



Deliverable No 1.1

“Preliminary Report on MSFD Biodiversity Descriptors/Indicators for the Mediterranean - A comparison of targets and associated Indicators & Proposal of a common set of Biodiversity Indicators for the Mediterranean Sea”

**Action Plans for Integrated Regional Monitoring
Programmes, Coordinated Programmes of
Measures and Addressing Data and Knowledge
Gaps in Mediterranean Sea**

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EXECUTIVE SUMMARY

In the framework of the Activity 1 “Systematic solutions of current gaps and needs in relation to articles 8, 9, 10 of the MSFD. Focus on biodiversity” of the Action Med project the National & Kapodistrian University of Athens is responsible for *Subtask 1.1.1: General overview of MSFD*. This subtask involves a review on MSs reporting for Article 8 - Initial Assessment, Article 9 - Definition of GES and Article 10 - Establishment of Environmental Targets of the MSFD for the Mediterranean ecoregion, and it intends to screen and estimate the heterogeneity of the MSs methodological approaches and standards, as well as investigate the commonalities and differences between MSs, including the work undertaken under the auspices of UNEP/MAP Barcelona Convention.

Therefore, the main objective of this deliverable is to analyze the data reported by Mediterranean MSs aiming to identify common approaches in GES definition and establishment of environmental targets related to the 11 MSFD Descriptors, however focusing on those relating to biodiversity. This deliverable constitutes the preliminary report of the task outcomes focusing on biodiversity descriptors 1, 4, 6 and 7, where the analysis of Articles 9 and 10 is presented, as well as a comparative socio-economic analysis of the MSs Initial Assessments of article 8 (8c). In addition, some elements of article 8 relating to pressures (8b) have been included to highlight the pressures exerted on biodescriptors as provided by MSs.

Furthermore, in this Deliverable 1.1, an integrated assessment of biodiversity in coastal and open sea areas is presented, which was conducted for 4 case studies across Greek waters (coastal to open) using a variety of benthic indices and tools in an effort to test, analyse and compare biodiversity indicators used by Member States in their Initial Assessments (IAs), their coherence with the common indicators in the context of UNEP/MAP-Barcelona Convention and in EU research projects. This work has been performed within the ActionMed framework (subtask 1.1.2 “Identify needs and gaps with emphasis on Biodiversity (Descriptors 1, 4, 6, 7)” lead by University of Salento and subtask 1.2.1 “Short term action plans” lead by HCMR) dedicated to provide a catalogue of biodiversity indicators/indices, the scientific considerations and documentation for defining GES, and where possible, targets for the Mediterranean ecoregion.

The case studies herein, developed within the framework of projects collaborating with ActionMed (namely PERSEUS and DEVOTES) were presented, further developed and discussed in the workshop “Identify gaps and settings targets for biodiversity indicators in the Mediterranean Sea” held in Athens from the 22nd - 24th of February 2016. During this workshop some general conclusion have been drawn and presented in this Deliverable 1.1., but will be fully discussed and recommendations will be formulated within the frame of the final Deliverable D1.3

The case studies were:

1. Testing the relationship of benthic indices to stressors by using correlations and multivariate visualization tools – Saronikos Gulf (coastal study).
2. Testing the relationship of benthic indices to stressors by using Signal Detection Theory (SDT) and Gold Standard (GS) - Saronikos Gulf (coastal study).
3. Application of the NEAT high level integration biodiversity assessment tool - Saronikos Gulf (coastal study).

4. Applying benthic Indicators from the coast to the open sea (N. Aegean Open Sea Case study).

The core analysis of article 8 on D1, D4, D6 and D7, as well as all results and conclusions on the produced catalogue of biodiversity indicators/indices, the scientific considerations and documentation for defining GES, and where possible, targets for the Mediterranean ecoregion will be fully discussed and recommendations will be formulated within the frame of the final Deliverable D1.3 “Final Report on MSFD biodiversity descriptors/indicators for the Mediterranean - A comparison of targets and associated indicators & proposal of a common set of biodiversity indicators for the Mediterranean Sea”, along with the overview of the rest of the MSFD descriptors.

GENERAL INTRODUCTION

The Marine Strategy Framework Directive (MSFD) aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020. MSFD is the first EU legislative instrument related to the protection of marine biodiversity, as it contains the explicit regulatory objective that "biodiversity is maintained by 2020", as the cornerstone for achieving GES.

One of the main aims of Activity 1 of the ActionMed project is to review the initial assessment, the GES definition and the environmental target setting in 2018, (Articles 8, 9, 10) with an emphasis on the biodiversity descriptors. As highlighted in the Article 12 Assessment, there is no consistent approach in the Mediterranean in relation to MSFD Descriptors and this is most obvious in the case of the biodiversity related Descriptors. Thus, the first part of the preliminary report for Deliverable 1.1 of Activity 1 highlights the gaps and needs in relation to articles 8 (IAs), 9 (GES), and 10 (Targets) with a special focus on issues and open questions concerning the biodiversity Descriptors and the hydrographical conditions (in particular D1, D4, D6 and D7). Also, a comparative socio-economic analysis of the MSs Initial Assessments of article 8 (8c) was performed, whereas in addition, some elements of article 8 relating to pressures (8b) have been included to highlight the pressures exerted on biodescriptors as provided by MSs.

Commission Decision Criteria and Indicators for Biodiversity Descriptors have a significant amount of overlap, therefore it is important to deal the three Biodiversity Descriptors together and develop Targets and Indicators on the basis of the biological components. Therefore, the second part of the deliverable is highlighting one of the main outcomes of the 1st Workshop on Biodiversity that took place in Athens from the 22nd to 24th of February 2016, where four case studies were developed for an integrated biodiversity assessment in the Mediterranean using and comparing indices and tools across coastal and open sea areas.

The integrated assessment of biodiversity in coastal and open sea areas is conducted in 4 case studies across Greek waters, by using a variety of benthic indices and tools. These case studies served as an effort to test common methodologies, which could produce comparable results in assessing the environmental state, by using indicators on a wider range of biodiversity and functional community features, such as species composition, biotic and functional indices (as body-size spectra) and can also be further used in testing benthic indicators in open sea areas. The case studies integrated biodiversity and seafloor integrity related indicators and will further assist to provide quantitative feedback in order to set thresholds at sub-regional scale. This is a preliminary attempt as indicated in the title and the full results will be presented in the deliverable D1.3.

**PART I: SYSTEMATIC SOLUTIONS OF CURRENT GAPS AND
NEEDS IN RELATION TO ARTICLES 8, 9, 10 OF THE MSFD.
FOCUS ON BIODIVERSITY**

INTRODUCTION

According to the requirements of the Marine Strategy Framework Directive (MSFD) 2008/56/EC, EU MSs had to report on Articles 8, 9 and 10 of the Directive in October 2012. Therefore, the data considered in order to perform the present analysis were reported by MSs to the Commission during the first cycle of the MSFD implementation, (Figure 1) starting in 2012. The Mediterranean countries which were considered in the present analysis are Spain, France, Italy, Malta, Slovenia, Croatia, Greece and Cyprus.



Figure 1: The Marine Strategy Framework Directive Obligations

MSs addressed the 11 Qualitative descriptors for Determining GES of the MSFD as they are described in Annex I of 2008/56/EC:

- D1 Biological diversity
- D2 Non-indigenous species
- D3 Commercial fish
- D4 Food webs
- D5 Eutrophication
- D6 Sea floor integrity
- D7 Alteration of hydrographical conditions
- D8 Contaminants and pollution effects
- D9 Contaminants in fish and other seafood
- D10 Marine Litter
- D11 Energy and Noise

METHODOLOGICAL APPROACH

The methodological approach involved a comparative analysis, which was performed with the use of data from:

- MSs' Articles 8/9/10 reporting uploaded on EIONET CDR (HTML files and National Paper Reports);
- ActionMed Art 09, ActionMed Art10, ActionMed Art08_8a_8b_8c excel sheets composed by UoA and completed by project partners by extracting information from MSs' reporting;
- Article 12 Technical Assessment of the MSFD 2012 obligations for SP, FR, IT, SL, GR, CY.

The difficulties encountered throughout the analysis were mainly due to:

- the big volume of data;
- the inconsistencies between the National Paper Reports and HTML files that were used for the reporting exercise;
- the fact that certain National Paper Reports were produced in national languages (SP, FR, IT, SI, HR);
- the inadequate or inappropriate database reporting reflected on the HTML files generated.

This preliminary report focuses on descriptors 1, 4, 6 and 7. D1, D4, D6 are called Biodiversity Descriptors, as they address biodiversity issues and they are presented jointly in this report. Furthermore, D7 is included in the analysis involving biodiversity components.

DESCRIPTOR 1

According to the Marine Strategy Framework Directive (2008/56/EC) and Commission Decision 2010/477/EU the definition for Descriptor 1 is:

Descriptor 1 (Biodiversity): 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.

A list of Criteria and Indicators on species, population, habitat and ecosystem, as indicated in Table 1, have been set, in order MSs can determine Good Environmental Status (GES) in marine regions and subregions.

Table 1: Criteria and indicators for D1 according to Commission Decision 2010/477/EU.

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

D1: ARTICLE 9 ANALYSIS

GES definition

According to the analysis performed, all 8 Mediterranean MSs have defined GES for D1. CY has defined GES according to COMDEC 2010/477/EU, whereas the other MSs have added specificities to it. Three MSs (GR, SP, SI) state in their GES definition how attributes of specific species will be maintained, in order to achieve GES.

All MSs except CY, mention at least one component from species, habitats or ecosystem levels, but to varying levels of detail in the GES definition at descriptor and criteria level. Four Member States (GR, SP, IT, SI) specifically mention *Posidonia oceanica* in their definitions, and four Member States (IT, SI, GR, HR) mention *Caretta caretta* in their definitions, making these species common habitat (Table 2).

Table 2: Common species/habitats mentioned by Mediterranean MSs in their GES definition for D1.

| | Spain | France | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|---------------------------|-------|--------|-------|-------|----------|---------|--------|--------|
| <i>Caretta caretta</i> | | | • | | • | • | • | |
| <i>Posidonia oceanica</i> | • | | • | | • | | • | |

Therefore, the **level of coherence** across the Mediterranean for the definition of GES for D1 is **moderate**.

Criteria and Indicators applied

All MSs except CY have incorporated some or most of the COM DEC 2010/477/EU criteria for D1, as presented in Chart 1. SI, HR, FR, GR have provided specific definitions for each of the seven criteria whereas IT, MT, SP have covered certain criteria. **The most popular criteria are 1.1 and 1.2**, with 7 out of the 8 MSs having adopted them (all except CY), as well as 1.3, with 6 out of 7 MSs having used it (all, except CY and MT). **The least popular are 1.4, 1.5 and 1.6**, with 50% of the Member States having adopted them (Chart 1).

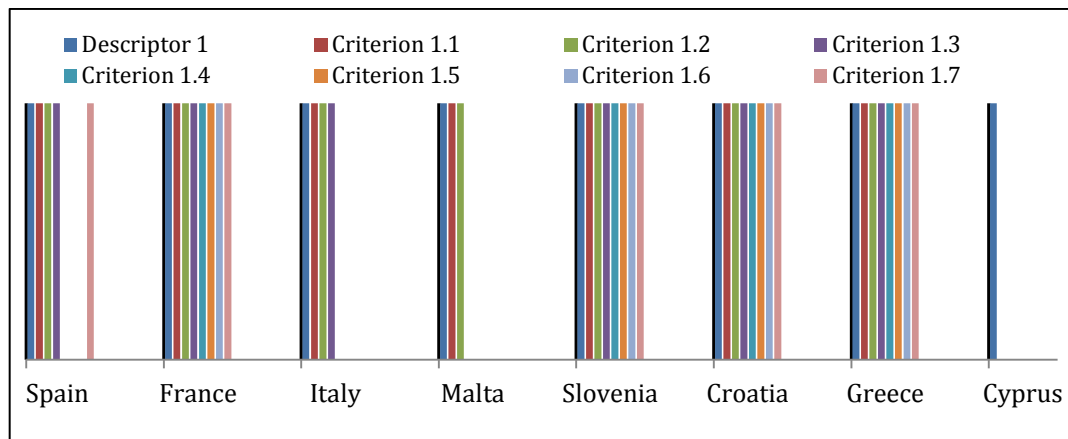


Chart 1: Use of Descriptor /Criteria in Art 9 for D1 by Mediterranean MSs.

