associated to the Maximum Sustainable Yield
MYTIAD	Monitoring of the quality of Adriatic coastal water by bio-integrators (2008)
MYTILOS	Monitoring of the quality of Western Mediterranean coastal water by bio-integrators (2004-2008)
MYTIMED	Monitoring of the quality of North-Eastern Mediterranean coastal water by bio-integrators (2007-2008)
MYTIOR	Monitoring of the quality of Cypriot and South-central Mediterranean coastal water by bio-integrators (2009-2010)
N	Nitrogen
NGO	Non-governmental organization
Ni	Nickel
NIS	Non-indigenous species
NO3	Nitrate
OSPAR	Convention for the Protection of the marine Environment of the North-East Atlantic
P	Phosphorus
PAH	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
PELMED	PELagic trawling survey in the MEDiterranean
PERSEUS	Policy-orientated marine Environmental Research for the Southern European Seas
PO4	Phosphate
POMI	<i>Posidonia oceanica</i> multivariate index
PREI	<i>Posidonia oceanica</i> Rapid Easy Index
RMS	Root Mean Square
ROV	Remotely Operated Vehicle
SCI	Sites of Community Importance (Habitats Directive)
Si	Silicate



PERSEUS Deliverable Nr. 5.2

SSB	Spawning Stock Biomass
STECF	Scientific, Technical and Economic Committee for Fisheries
TBT	Tributyltin
TG 8	MSFD Task Group on Descriptor 8
TPH	Total Petroleum Hydrocarbon
TRIX	Trophic Index
UNEP/MAP	United Nation Environment Programme Mediterranean Action Plan
US EPA	United States Environmental Protection Agency
WFD	European Water Framework Directive (2000/60/EC)
WP	PERSEUS project Work Package
Zn	Zinc