Concerning indicators popularity, **1.3.1 was the most popular indicator** used by 3 MSs (SP, FR, IT), whereas indicators **1.1.3 and 1.3.2 were not used at all**. France adopted all indicators except three (1.1.3, 1.3.2 and 1.7.1), Italy used 6 out of the 14 indicators and Spain used 2 of the 14 indicators (Table 3).

Table 3: Use of Descriptor/Criteria/Indicators in Art 9 GES definition for D1 by Mediterranean MSs.

| | Spain | France | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|------------------------|-------|--------|-------|-------|----------|---------|--------|--------|
| Descriptor 1 | √ | √ | √ | √ | √ | √ | √ | √ |
| Criterion 1.1 | √ | √ | √ | √ | √ | √ | √ | - |
| Criterion 1.2 | √ | √ | √ | √ | √ | √ | √ | - |
| Criterion 1.3 | √ | √ | √ | - | √ | √ | √ | - |
| Criterion 1.4 | - | √ | - | - | √ | √ | √ | - |
| Criterion 1.5 | - | √ | - | - | √ | √ | √ | - |
| Criterion 1.6 | - | √ | - | - | √ | √ | √ | - |
| Criterion 1.7 | √ | √ | - | - | √ | √ | √ | - |
| Indicator 1.1.1 | √ | √ | - | - | - | - | - | - |
| Indicator 1.1.2 | - | √ | - | - | - | - | - | - |
| Indicator 1.1.3 | - | - | - | - | - | - | - | - |
| Indicator 1.2.1 | - | √ | √ | - | - | - | - | - |
| Indicator 1.3.1 | √ | √ | √ | - | - | - | - | - |
| Indicator 1.3.2 | - | - | - | - | - | - | - | - |
| Indicator 1.4.1 | - | √ | - | - | - | - | - | - |
| Indicator 1.4.2 | - | √ | - | - | - | - | - | - |
| Indicator 1.5.1 | - | √ | √ | - | - | - | - | - |
| Indicator 1.5.2 | - | √ | - | - | - | - | - | - |
| Indicator 1.6.1 | - | √ | √ | - | - | - | - | - |
| Indicator 1.6.2 | - | √ | √ | - | - | - | - | - |
| Indicator 1.6.3 | - | √ | - | - | - | - | - | - |
| Indicator 1.7.1 | - | - | √ | - | - | - | - | - |

Approach

Two MSs (SI, SP) have quantitatively approached Descriptor 1, while the approach for the rest of the MSs was qualitative (CY, FR, HR, IT, GR, MT).

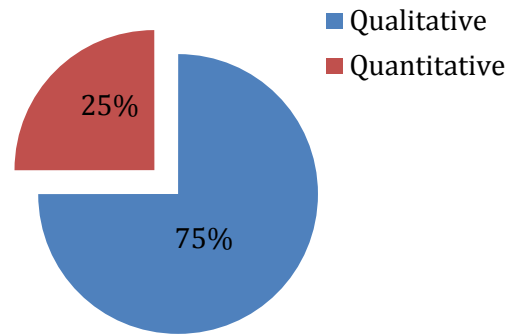


Chart 2: MSs approach to D1 GES definition.

For criteria 1.4 and 1.6 SI and SP provided threshold values and baselines on various aspects of seabed habitats, but not on water column habitats, as depicted in Table 4, whereas MT has used a baseline as well. Regarding assessment methods, FR, SP have established an assessment method and MT will establish one through the MSFD monitoring program. In other cases, the development status of the assessment method is either not mentioned (GR, CY, IT, HR) or needs further development (SI).

Table 4: Assessment methods, thresholds and baselines set by SI and SP.

| MS | Criterion Indicator | Threshold/ Assessment method | Baseline |
|----|---------------------|---|---|
| SI | 1.4 | <ul style="list-style-type: none"> For soft bottoms invertebrates: M-AMBI above the limit of 0.62; For macroalgae on rocky bottom: EEIc values are above 5.84 Conditions of meadows of <i>Posidonia oceanica</i> (density of shoots per m²) and of <i>Cymodocea nodosa</i> (index MediSkew) For habitat types: IHT index density of grasses (Labridae) (on a transect 100m²). | The impact of anthropogenic interventions on the area of distribution of benthic habitat types is minimal. |
| | 1.6 | <p>According to WFD</p> <ul style="list-style-type: none"> For soft bottoms invertebrates at a depth of 7-10 m: M-AMBI above the limit of 0.62; For macroalgae on rocky bottom: EEIc values are above 5.84 For water column habitat: the multiannual geometric mean value of concentrations of chl-a is lower than 1.57 µg /L in the surface water layer Conditions of meadows of <i>Posidonia oceanica</i> (density of shoots per m² according to Giraud (1977) and the determination of the ecological status according to Panayotidis, Lipej <i>et al.</i>, 2007a). For the evaluation of the status of <i>Cymodocea nodosa</i> the MediSkew index (Orlando-Bonca <i>et al.</i>, 2015) whereas sampling and laboratory protocols according to Orfanidis <i>et al.</i> (2007, 2010); For habitat types of the rocky infralittoral belt t: IHT index For the assessment of coastal fish communities the density of wrasses (Labridae) (number of individuals/100 m² of transect). to evaluate the shift in the composition of species or groups the index of abundance of phytoplankton (index IE) (Orlando Bonaca <i>et al.</i> (2010) and Francé <i>et al.</i> (2011)) and for zooplankton biomass the multiannual geometric mean of dry weights., mg/m³). | <p>Current reference conditions.</p> <ul style="list-style-type: none"> Reference values for benthic invertebrates of soft bottoms at a depth of 7-10 m are defined for separate metrics: AMBI = 1.34; Shannon Wiener diversity index H' = 5.87; number of identified species S = 91. Macroalgal communities in the upper infralittoral belt dominate species of the genus <i>Cystoseira</i>; EEIc values are above 8.9. For the water column habitat: the concentration of chlorophyll a is about 0.15 µg/L (reference conditions for the Adriatic Sea, established on the basis of modeling) For <i>Posidonia oceanica</i> the shoot density is above 1100 shoots/m² and for <i>Cymodocea nodosa</i> leaves have the shortest length (an average of about 11 cm), MediSkew index <0.2). For habitat types in the rocky infralittoral belt: IHT values above 0.80. Density of wrasses have to be higher than 50 individuals/100m² of transect. Phytoplankton over years is not over-growing (IE = 8%), jellyfish have a frequency of occurrence of about 8-12 years. |
| SP | 1.4/ 1.6 | According to WFD and HD. | As established by the WFD, the Habitats Directive and the IBA criteria |

Level of Integration with other Directives

Three MSs (SP, IT, SI) refer specifically to the Birds Directive, as well as to the Habitats Directive in their GES definitions. Two MSs mention endangered/protected species (GR, HR) but do not specify the legislation.

Therefore, **the level of Integration with other Directives is low.**

Regional/ International Cooperation

Only two MSs (IT and FR) have included a reference to the Barcelona Convention (SPA/BD Protocol), whereas France has also referred to OSPAR. As a result, **the level of Regional/ International Cooperation is low.**

Article 12 Assessment

According to the results of Article 12 assessment conducted by the Commission, the definition of GES for Descriptor 1 for each MS (except MT and HR) is considered:

- adequate for SP
- partially adequate for FR, IT, SI and GR
- inadequate for CY

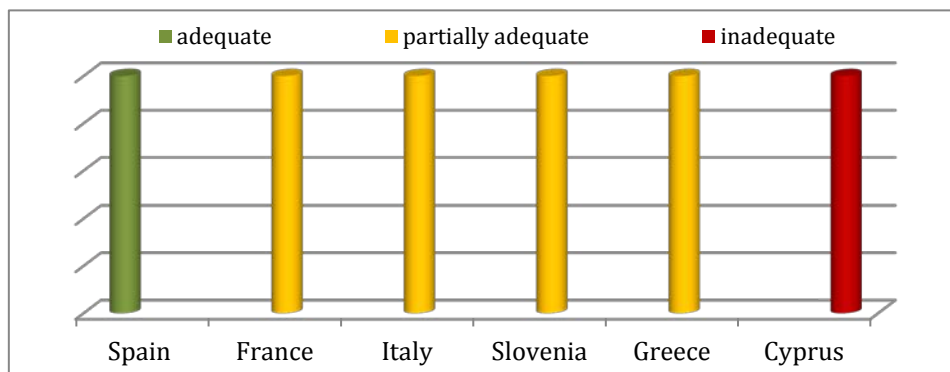


Chart 3: Art 12 Assessment of MSs' GES definition for D1 (MT and HR excluded).

Table 5 presents a synopsis of the analysis performed for Descriptor 1 per MS.

Table 5: Synopsis for each MS regarding D1.

| | |
|----|---|
| SP | <ul style="list-style-type: none"> • GES definition at criteria and indicator level • Adequate use of Criteria (4/7) and inadequate use for Indicators (2/14) • Quantitative approach • Use of thresholds and baselines according to WFD, the Habitats Directive and the IBA criteria • Reference to relevant agreements/standards (EU, RSC, international) |
| FR | <ul style="list-style-type: none"> • GES definition at criteria and indicator level • Adequate coverage of Decision criteria (7/7) and indicators (11/14) • Covers all biodiversity components • Reference to predominant habitats and functional groups • Qualitative descriptions • No thresholds • Reference to relevant international, EU or regional legislation/agreements |
| IT | <ul style="list-style-type: none"> • GES definition at criteria and indicator level • Partial Coverage of the Commission Decision criteria (3/7) and partial approach of indicators (6/14) • Qualitative approach • All ecosystem components are not covered equally – a number of species and habitats are addressed specifically • Reference to the Habitats and Birds Directives, WFD, Barcelona Convention |
| MT | <ul style="list-style-type: none"> • GES Definition at Criteria Level • Inadequate coverage of Criteria (2/7) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |
| SI | <ul style="list-style-type: none"> • GES definition at criteria level • Adequate coverage of Criteria (7/7) • Species covered by GES definition only listed/protected species • Quantitative approach • Threshold values and baselines (use of the IA as a baseline) defined for habitats criterion • Reference to relevant EU legislation and regional and international agreements |
| HR | <ul style="list-style-type: none"> • GES definition at Criteria Level • Adequate coverage of Criteria (7/7) • Qualitative approach • Reference to predominant species • No reference to relevant international, EU or regional legislation/agreements |
| GR | <ul style="list-style-type: none"> • GES definition at Criteria Level • Adequate coverage of Criteria (7/7) |



| | |
|----|---|
| | <ul style="list-style-type: none">• Definition of GES in two parts. First part defines GES for all ecosystem components equally, while second part defines GES conditions for specific, presumably common, species in Greek waters• Qualitative approach• No reference to relevant international, EU or regional legislation/agreements |
| CY | <ul style="list-style-type: none">• GES definition at Descriptor Level• No use of the Commission Decision criteria and indicators• Qualitative approach• No reference to relevant international, EU or regional legislation/agreements |

D1_ARTICLE 10 ANALYSIS

The analysis of the reported information by MSs under D1 included environmental targets and associated indicators established by MSs and their nature. Among MSs, Spain and France have addressed biodiversity descriptors D1, D4, D6 as a group and not individually.

SPAIN

Spain has provided 1 environmental target and 1 associated target specifically for D1, whereas an extensive list of targets has been compiled for all biodiversity descriptors; 22 environmental targets and 19 associated indicators. A number of targets reported by Spain are also related to other descriptors (e.g. D2 or D3), thus the approach is **holistic**. The defined targets are **qualitative**, so they lack specific thresholds and baselines. Certain are quite general and relate directly to the maintenance of the **status** of species and habitats (distribution range, size, condition, etc.). In addition, Spain has set **pressure and impact** targets, which address specific anthropogenic activities accidental or unwanted catches, bottom trawling, dredging and aquaculture. Several targets are **legislative/policy**, since they relate to the implementation of existing policies, networks, agreements and call for their implementation or strengthening (e.g. Natura 2000, regulations on the commercial exploitation and by-catch of deep elasmobranchs). Finally, a large number of targets aim to increase **knowledge** on ecosystems or ecosystem components (e.g. deep sea habitats, marine bottom, food webs).

Table 6: Environmental targets and associated indicators set by Spain for D1-D4-D6.

| Table 6a: Environmental targets and associated indicators for D1 | | |
|---|-----------------------------|---|
| 1 | <i>Environmental target</i> | Reduce the intensity and the area of influence of the significant anthropogenic pressures on the benthic habitats, especially the biogenic or protected habitats that represent biodiversity hot spots and are crucial to ensure the services and functions of the marine environment: maërl bottoms, laminaria community, cold water coral communities, communities dominated by Pennatulacea, aggregations of circumlittoral and deep sponges, and coral gardens. In particular avoid fishing with bottom gear at most sensitive habitats, such as the seamounts, coral and maërl communities, and cold water coral; avoid or reduce the construction of infrastructures that may affect the sensitive habitats; avoid/reduce the direct and indirect effects of dredging on the vulnerable benthic habitats; and avoid the adverse effects of the exploitation of non-renewable marine resources on the biogenic and/or protected habitats |

| | | |
|--|-----------------------------|--|
| | <i>Associated indicator</i> | Surface (or any other appropriated indicator) of biogenic and/or protected habitats potentially affected by human activities and their trends. |
|--|-----------------------------|--|

| Table 6b: Environmental targets and associated indicators for D1-D4-D6 | | |
|---|---|---|
| Environmental targets | | Associated indicators |
| 1 | Reduce the main causes of mortality and of reduction of the populations of groups of species at the top of the trophic web (marine mammals, reptiles, sea birds, pelagic and demersal elasmobranchs), such as accidental capture, collisions with vessels, in taking of litter at sea, introduced terrestrial predators, pollution, habitat destruction, overfishing. | Mortality of the populations of species in the top of trophic chains. |
| 2 | Prevent the impacts on the trophic web of marine farming, especially farming of non-native or non-common species | |
| 3 | Push towards enacting of regulations to avoid commercial exploitation and by-catch of deep elasmobranchs included in the annexes of applicable national law, European directives, or international agreements. | Catches of these species |
| 4 | Establish a national coordination system of the accidental catch monitoring programmes of birds, reptiles, marine mammals, and mammal and reptile stranding and bird tracking. | Existence of the coordination system |
| 5 | Develop initiatives of species recovery and habitats rehabilitation, when their degradation affects the achievement of good environmental status of the biodiversity descriptors. | Conservation status of habitats and species |
| 6 | Strengthen the Spanish Marine Protected Areas Network in the sub-region, in order to adequately protect the biogenic habitats, protected habitats and other identified in the initial evaluation as of being of special interest, including a sufficient amount of habitats and applying specific management measures. | Trends in the areas of distribution of those habitats. |
| 7 | Complete the Natura 2000 network through the designation of marine IBA (Important Bird Areas) as Special Protection Areas (SPA) for Birds, proposal of new Sites of Community Importance and the elaboration and implementation of management plans that ensure the maintenance of values that led to their classification. | |
| 8 | Maintain stable the size distribution of the teleost and elasmobranch demersal and benthic fish species considered big (according with the threshold size established for the sub-region in indicator 4.2.1 of the initial evaluation) in the time series of resource evaluation scientific campaigns, so that | Trends in the 95% percentile of the length distributions |

| | | |
|----|---|--|
| | there are no decreasing trends from evaluation to evaluation. | |
| 9 | Maintain the CSF (Conservation Status of Fish), estimated based on the big fish resource evaluation scientific campaigns (according to the threshold size established for the sub-region in indicator 4.2.1 of the initial evaluation), below 1 in the IUCN vulnerability scale (0: non-vulnerable; 1: vulnerable; 2: threatened; 3: in risk of extinction) | CFS |
| 10 | Maintain the distribution range of species so it does not decrease for a number of species that statistically cannot be considered to be due to natural and climatic variability. | Distribution range |
| 11 | Maintain positive or stable trends for the populations of key species or apex predators (marine mammals, reptiles, seabirds and fish) and maintain commercially exploited species within safe biological limits. | Trends in the populations of those species used as elements for evaluations |
| 12 | Maintain positive or stable trends in the area of distribution of the biogenic habitats and/or protected habitats and unique habitats. | Number of international initiatives |
| 13 | Maintain the parameters and trends of the descriptors of state or condition of the benthic communities (and its different faces and associations) within values that ensure their sustainability and functioning, as well as the maintenance of its characteristic species, key species and unique species. | Indicators applied to evaluate the status or condition of benthic communities, or of their characteristic and key species and their long term trends, in habitats selected for the monitoring. |
| 14 | Maintain updated the lists of the threatened species and the evaluation of their populations | Revisions of the menaced species catalogues |
| 15 | Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles) | |
| 16 | Elaborate regulatory plans for the recreational marine activities and/or associated uses, such as vessel anchoring, diving, sport fishing, marine sports, cetaceous watching, etc for each zone of the sub-region, where these are relevant activities. | Existence of management plans of activities and uses. |
| 17 | Increase knowledge on marine bottom, especially on bottom topography, morphology, composition, depth and associated variables that influence the habitats distribution. | Proportion of the Marine Demarcation studied. |
| 18 | Improve and complete the existing knowledge on the extent, distribution, structure and status of the coastal habitats (until 50 m) and their long-term trends, with special attention to sub and near littoral rock communities and to the coastal soft bottom communities. | Proportion of coastal habitats studied |

| | | |
|----|--|---|
| 19 | Improve knowledge on the extent, distribution, structure, and status of deep habitats and their long-term trends, with special attention to biogenic and protected habitats of rock bottom and near-shore sediment bottom, seamounts and canyons, and seabed deeper than 1000 meters. | Proportion of deep habitats studied |
| 20 | Increase knowledge on the effect of human activities on habitats, in particular on biogenic and protected habitats, and their species, populations and communities, their sensitiveness, tolerance limits, and adaptation capacity, especially those related with fishing activities, infrastructure construction, dredging, extraction of non-renewable marine resources, pollution, and the interaction with climate change effects (acidification, temperature increase, etc.) | Number of studies and projects on these matters. |
| 21 | Increase knowledge on food webs both coastal as well as deep ecosystems, including the study of key organisms and the effect of seasonal variations in order to develop new indicators to evaluate future network status trophic and define properly the Good Environmental Status. | Existence of adequate indicators for evaluating the trophic webs. |
| 22 | Promote a national monitoring system of hydrographic and hydrodynamic ocean variability and establish a warning system on the occurrence of climate anomalies that can pressure the different marine ecosystems. The system shall include a register of biologic and hydrographic variables, as well as occurrence of massive and extreme events in the marine ecosystems such as : unusual algal blooms, occurrence of non-common species in a given zone or at a given season, massive occurrence of species and processes (mortality, breeding), etc. | Existence of the national monitoring system of river and ocean hydrodynamics variability and alert system and register of mass events and ends. |

FRANCE

France has set **24 environmental targets and 33 associated indicators**, in order to address the three biodiversity descriptors. The targets set for the Mediterranean region of France are organized by biodiversity component and address impacts/pressures and activities. All the targets set are **qualitative**, with no baselines or threshold values defined.

Specific targets and associated indicators are provided for habitats (11 environmental targets/16 associated indicators), fish (4 environmental targets/4 associated indicators), mammals (4 environmental targets/7 associated indicators) and birds (5 environmental targets/6 associated indicators). Many of the targets are related to other descriptors too, so there is a **holistic approach**.

Several targets refer to biodiversity elements, pressures or protected areas without giving enough details. The targets are **state, impact, pressure and policy/ legislative**.

Although the targets and indicators set by France are very close to criteria/indicators set by 2010/477/EU, they are characterized as “GES Other”, that is why they do not appear in the table and charts that follow.

Table 7: Environmental targets and associated indicators set by France for D1-D4-D6.

| Environmental target | Associated indicator |
|--|---|
| | Habitats |
| Target A. Maintain or restore biodiversity and ecosystem functioning of coastal bottoms (medio, infra and circalittoral) | |
| Target A.1. Preserve areas of functionality for marine wildlife (spawning, nursery...) | Indicator of habitat area: <i>Posidonia</i> meadow at this stage (to develop incrementally depending on the definition of areas of functionality) |
| | Indicator of habitat volume (to develop) |
| | Indicator of good state of conservation (to develop) |
| | Surface of functionality areas benefitting from a protective or management regime (marine protected areas, environmental contracts, etc.) |
| Target A.2. Strengthen conservation of coral and seagrass areas | Seagrass area integrated in the perimeter of a marine protected area relative to the total area of these habitats at the scale of the marine sub-region |
| | Coral area integrated in the perimeter of a marine protected area relative to the total area of these habitats at the scale of the marine sub-region |

| | |
|---|--|
| | Indicator of good conservation status |
| Target A.3. Remove the residual abrasion of coastal sea bottom by trawling in areas where it is regulated | Number of fines for trawling in prohibited zone compared to the number of controlled trawlers |
| Target A.4. Master pressure of marine uses on the environment by developing spatial organisation of uses | Areas covered by planning documents (maritime aspects of SCOT, orders for water body organizing...) |
| Target A.5. Limit the artificialisation of the coastal area, from low water to 20 meters deep | Percentage of artificialised area, by bathymetric floor, from the MEDAM tool |
| Target A.6. Identify sites of presenting degraded habitats and initiate restoration of half of these sites | Number of sites where action is taken with respect to the number of degraded site identified in the program of measures of PAMM |
| Target A.7 Optimize the ecological role of coastal artificial bottoms (dikes, rip-rap...) | Area and linear planning undergoing an operation to optimize their ecological role prescribed by the program of measures of PAMM |
| Target B. Maintain a good state of conservation of habitats of deep submarine canyons | |
| Target B.1. Limit degradation by abrasion in test canyon areas from human activities (fishing, submarine cables, etc.) | Fishing effort on the head of the canyon (number of French and foreign vessels by type of fishing gear used, number of fishing days, power and tonnage of the vessels concerned) |
| | Authorized areas for other activities generating abrasion (cables, mining materials, etc.) in areas of heads of canyons |
| Target B.2 Reduce the risk of smothering of habitats of interest or vulnerable marine ecosystems of the heads of canyons by anthropogenic activities generating various deposits or resuspension of sediments | Authorized areas for activities generating deposits of materials or resuspended sediments (dredging, extraction of materials, etc.) on the heads of canyons |
| | Volume of materials concerned with these authorizations |
| Fish | |
| Target C. Preserve fisheries' resources of the Gulf of Lion's shelf and coastal areas | |
| Target C.1. Develop professional fishing practices compatible with the maintenance of living resources in the Gulf of Lion and coastal areas, at sustainable exploitation levels | Number of fishing vessels engaged in sustainable fishing practices defined in the program of measures PAMM |
| Target C.2. Organize recreational fishing practices compatible with the maintenance of fish populations of | Number of recreational fishermen engaged in sustainable fishing practices defined in the program of measures PAMM |

| | |
|--|---|
| coastal areas | Number of associations of recreational fishermen engaged in sustainable fishing practices defined in the program of measures PAMM |
| Target C.3. Identify and preserve keys habitats of fishery resources, particularly by integrating the protection of spawning areas in the heads of canyons of the Gulf of Lion | Surface of key areas benefitting from a protective or management regime (marine protected areas, contracts “environment”, etc.) |
| Marine mammals | |
| Target D. Maintain or restore populations of marine mammals in a good state of conservation | |
| Target D.1 Reduce the risk of vessel collision with marine mammals | Number of deaths of large cetaceans caused by a collision with respect to the total number of deaths of cetaceans identified |
| | Number of ships equipped with devices for the prevention of collisions |
| Target D.2 Limit the acoustic disturbances to marine mammals by anthropogenic activities | Temporal and spatial distribution of underwater noise |
| | Trend of the ambient noise level |
| | Number of deaths of large cetaceans from acoustic disturbance by the total number of deaths of cetaceans identified |
| Target D.3. Limit other human disturbances (excluding specific objectives D1 and D2) | Number of vessels engaged in whale watching activities |
| | Number of vessels engaged in whale watching activity adhering to a good practice scheme (e.g. charter, etc.) |
| Birds | |
| Target E. Ensure the hosting potential of the marine environment with regard to birds: feeding, resting, reproduction, travelling | |
| Target E.1. Protect the functional areas for birds (feeding, resting, travelling and reproduction areas, including offshore), possibly with Spain and Italy | Surface of functional areas for birds protected |
| | Surface area of species’ habitats in a good state of conservation |
| Target E.2. Reduce the pressure exerted by some terrestrial species on islands and islets used for breeding sites | Population (number of individuals) of harmful species on islands and islets |
| | Reproductive rate of the birds species in the area concerned |
| Target E.3. Limit disturbances, including noise and light in nesting sites | Surface area of the species habitats in a good state of conservation in relation to noise and light pollution (Natura 2000 indicator) |
| Target E.4. Control the pressure on the environment and other avian species populations by the Yellow-legged Gull | Abundance of Yellow-legged Gulls populations in the area of special protection (number of individuals) |

ITALY

Italy has established 6 environmental targets and 8 associated indicators to address Descriptor 1. The targets are set at indicator level and they are both qualitative and quantitative. Threshold values are provided but without baselines. They focus on some of the species/functional groups covered by the GES definition, thus, the targets do not address all components of biodiversity. Community legislation is mentioned in a lot of targets, but it is not clear whether it is/will be implemented. The targets are impact, pressure and policy/ legislative.

Table 8: Environmental targets and associated indicators set by Italy for D1.

| Environmental Targets | | Associated Indicators |
|-----------------------|--|--|
| 1 | Proper management of coastal fish catch | Increasing surveillance and number of inspections at sea and on land by the authorities in charge (+20% of number of surveillance and controls) |
| | | Encouraging the cooperation of professional and recreational fishermen by means of awareness-raising activities on "best practices" concerning the exploitation of marine resources as well as training activities on the current fisheries legislation (50% of organisations present within the territory met). |
| 2 | By-catch reduction in the areas of aggregation of <i>Caretta caretta</i> | <p>1) Spatial identification of the areas with highest use of pelagic long line (southern Tyrrhenian and southern Ionian sea) and trawling (northern Adriatic)</p> <p>2) Completion of the spatial definition of <i>Caretta caretta</i> aggregation areas based on an approach capable of assessing temporal and seasonal distribution differences for each aggregation area (based on indicator 1.1.2 completion) so as to provide a final definition of the operative target</p> <p>3) Monitoring of accidental captures in the areas subjected to operational target</p> <p>4) Application of by-catch reduction measures (in areas listed in point 3), through one or more of the following activities:</p> <ul style="list-style-type: none"> - Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling net through structural modifications to the gear (i.e. circle hooks, TEDs etc.), and - Application of best practices for the reduction of mortality following capture (percentage). <p><u>Note:</u> in order to allow an immediate reduction of the pressure it is advised that best practices be applied in the geographic areas where preliminary knowledge already defines the presence of an aggregation area, before</p> |

| | | |
|---|--|--|
| | | defining the incidence of total capture in the specific gear. - Reduction of fishing pressure (percentage) |
| 3 | Implementation of training and awareness actions to reduce mortality from by-catch of demersal elasmobranchs | |
| 4 | By-catch mitigation: setting up of a mechanism for assessing the sustainability of incidental mortality caused by fishing activities on cetaceans | |
| 5 | Implementation of control and training activities to avoid catching of benthic species | Increasing surveillance and number of inspections at sea and on land by the authorities in charge (20% increase); |
| | | Increasing the cooperation and information by means of awareness-raising activities on "best practices" concerning the exploitation regulations of marine resources, in particular at the AMP (80% increase of meetings and training activity) |
| 6 | Waste water treatment plants with secondary treatment - Directive 91/271/EEC concerning urban waste water treatment related to the habitat "Pelagic" (<i>same as for D5</i>) | |

MALTA

Malta has provided 17 environmental targets and 17 associated indicators to address Descriptor 1. The targets are set at indicator level with emphasis at habitats (1.4.1, 1.5.1, 1.6.1, 1.6.2 and 1.6.3). Regarding species, two indicators were used (1.2.1 and 1.3.1). No target was set at ecosystem level. The targets are state, impact pressure, policy/legislation and knowledge and they are all qualitative. Malta has mentioned a lot of species in the description of the targets and associated indicators. The choice of species-level targets is protected/listed species; however does not contain the whole range of biodiversity components. Community legislation (Birds Directive, Water Framework Directive) is mentioned in some of the targets.

Table 9: Environmental targets and associated indicators set by Malta for D1.

| Environmental Targets | | Associated Indicators |
|-----------------------|--|--|
| 1 | Efforts are undertaken, through implementation of conservation measures or existing permitting and licensing procedures, to ensure maintenance of the distributional range and extent of selected habitat types in selected areas. | Indicators for range and extent of selected habitat types OR Information on Conservation measures or permitting and licensing processes. |
| 2 | Species composition and/or abundance associated with selected marine habitats is stable based on definition of status through the implementation of the EU Water Framework Directive. | Community indicators (to be developed) Relative abundance of selected key species |
| 3 | Health status of seagrass meadows is maintained. Benthic habitats affected by currently regulated anthropogenic activities show signs of recovery. | Community indicators (to be developed) |
| 4 | Maintaining and enforcing regulations governing fishing activities within the 25 nautical mile Fisheries Management Zone. | Indicators on the distribution of fishing activities OR on areas impacted by fishing activities (to be developed). |
| 5 | Localised or sensitive marine habitats are afforded legal protection by 2025 | Protected Areas |
| 6 | To strengthen knowledge on the conservation status of <i>Tursiops truncatus</i> , <i>Delphinus delphis</i> , and <i>Stenella coeruleoalba</i> in Malta, and on interactions of these species with human activities, with a view to contribute to the regional conservation of marine mammals in the long-term. | An indicator on the level of knowledge on <i>Tursiops truncates</i> , <i>Delphinus delphis</i> and <i>Stenella coeruleoalba</i> |

| | | |
|----|--|--|
| 7 | To strengthen knowledge via updated data on key characteristics of the water column, including plankton communities that would enable Malta to further develop the definition of this habitat type in line with the requirements of the Marine Strategy Framework Directive. | Level of knowledge on water column habitat types |
| 8 | To ensure systematic collection of records of turtle by-catch by the Maltese registered fishing fleet and of data on mortality rate of landed turtles. | An indicator on the systems of data collection in place OR indicators on incidentally caught turtles and mortality of landed turtles |
| 9 | Species composition and/or abundance of demersal fish and demersal elasmobranchs associated with shelf and upper bathyal sublittoral sediments is stable over a period of time. | Community Indicators (to be developed) |
| 10 | To ensure better use of fishery independent data in analysis of fish populations. | Level of knowledge on selected fish species. |
| 11 | To strengthen knowledge via updated data on key characteristics of the water column, including plankton communities, in order to define this habitat type in line with the requirements of the Marine Strategy Framework Directive. | Level of knowledge on water column habitat types |
| 12 | Control the population of the yellow-legged gull on the islet of Filfa | Breeding pairs of the yellow legged gull |
| 13 | Reduce current levels of pressures originating from light pollution and predation by rats in areas to be selected | Level of pressures under consideration (to be developed) |
| 14 | Marine SPAs are designated within the framework of the Birds Directive to include marine areas used by seabirds throughout their lifecycle | Number of marine SPAs |
| 15 | Efforts are undertaken, through conservation measures or existing permitting and licensing procedures to ensure stable distributional range of breeding sites of <i>Puffinus yelkouan</i> , <i>Calonectris diomedea</i> and <i>Hydrobates pelagicus</i> | Location and extent of breeding sites for selected seabirds |
| 16 | Population abundance of breeding seabirds is stable over a period of twelve years, taking into consideration the natural variability of the species population and their ecology | Number of breeding pairs |
| 17 | Long-line fisheries are adequately using mitigation measures aimed at reducing seabird by-catch | Indicator on mitigation measures to be developed |

SLOVENIA

Slovenia has defined 7 targets and 14 associated indicators for Descriptor 1, in accordance with the objectives of the Birds Directive, the Habitats Directive and the Water Framework Directive, as well as the objectives of the Barcelona Convention. The targets are quantitative with a threshold value and a baseline, whereas the associated indicators specify further the species and habitats considered. However, only a limited number of species/habitats are mentioned. The targets set are state, impact and legislative.

Table 10: Environmental targets and associated indicators for D1 set by Slovenia.

| | Environmental Targets | Associated Indicators |
|---|--|--|
| 1 | Environmental objectives in relation to the distribution and status of species are in line with the objectives of the Birds Directive (92/43/EC) | Preserving habitat for maintenance of stable population of common tern Preserving habitat for maintenance of stable population of little tern |
| 2 | Environmental targets for the distribution, size and condition in accordance with the objectives of the Barcelona Convention | Achievement of good status and prevention of deterioration due to human activities regarding the distribution and cover of coral rock, with regard to biomass of coral rock and in relation to demographic characteristics. Achievement of good status and prevention of deterioration due to human activity regarding the spatial and depth distribution of meadows of <i>Cymodocea</i> Achievement of good status and prevention of deterioration due to human activity regarding the spatial and depth distribution of meadows of <i>Posidonia oceanica</i> |
| 3 | Environmental targets for the distribution, size and condition in accordance with the Habitats Directive (2009/147/EC) | Achievement of favourable status and prevention of deterioration due to human activity regarding the distribution, number and demographic characteristics of bottlenose dolphins. Achievement of favourable status and prevention of deterioration due to human activity regarding the distribution, number and demographic characteristics of loggerhead sea turtle. Achievement of favourable status and prevention of deterioration due to |

| | | |
|---|---|---|
| | | human activity regarding the extent of cover, biomass and demographic characteristics of <i>Pinna nobilis</i> . |
| 4 | Environmental objectives for the description of the habitat regarding the distribution, size and condition are in accordance with Directive 2000/60/EC and the Habitats Directive (2009/147/EC). Achievement of good status and prevention of deterioration due to human activities regarding the distribution, extent and condition of habitats in mediolittoral, infralittoral and circalittoral. | Meadows of <i>Posidonia oceanica</i> Meadows of <i>Cymodocea</i> Invertebrates of soft seabed Habitat types Macroalgae of rock seabed Cunner density |
| 5 | The establishment of protected areas in Slovenian waters and the Adriatic by 2020. | |
| 6 | All relevant criteria, indicators and targets should be considered in the EIA. | |
| 7 | Eliminate the uncertainties and gaps in determining the initial status; assess the status and set objectives and targets for each of the criteria and indicators. | |

CROATIA

Croatia has defined 9 qualitative environmental targets to cover Descriptor 1 at indicator level. The targets are state whereas they are not related to other descriptors. The values set in the Habitats Directive are mentioned. Croatia has used selected species (*Caretta caretta* and *Corallium rubrum*), as well as three more general categories of organisms (cetaceans, seabirds and fish). The targets relate to other species/habitats as well, such as *Cystoseira amantacea*, *Posidonia oceanica* etc.

Table 11: Environmental targets set by Croatia for D1.

| Environmental Targets | |
|-----------------------|--|
| 1 | <ul style="list-style-type: none"> a) There is no statistically significant reduction in the distribution range of monitored cetaceans. b) Nest-site distribution of selected seabirds is stable or increasing. c) Geographic and depth distribution of selected fish meet individual indicator targets in a statistically significant proportion of species monitored. d) There is no decrease in current (baseline) range (FRR according to Habitats Directive) for <i>Caretta caretta</i>. e) Distribution range of species <i>Corallium rubrum</i> is stable or increasing and not smaller than the FRR values (Favourable Reference Range under Habitats Directive). |
| 2 | The distribution of monitored cetacean species is in concordance with the expected pattern throughout the previously established distribution area. |
| 3 | <ul style="list-style-type: none"> a) The number of individuals in local populations of bottlenose dolphins that are monitored in areas of territorial sea (Vis-Hvar-Lastovo; Kornati; N. Dalmatia; Kvarnerić) and in areas put forth as SCI for bottlenose dolphins is stable or increasing. b) Annual abundance of breeding seabirds for each selected species/nest location or area is stable or increasing. c) Population abundance of <i>Caretta caretta</i> in the Adriatic Sea is not reducing. d) Population abundance density and population biomass density of sensitive fish species meet individual indicator targets in a statistically significant proportion of species monitored. e) Density of red coral settlement is increasing. |
| 4 | <ul style="list-style-type: none"> a) The number of young animals in three local populations of bottlenose dolphins monitored in territorial waters (Vis-Hvar-Lastovo; Kornati; N. Dalmatia; Kvarnerić) and in proposed bottlenose dolphin SCI areas, is stable or increasing. b) Mortality of seabirds due to fishing by catch is sufficiently low and annual breeding success is not lower than expected. c) Mortality of <i>Caretta caretta</i> due to fishing bycatch and ingestion of marine litter is reduced and does not affect population size. d) Demographic characteristics of selected sensitive fish species meet individual targets in a statistically significant proportion of species monitored. e) The number of adult specimens of <i>Corallium rubrum</i> is increasing. |

| | |
|---|--|
| 5 | <p>a) Range of photophilic algal community is stable or increasing according to all indicators monitored and not below then Favourable Reference Range (according to Habitat Directive).</p> <p>b) Range of <i>Posidonia oceanica</i> meadow is stable or increasing and is not less than the FRR value (Favourable Reference Range for HD habitats).</p> <p>c) Distributional range of Coralligenous assemblages in Croatia is stable or increasing and not smaller than the FRR value (Favourable Reference Range for Habitats Directive).</p> |
| 6 | <p>Distribution of photophilic algal community is in accordance with the expected pattern throughout the established distributional range.</p> |
| 7 | <p>a) Coastline colonized by <i>Cystoseira amantacea</i> is stable or increasing and not smaller that the baseline value.</p> <p>b) The upper and lower limits of <i>Posidonia</i> meadows are not in regression.</p> |
| 8 | <p>a) <i>Posidonia oceanica</i> shoot density is not decreasing.</p> <p>b) Relative abundances and plankton biomass are not significantly changed from naturally occurring conditions.</p> |
| 9 | <p>Weight and length structure of selected fish species are in good status.</p> |

GREECE

Greece has defined 5 environmental targets and 4 associated indicators to address D1, mainly following the GES definition, with some addressing specific species/habitats (*Monachus monachus*, *Caretta caretta*, *Posidonia oceanica*, Maerl-type biogenic sediment areas). These targets are state, related to the maintenance and/or mapping of a particular feature. The overall approach is qualitative, so no baselines or threshold values are set.

Table 12: Environmental targets and associated indicators set by Greece for D1.

| Environmental Targets | | Associated Indicators |
|-----------------------|--|---|
| 1 | Maintain the population of monk seals <i>Monachus monachus</i> in Greek waters. | Size, characteristics and distribution of the population of the Mediterranean monk seal <i>Monachus monachus</i> in the marine subregions |
| 2 | Census of marine turtle <i>Caretta caretta</i> reproducing in the Greek coasts and conservation of spawning areas. | Breeding area of the sea turtle <i>Caretta caretta</i> and monk seals <i>Monachus monachus</i> |
| 3 | Conservation and mapping of <i>Posidonia oceanica</i> meadows. | Presence of <i>Posidonia oceanica</i> meadows. |
| 4 | Inventory of area occupied by biogenic Maerl type sediments and other sensitive coralligenous habitats | Presence of the Maerl-type biogenic sediment areas. |
| 5 | Preservation of the structure of the benthic macrofauna and plankton communities. | Presence and composition of benthic macrofauna communities and planktonic communities. |

CYPRUS

Cyprus has set one quantitative target for Descriptor 1, calculated from 19 indicators following the GES definition and covers most D1 criteria and indicators except 1.3, 1.4 and 1.3.1, 1.3.2, 1.4.1, 1.4.2 as indicated in Table 13.

There is a particular methodology followed for the assessment of the target; univariate biotic indices and parameters (species number of macroalgae, zoobenthos, fishes as well as their abundance) where the observed variability is high should have a divergence from the reference conditions equal to or not greater than 50%; for multivariate biotic indices, qualitative indices and abiotic parameters, a divergence equal to or less than 25% should be achieved. The reference conditions are not specified.

Table 13: Environmental targets and associated indicators set by Cyprus.

| Environmental targets | Associated Indicators* | Relation to MSFD Criteria/Indicators |
|---|--|--------------------------------------|
| Target: The marine environment of Cyprus is considered to be in good environmental status by the year 2020 if 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. | | |
| Divergence < 50 % from reference conditions | Macroalgae-diversity indices (Species number, H',J') | 1.1 1.1.1/1.1.2/1.1.3 |
| Divergence < 50 % from reference conditions | Zoobenthos-diversity indices (Species number, H',J') | |
| Coefficient of Variance < 0.50 | Fishes-diversity indices (Species number, H',J') | |
| Divergence < 50 % from reference conditions | Macroalgae-abundance (% Coverage) | 1.2 1.2.1 |
| Divergence < 50 % from reference conditions | Zoobenthos-abundance (Individuals/sample) | |
| Coefficient of Variance < 0.50 | Fishes-abundance (Individuals/km ²) | |
| Divergence < 50 % from reference conditions, expert judgement | Area and distribution of angiosperms (area in ha) | 1.5 1.5.1/1.5.2 |
| Divergence < 50 % from reference conditions | Abundance of perennial seaweeds | 1.6 1.6.1/1.6.2/1.6.3 |
| Divergence < 50 % from reference conditions | Abundance of shade-adapted, slow growing calcareous species (% Coverage) | |
| Divergence < 50 % from reference conditions | Abundance of opportunistic macroalgae (% Coverage) | |

| | | |
|---|-----------------------------------|--------------|
| Divergence < 25 % from reference conditions | Ecological Evaluation Index (EEI) | 1.7 1.7.1 |
| Divergence < 25 % from reference conditions | PREI (Posidonia) | |
| Divergence < 25 % from reference conditions | BENTIX index | |

*The term associated indicator is used more as parameter.

Comparative Analysis

For Descriptor 1, its criteria and indicators, all MSs of the Mediterranean marine region have defined environmental targets, as indicated in Table 14. Although the targets and indicators set by France are very close to criteria/indicators set by 2010/477/EU, they are characterized as “GES Other”, that is why they do not appear in the table and charts.

Table 14: Targets for D1 set at Descriptor/Criteria/ Indicators level by MSs (* France characterizes criteria and indicators as “GES Other”).

| | Spain | France* | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|------------------------|-------|---------|-------|-------|----------|---------|--------|--------|
| Descriptor 1 | √ | √ | √ | √ | √ | √ | √ | √ |
| Criterion 1.1 | - | - | √ | √ | √ | √ | √ | √ |
| Criterion 1.2 | √ | - | √ | √ | √ | √ | √ | √ |
| Criterion 1.3 | - | - | - | √ | √ | √ | √ | - |
| Criterion 1.4 | √ | - | - | √ | √ | √ | - | - |
| Criterion 1.5 | - | - | - | √ | √ | √ | √ | √ |
| Criterion 1.6 | √ | - | √ | √ | √ | √ | √ | √ |
| Criterion 1.7 | √ | - | - | √ | - | √ | - | √ |
| Indicator 1.1.1 | √ | - | - | √ | √ | √ | √ | √ |
| Indicator 1.1.2 | - | - | - | - | - | √ | √ | √ |
| Indicator 1.1.3 | - | - | - | - | √ | - | √ | √ |
| Indicator 1.2.1 | - | - | √ | √ | √ | √ | √ | √ |
| Indicator 1.3.1 | √ | - | √ | √ | - | √ | √ | - |
| Indicator 1.3.2 | - | - | - | - | - | - | - | - |
| Indicator 1.4.1 | - | - | - | √ | - | √ | √ | - |
| Indicator 1.4.2 | - | - | - | - | - | √ | √ | - |
| Indicator 1.5.1 | - | - | √ | √ | - | √ | √ | √ |
| Indicator 1.5.2 | - | - | - | - | - | - | √ | √ |
| Indicator 1.6.1 | - | - | √ | √ | √ | - | √ | √ |
| Indicator 1.6.2 | - | - | √ | √ | - | √ | √ | √ |

| | | | | | | | | |
|------------------------|---|---|---|---|---|---|---|---|
| Indicator 1.6.3 | - | - | - | - | - | - | - | √ |
| Indicator 1.7.1 | - | - | - | - | - | √ | - | √ |

Six of the Member States (GR, IT, SI, HR, MT, CY) have defined separate targets for each of the three biodescriptors, while FR and SP have addressed them through one set of targets, with FR grouping them by ecosystem component (e.g. habitats, fish, mammals, birds). The number of targets for D1 varies from one (CY) to 24 (FR). In general, MSs have defined a large number of targets and associated indicators (Chart 4).

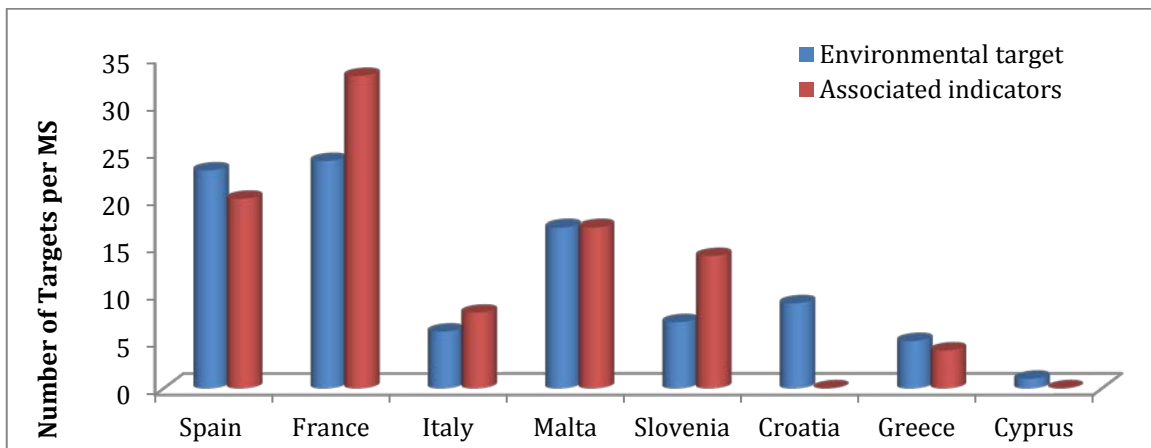


Chart 4: Number of environmental targets and associated indicators set by MSs for D1 (*The targets for SP and FR apply to all biodiversity Descriptors D1-D4-D6).

Targets for Descriptor 1 represent a mix of state-, impact-, pressure- and policy/legislation targets, with a dominance of state- and impact-targets. State-targets relate mostly to maintaining or improving the condition of specific ecosystem components (e.g. fish community indices) and impact-targets focus on reducing impacts from certain pressures on ecosystem components (e.g. dolphin by-catch, impacts on the seabed). The pressures addressed are mainly related to fishing activities and/or causing physical damage to the seafloor (including selective extraction of species, dredging, bottom trawling, by-catch, discards, etc.). Shipping activities, infrastructure construction and land-based polluting activities (e.g. industries) are also flagged as pressures on biodiversity that need to be reduced to achieve GES. Three MSs have not defined pressure-targets at all (CY, GR, and HR).

All MSs of the Mediterranean marine region have defined environmental targets for D1, and its Criteria as indicated in Chart 6. The targets and associated indicators set by FR are close to 2010/477/EU, but they are characterized as “GES Other”, thus they do not appear in the chart.

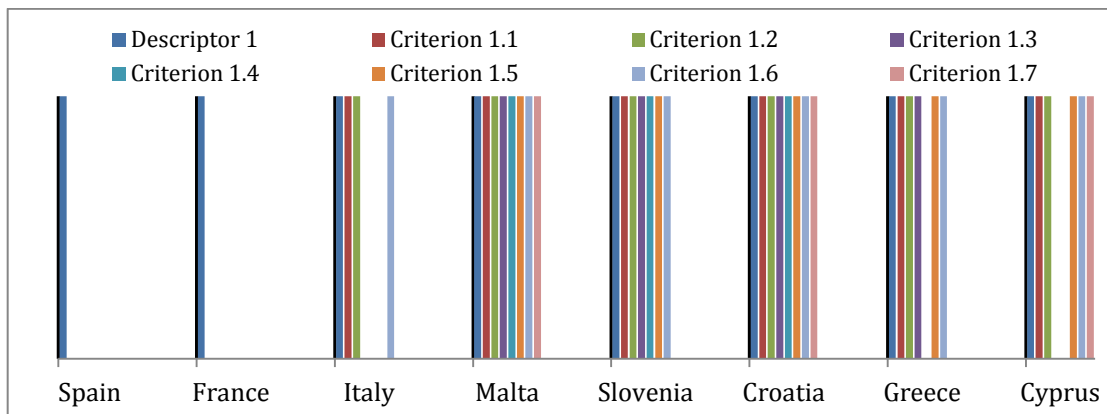


Chart 5: Use of Descriptor /Criteria in Art10 targets set by Mediterranean MS for D1 (* France characterizes criteria and indicators as “GES Other”).

As presented in Table 14, seven out of eight MS have set targets at indicator level (except FR). The most popular Criteria are 1.2 and 1.6, with 7 out of the 8 Member States having approached them, presenting as a result **good coherence**. The less popular Criteria are 1.3, 1.4 and 1.7 with 4 out of the 8 Member States having approached them. It is worth mentioning that even the less popular Criteria have been used by the 50% of the MSs. The most popular indicators are 1.1.1 and 1.2.1, with 6 out of the 8 MSs having used them; 5 out of the 8 MSs have approached indicators 1.3.1, 1.5.1, 1.6.1 and 1.6.2. The less popular indicator is 1.3.2 as no MS has used it and 1.6.3 with only CY having approached it. Therefore, indicators 1.1.1 and 1.2.1 present a good coherence among the Mediterranean MSs. Although the targets and indicators set by France are very close to Criteria/Indicators set by 2010/477/EU, they are characterized as “GES Other”, therefore they are not taken into consideration.

Approach

Five Member States (GR, SP, FR, HR, MT) have qualitatively approached the targets set for Descriptor 1, while the approach of CY was quantitative. IT and SI have set both qualitative and quantitative targets.

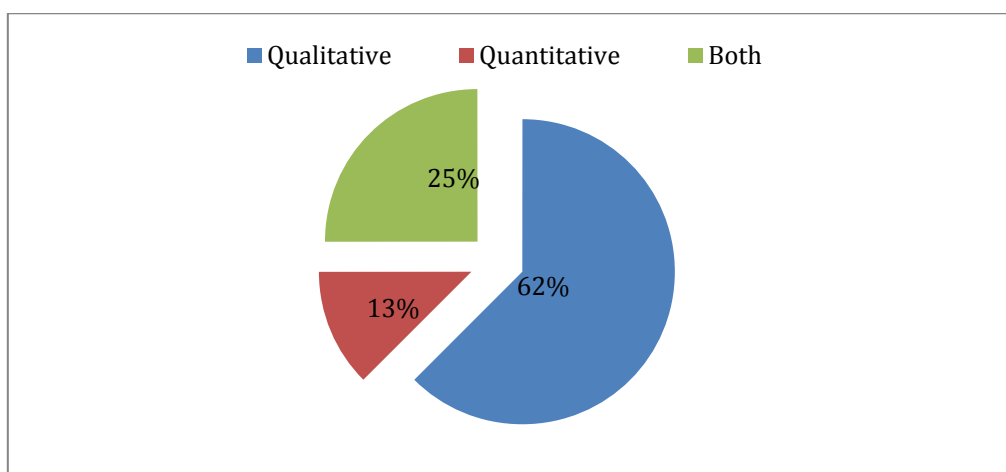


Chart 6: MS approach for D1



Table 15: Assessment methods, thresholds and baselines in targets set by SI for D1.

| MS | Target | Threshold | Baseline | Assessment Method |
|----|---|--|--|--|
| SI | Habitat conservation of the Common Stern (<i>Sterna hirundo</i>) for maintenance of the stable population | 40-100 nesting pairs | Extent and distribution known for Slovenian sea. Status not given as it should be made for the whole Adriatic subregion. | |
| | Habitat conservation of the Little Stern (<i>Sterna albifrons</i>) for maintenance of the stable population | 10-30 nesting pairs | Extent and distribution known for Slovenian sea. Status not given as it should be made for the whole Adriatic subregion. | |
| | Reaching GES and prevention of the decline in the environmental status because of the anthropogenic activities regarding spatial distribution, abundance and demographic characteristics of the population of the Common Bottlenose Dolphin (<i>Tursiops truncatus</i>) | | Number of dolphins observed in the Slovenian sea is estimated between 50-200, population seems stable, expert judgments of the habitat is that its "moderate". | |
| | Seagrass meadow of <i>Posidonia oceanica</i> | shoot density > 500/m ² | 1100 shoots/m ² | Density; Giraud (1977) ecological status (Lipej <i>et al.</i> , 2007a) |
| | Seagrass meadow of <i>Cymodocea nodosa</i> | MediSkew index < 0.4 | lowest leaf length around 11 cm, frequency distribution of leaf length is ln-normal; MediSkew index < 0.2 | Sampling and laboratory; Orfanidis <i>et al.</i> (2007, 2010) MediSkew index (Orlando-Bonaca <i>et al.</i> , 2015) |
| | soft-bottom benthic invertebrates | M-AMBI > 0.62 | | |
| | infralittoral habitat types | IHT values | IHT >0.80 | |
| | Rocky-bottom macroalgae | EEIc > 5.84 | dominance of macroalgae of the genus <i>Cystoseira</i> , EEIc > 8.90 | |
| | Density of the labrid fish (Labridae) | density of labrids > 50 specimens per 100 m ² | | |

Common Elements

Most MSs have addressed the main three species groups in their targets: **fish, birds, mammals** whereas GR, IT, SI, HR, SP have also mentioned reptiles, **turtles** in particular. In terms of habitat types, all MSs address benthic habitats in a general manner or through the condition of the benthic community. MSs often address specific sensitive/threatened species and habitats. Species and habitats commonly

addressed include *Posidonia oceanica* seagrass meadows (GR, FR, SI, MT) and the loggerhead sea turtle *Caretta caretta* (GR, IT, SI, HR).

| | Spain | France | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|---------------------------|-------|--------|-------|-------|----------|---------|--------|--------|
| <i>Caretta caretta</i> | | | • | | • | • | • | |
| <i>Posidonia oceanica</i> | | • | | • | • | | • | |

Chart 7: Common species/habitas among Mediterranean MS mentioned in targets set for D1.

Level of Integration with other Directives

All MSs, except GR and CY, have referred to EU existing legislation or agreements; SP, IT, SI, FR and HR refer specifically to the Habitats Directive, whereas SP, SI, MT refer to the Birds Directive. Thus, **the level of Integration with other Directives is good.**

Regional/ International Cooperation

SP, FR and SI have included a reference to the Barcelona Convention and France has also referred to OSPAR.

Article 12 Assessment

According to the results of Article 12 assessment conducted by the Commission, the targets set for Descriptor 1 by each MS in order to achieve GES are generally considered:

- adequate for SP
- partially adequate for SI, FR (as biodiversity descriptors)
- inadequate for IT, GR, CY

For MT and HR the reports are not available

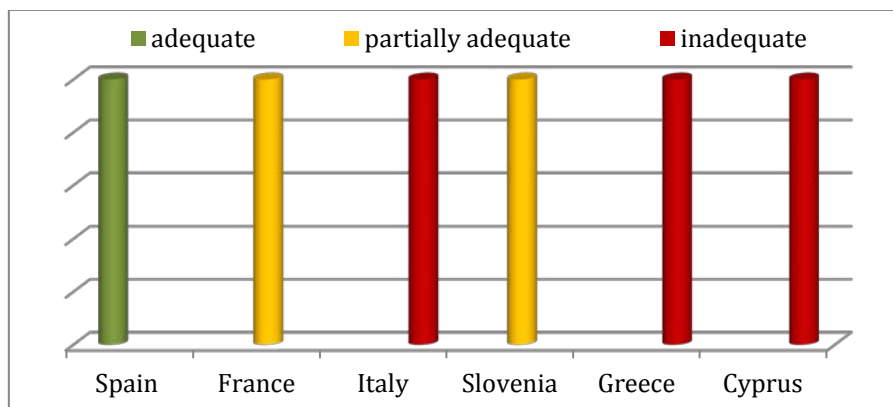


Chart 8: Characterization of targets set by Mediterranean MSs for D1 (except MT and HR) according to Art 12 Assessment.

Table 16: Synopsis for each country regarding D1.

| | |
|----|--|
| SP | <ul style="list-style-type: none"> • 1 environmental target and 1 associated indicator for D1. 22 environmental targets and 19 associated indicators set for D1-D4-D6. • Targets set at Indicator level • The targets are state, pressure, impact, policy /legislative. • Qualitative approach • Holistic approach • Several targets relate to the implementation of existing agreements (e.g. Barcelona Convention, Water Framework Directive, Habitats and Birds Directive). |
| FR | <ul style="list-style-type: none"> • Targets set at Descriptor Level and others characterized as GES other. • 24 environmental targets and 33 associated indicators for D1-D4-D6, grouping them by ecosystem component (habitats, fish, birds, mammals). • The targets are state, pressure, impact and policy/legislation • Qualitative approach • Holistic approach of targets • Reference to relevant international, EU or regional legislation/agreements (Barcelona Convention, Habitats Directive, ACCOBANS agreement, OSPAR) |
| IT | <ul style="list-style-type: none"> • Targets set at Indicator Level • 6 environmental targets and 8 associated indicators • The targets are state, pressure and impact • 4 out of nine targets are quantitative, the others qualitative • Thresholds have been set, but not very specific • No holistic approach of targets • Reference to relevant international, EU or regional legislation/agreements (Habitats Directive, UE CO 7723/09 on 03/17/2009 on a Community action plan for conservation and management of sharks, Common Fisheries Policy, Regulation (EC) No 812/2004, European Regulations EC 1967/2006) and EU Reg. N. 1224/2009, Good Practice Handbooks, EU Action Plan for the Conservation and Management of Sharks) |
| MT | <ul style="list-style-type: none"> • Targets set at Indicator Level • 17 environmental targets and 17 associated indicators • The targets are state, impact, pressure and policy/legislation • All targets are qualitative • No holistic approach of targets • Reference to Birds Directive, WFD |
| SI | <ul style="list-style-type: none"> • Targets set at Indicator Level • 7 environmental targets and 14 associated indicators • The targets are state, impact and policy/legislation • 4 out of nine targets are quantitative, the other qualitative • Thresholds have been set, Moreno very specific • No holistic approach of targets • Reference to Birds Directive, Habitats Directive, WFD, Barcelona Convention |

| | |
|----|---|
| HR | <ul style="list-style-type: none"> • Targets set on Indicator level • 9 environmental targets • Qualitative targets • The targets are state • No holistic approach of targets • Reference to Habitats Directive |
| GR | <ul style="list-style-type: none"> • Five environmental targets and 4 associated indicators set • Targets focus on specific species/habitats • Target set at Indicator level • The aim of the targets is state • Qualitative approach • No holistic approach • No reference to relevant international, EU or regional legislation/agreements |
| CY | <ul style="list-style-type: none"> • One environmental target set • The target is a verbatim copy of the GES definition for descriptor 1 • The target is state • Target set at criteria and indicator level • Quantitative approach • Threshold value set at 0.75 (calculated number from 19 indicators), no baseline set. • No holistic approach • No reference to relevant international, EU or regional legislation/agreements |

DESCRIPTOR 4

According to Marine Strategy Framework Directive (2008/56/EC) and Commission Decision 2010/477/EU, Descriptor 4 is:

Descriptor 4 (Food Webs): 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

A list of criteria and indicators, as indicated in Table 17, have been set in order that MSs can determine Good Environmental Status (GES) in marine regions or subregions

Table 17: Criteria and indicators for D4 according to Commission Decision 2010/477/EU.

| Criteria | Indicators |
|--|--|
| 4.1. Productivity (production per unit biomass) of key species or trophic groups | Performance of key predator species using their production per unit biomass (productivity) (4.1.1) |
| 4.2. Proportion of selected species at the top of food webs | Large fish (by weight) (4.2.1) |
| 4.3. Abundance/distribution of key trophic groups/species | Abundance trends of functionally important selected groups/species (4.3.1) |

D4: ARTICLE 9 ANALYSIS

GES definition

Six MSs have defined GES for D4, whereas MT and CY have not defined it at all. IT has followed COM DEC 2010/477/EU, while the Greek, Spanish, Slovenian and Croatian definition deviate in a number of ways from 2010/477/EU. For France there is an extended definition for each of the Commission Decision criteria. Therefore, **the level of coherence for D4** across the Mediterranean is **low**.

Criteria and Indicators applied

All MSs with the exception of CY and MT defined GES for D4, having incorporated some or most of the Commission Decision Criteria; GR, SP and HR have defined GES for D4 at the level of the Criteria, whereas IT, FR and SI at indicator level as presented in Chart 9. The **level of coherence** across the Mediterranean marine region for the definition of GES for D4 is **low**.

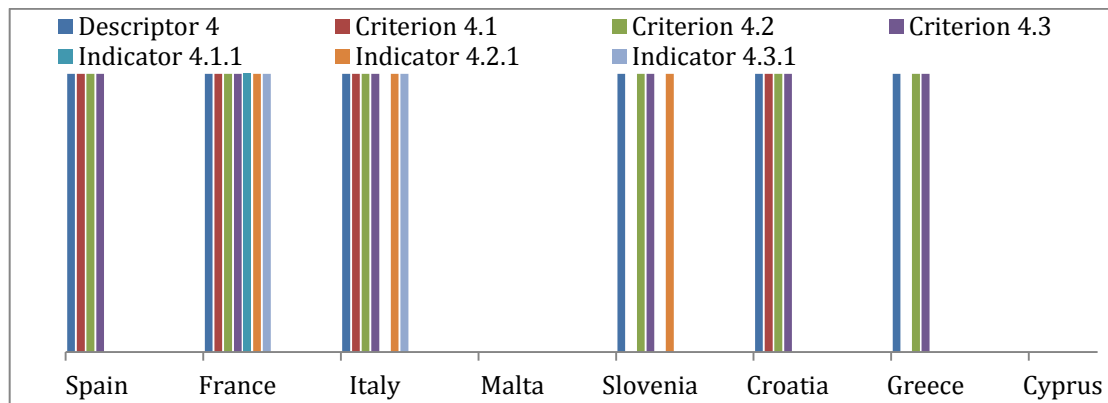


Chart 9: Use of Descriptor /Criteria/Indicators by Mediterranean MS in Art 9 for D4.

Although GR and HR have not followed the Commission Decision criteria, the Criteria they use are similar. All MSs reporting under D4 have defined GES based on Criteria 4.2 and 4.3, therefore they demonstrate good coherence. Criterion 4.1 was the least popular having been used by 4 out of 6 MSs. Only IT, FR and SI have defined GES to indicator level; SI has used 1, IT 2 and France all 3 indicators.

Table 18: Use of Descriptor/Criteria/Indicators in Art9 GES definition by Mediterranean MSs for D4.

| | Spain | France | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|------------------------|-------|--------|-------|-------|----------|---------|--------|--------|
| Descriptor 4 | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | - |
| Criterion 4.1 | ✓ | ✓ | ✓ | - | - | ✓ | - | - |
| Criterion 4.2 | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | - |
| Criterion 4.3 | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | - |
| Indicator 4.1.1 | - | ✓ | - | - | - | - | - | - |
| Indicator 4.2.1 | - | ✓ | ✓ | - | ✓ | - | - | - |
| Indicator 4.3.1 | - | ✓ | ✓ | - | - | - | - | - |

All MSs use the same method to assess the status of large fish in Criterion 4.2. Some MSs have defined GES in such a way that it covers all food web components (i.e. from plankton to higher trophic levels) (GR, FR, SP, HR), but also mention specific food web components in their GES definition. GR, SP, FR, IT and HR mention ‘key’ or ‘main’ species or functional groups; large fish is mentioned by GR, IT, FR, SI and small pelagic fish by HR. No MS has included specific species although IT, HR mention specific types of ecosystem components (e.g. top predators, mammals, fishes, zooplankton, seagrasses), as well as *Posidonia* meadows as a specific type of habitat.

Approach

All six MSs have qualitatively approached Descriptor 4. SI has defined its baseline as being in line with “natural conditions” and SP and IT as being in line with “prevailing natural conditions.”

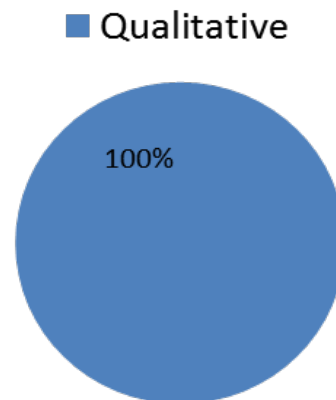


Chart 10: MSs approach to D4 GES definition.

SI, HR, FR and SP have defined the assessment method; HR defines assessment for the determination of phytoplankton, microzooplankton, picoplankton, heterotrophic bacteria, nanoflagellates, DOC, TOC and POC. Finally, FR has well defined the current status and SI admits that the methods need further development.

Level of Integration with other Directives

None of the MSs reporting under D4 refers specifically to other Directives, such as the Birds Directive or the Habitats Directive. **As a result, the level of Integration with other Directives is low.**

Regional/ International Cooperation

None of the MSs has included a reference to the Barcelona Convention, except France that has referred to OSPAR. Thus, **the level of international cooperation is low.**

Article 12 Assessment

According to the results of Article 12 assessment conducted by the Commission, the definition of GES for D4 for each MS is considered as:

- adequate for FR
- partially adequate for GR
- inadequate for SP, IT, SI

The Article 12 assessment is not available for HR, whereas as mentioned above MT and CY did not report under D4.

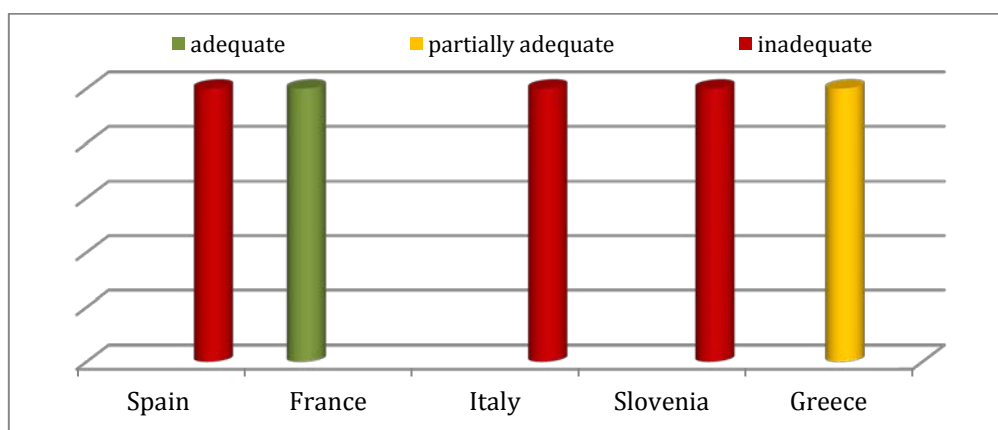


Chart 11: Art12 Assessment of MSs' GES definition for D1 (MT and HR excluded).

Table 19 presents a synopsis of the analysis performed for Descriptor 4 per MS.

Table 19: Synopsis for each MS regarding D4.

| | |
|----|---|
| MT | <ul style="list-style-type: none"> • Malta has not defined GES for D4. |
| SP | <ul style="list-style-type: none"> • GES Definition at Descriptor and Criteria level • Adequate use of Decision criteria (3/3) • Qualitative approach |
| FR | <ul style="list-style-type: none"> • GES Definition at Descriptor, Criteria and Indicator level • Adequate use of Decision criteria (3/3) and indicators (3/3) • Qualitative approach • Reference to OSPAR |
| IT | <ul style="list-style-type: none"> • GES Definition at Descriptor, Criteria and Indicator level • Partial use of Decision criteria (3/3) and indicators (2/3) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |
| SI | <ul style="list-style-type: none"> • GES Definition at Descriptor, Criteria and Indicator level • Partial use of Decision criteria (2/3) and indicators (1/3) • Qualitative approach • GES definition addresses only a small number of food web components • No reference to relevant international, EU or regional legislation/agreements |
| HR | <ul style="list-style-type: none"> • GES Definition at Descriptor and Criteria level |

| | |
|----|---|
| | <ul style="list-style-type: none"> • Adequate use of Decision criteria (3/3) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |
| GR | <ul style="list-style-type: none"> • GES Definition at Descriptor and Criteria level • Adequate coverage of Criteria (2/3) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |
| CY | Cyprus has not defined GES for D4. |

D4: ARTICLE 10 ANALYSIS

The analysis of the reported information by MSs under D4 included environmental Targets and associated Indicators established by MSs and their natural characteristics. Among MSs, Spain and France have addressed biodiversity Descriptors D1, D4, D6 as a group establishing a set of common Targets, with FR grouping them by ecosystem component (e.g. habitats, fish, birds, mammals), as presented in the previous section under Descriptor 1 (Table 6 and Table 7). In addition, CY and MT have not defined environmental Targets for D4 at all.

ITALY

Italy has defined only one qualitative environmental target for D4 in the national report and a second one mentioned only in the reporting sheets related to *Caretta caretta* (also reported under Descriptor 1) as presented in Table 20. The target is set at Indicator level. The first target relates also directly to Descriptors 1, 3, 5 and 6. The targets include state, pressure, impact and policy/legislation components. EU legislation and Habitats Directive are mentioned as compatible with the existing targets.

Table 20: Environmental targets and associated indicators set by Italy for D4.

| Environmental targets | |
|------------------------------|--|
| 1 (in national report) | It is necessary to make progress towards improving the status of the individual structural components of ecosystems through the implementation of environmental targets which are identified within the MSFD descriptors considered in context (in particular D1, D3, D6, D5) by 2018. In clearly critical geographic areas (assessment areas or ecosystems) targets are addressed towards mitigation / removal of the causes of human disturbance. T=100% |
| 2 (in reporting sheets) | <p>1) Spatial identification of the areas with highest use of pelagic longline (southern Tyrrhenian and southern Ionian sea) and trawling (northern Adriatic)</p> <p>2) Completion of the spatial definition of <i>Caretta caretta</i> aggregation areas based on an approach capable of assessing temporal and seasonal distribution differences for each aggregation area (based on indicator 1.1.2 completion), so as to provide a final definition of the operative target</p> <p>3) Monitoring of accidental captures in the areas subjected to operational target</p> <p>4) Application of by-catch reduction measures in areas listed in point 3, through one or more of the following activities:</p> <ul style="list-style-type: none"> - Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling nets through structural modifications to the gear (i.e. circle hooks, TEDs etc.) and application of best practices for the reduction of mortality following capture. <p><u>Note:</u> in order to allow an immediate reduction of the pressure it is advised that best practices be applied in the geographic areas where preliminary knowledge already defines the presence of an aggregation area, before defining the incidence of total capture in the specific gear.</p> <ul style="list-style-type: none"> - Reduction of fishing pressure |

SLOVENIA

Slovenia has established four environmental targets and one associated indicator under Descriptor 4, as presented in Table 21, both quantitative and qualitative. For the quantitative target, baseline and threshold values have been set. The quantitative target is set at indicator level, while the three qualitative targets are set at criterion level. The first target is state, whereas the other three intend to gather knowledge.

Table 21: Environmental targets and associated indicators set by Slovenia for D4.

| | Environmental targets | Associated indicators |
|---|---|--|
| 1 | Achievement of good status and prevention of deterioration of the indicator 4.3.1. | Geometric mean biomass of mezozooplankton below the threshold. |
| 2 | To obtain data to assess the relevance of indicators to describe criteria 4.1 and 4.2, in co-operation with neighbouring countries. | |
| 3 | To obtain data for the upgrade assessment under criterion 4.3 in co-operation with neighbouring countries. | |
| 4 | Relevant missing metrics should be tested and coordinated at the sub-regional level. | |

CROATIA

Croatia has defined three qualitative environmental targets, set at Indicator level, to cover D4 and 13 associated indicators. Each target concerns a certain ecosystem component, which needs to be preserved in terms of biomass stability, species composition and condition and community structure. Reference is being made to ICCAT.

Table 22: Environmental targets and associated indicators set by Croatia for D4.

| | Environmental targets | Associated indicators |
|---|--|--|
| 1 | Small pelagic fish (sardine): a) Long-term biomass stability of food web components is not significantly disturbed. b) Species composition is not significantly changed. c) Species condition is not significantly changed. | Monitoring of biomass productivity, size composition and condition of target species Size structure metrics (for example: slope of size spectrum) |
| 2 | Top predators (<i>Thunnus thynnus</i> , <i>Thunnus albacore</i> , <i>Xiphias gladius</i>): a) Long-term biomass stability of food web components is not significantly disturbed. b) Species composition and distribution are not significantly changed. c) Species condition is not significantly changed | <ul style="list-style-type: none"> • Monitoring of biomass of target species and their proportion at the top of food web • Monitoring of meeting the given criteria by ICCAT |
| 3 | Primary producers, heterotrophic microbes (microbial food web) and mesozooplankton (Copepods): a) Long-term stability of abundance/ biomass and productivity of food web components is not significantly disturbed. b) Structure of plankton communities, food web types and important trophic group ratios are not significantly changed. c) Species composition and diversity are not significantly changed. d) Seasonal patterns of important trophic groups are not significantly disturbed. e) The flow of energy throughout plankton food web is not significantly disturbed. f) Dominance of crustacean over gelatinous component in mesozooplankton. g) Sporadic and locally restricted occurrence of large Jellyfish. h) Copepod abundances within normal ranges and stable on multiannual scale. i) Dominance of copepods in the diet of small pelagic fish. | <ul style="list-style-type: none"> • Monitoring of abundance/biomass and productivity of target trophic groups. • Identifying the structure of food web (trophic relationship, number of trophic links) • Monitoring of crustacean vs. gelatinous component in mesozooplankton • Monitoring of occurrence of large jellies • Monitoring of relative importance of herbivore vs. microbial food web • Primary production to production at higher trophic levels (mesozooplankton, small pelagic fish) • Bacterial production to primary production as indicator of biomass flow through the microbial food web (this indicator has relevance for fish yield, vertical flux of material and benthic biomass production) • Chl a to bacterial production as indicator of phytoplankton mediated |

| | | |
|--|--|---|
| | | <p>bottom-up control of bacteria and efficiency of fixing photosynthetically produced DOC</p> <p>bacterial production to bacterial biomass and bacterial abundance to heterotrophic nanoplankton abundance, as indicators of relative strength of bottom-up and top-down control of bacteria and efficiency of bacterial carbon transfer to higher trophic level</p> <ul style="list-style-type: none"> • Zooplankton biomass to small pelagic fish biomass • Proportion of primary production removed by fisheries (food web efficiency) |
|--|--|---|

GREECE

Greece has defined one qualitative environmental target and one associated indicator for Descriptor 4. The target is set at indicator level; it is state and focused on one functional group (demersal fish). GES definition is not covered since the description of the target set does not cover the most important groups of the food web. No legislation is mentioned.

Table 23: Environmental targets and associated indicators set by Greece for D4.

| | Environmental targets | Associated indicators |
|---|--|--|
| 1 | The monitoring and assessment of balance biomass at higher trophic levels in the total catch of demersal fish. | The ratio of biomass in the higher trophic levels to the total catch of demersal fish. |

Comparative Analysis

For Descriptor 4, its criteria and indicators, all MSs of the Mediterranean marine region, except MT and CY have defined environmental targets, as indicated in Table 24.

Table 24: Targets for D4 set at Descriptor/Criteria/ Indicators level by MSs.

| | Spain | France* | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|------------------------|--------------|----------------|--------------|----------------|-----------------|----------------|---------------|----------------|
| Descriptor 4 | √ | √ | √ | No targets set | √ | √ | √ | No targets set |
| Criterion 4.1 | - | - | - | | √ | √ | √ | |
| Criterion 4.2 | √ | - | - | | √ | √ | √ | |
| Criterion 4.3 | - | - | √ | | √ | √ | - | |
| Indicator 4.1.1 | - | - | - | | - | √ | √ | |
| Indicator 4.2.1 | - | - | - | | - | √ | √ | |
| Indicator 4.3.1 | - | - | √ | | √ | √ | √ | |

From the MSs that approached D4, GR, IT, SI and HR have defined separate targets for each of the three biodescriptors, while FR and SP have addressed the descriptors D1-D4-D6 through one set of targets, with FR grouping them by ecosystem component (e.g. habitats, fish, birds, mammals, etc.).

The number of targets to cover Descriptor 4 varies from one (GR, IT) to 24 (FR). In general, the Member States have defined a large number of targets and/or associated indicators. Although the targets and indicators set by France are very close to

criteria/indicators set by 2010/477/EU, they are characterized as “GES Other”, that is why they do not appear in the table and chart.

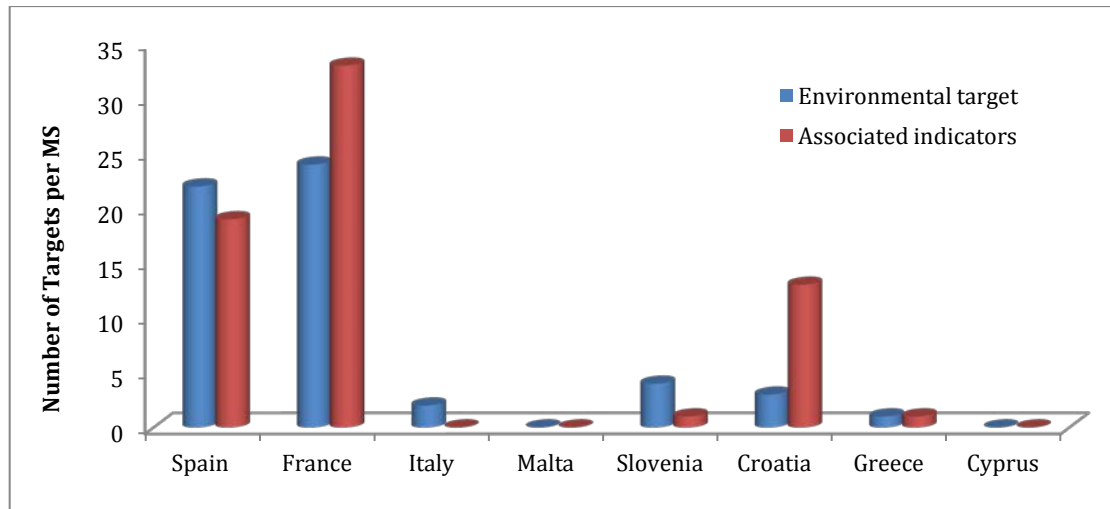


Chart 12: Number of environmental Targets and associated Indicators for D4 set by Mediterranean MSs.

*MT and CY have not reported under D4

**The targets for Spain and France apply to D1-D4-D6

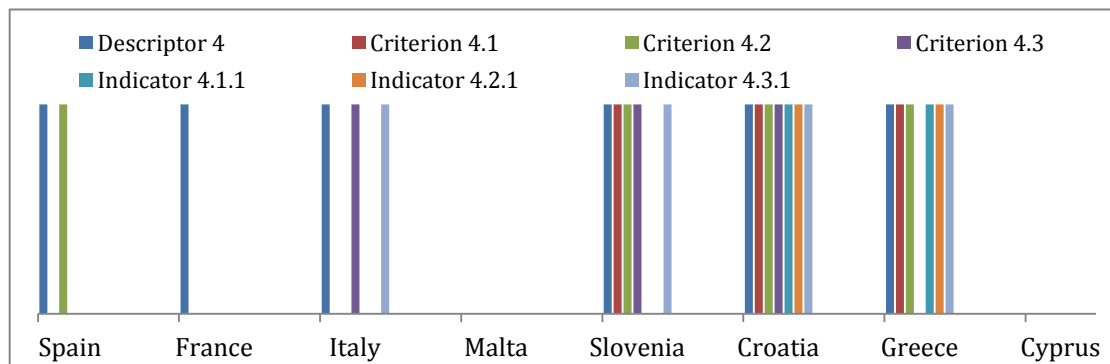


Chart 13: Use of Descriptor/Criteria in Art10 targets set by Mediterranean MSs for D4.

Obviously Descriptor 4 poses difficulties in its application, which justifies why CY and MA did not approach it at all. Although the Targets and Indicators set by France are very close to Criteria/Indicators set by 2010/477/EU, they are characterized as “GES Other”, that is why they do not appear in the table and charts.

Among SP, FR, IT, SI, HR and GR, three have approached Criterion 4.1 (SI, HR, GR), four have approached criterion 4.2 (SP, SI, HR, GR) and three have approached Criterion 4.3 (IT, SI, HR). So, the most popular Criterion is 4.2, with 4 out of 6 Member States having approached it. Three Member States have approached all three Criteria (SI, GR and HR).

Four out of six MSs have approached Indicator 4.3.1. The other two Indicators (4.1.1 and 4.2.1) were approached only by GR and HR (2 out of 6 Member States). As a result, Indicator 4.3.1 presents a good coherence among Member States.

Approach

All MSs except SI have qualitatively approached the targets set for Descriptor 4. One target set by SI was quantitative and the Member State has set baselines and threshold values, while the other targets were qualitative.

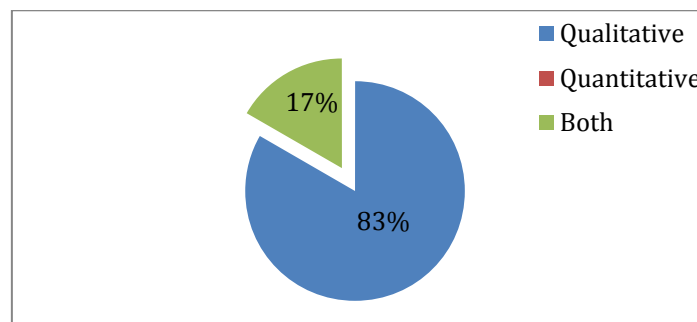


Chart 14: MSs' approach for D4

Level of Integration with other Directives

Among the four Member States that have approached D4 at indicator level, GR, SL, do not refer to any legislation, HR refers to ICCAT and IT refers to Birds Directive.

Regional/ International Cooperation

No reference to the Barcelona Convention.

Article 12 Assessment

According to the results of Article 12 assessment conducted by the Commission, the targets for GES set for Descriptor 4 for each Member State (except MT and HR) is considered:

- partially adequate for FR (described as biodescriptors-D1-D4-D6)
- inadequate for SP, IT, SI, GR
- CY has not provided targets for D4

The Article 12 assessments are not available for HR and MT.

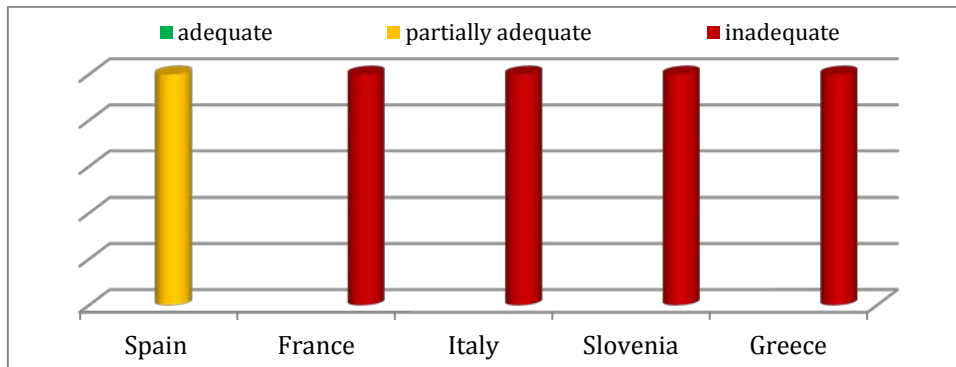


Chart 15: Characterization of targets for GES for D4 set by each MS (except MT and HR) according to Art12 Assessment

Table 25: Synopsis for MSS regarding D4

| | |
|----|---|
| IT | <ul style="list-style-type: none"> • Targets set at Indicator Level • 2 environmental targets • The targets are state and impact • Qualitative target • The second target is reported in D1 as well • European community legislation and Habitats Directive are mentioned |
| SI | <ul style="list-style-type: none"> • Three targets set at Criterion level and one at Indicator Level • 4 environmental targets and 1 associated indicator • The targets are state and knowledge • Three targets are qualitative and one quantitative • No holistic approach of targets • No reference to relevant international, EU or regional legislation/agreements) |
| HR | <ul style="list-style-type: none"> • Targets set at Indicator Level • 3 environmental targets and 13 associated indicators • The targets are state • Qualitative targets • No holistic approach of targets • Reference to ICCAT. |
| GR | <ul style="list-style-type: none"> • Target set at Indicator Level • 1 environmental target and 1 associated indicator • The targets are state (monitoring target) • Qualitative target • No holistic approach of targets • No reference to relevant international, EU or regional legislation/agreements |

DESCRIPTOR 6

According to Marine Strategy Framework Directive (2008/56/EC) and Commission Decision 2010/477/EU, Descriptor 6 is:

Descriptor 6 (Sea-floor integrity): 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.

A list of criteria and indicators, as indicated in Table 26, have been set in order that MSs can determine in marine region or subregion Good Environmental Status (GES).

Table 26: Criteria and Indicators for D6 according to Commission Decision 2010/477/EU.

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

D6_ARTICLE 9 ANALYSIS

GES definition

All MSs have defined GES for D6, however, in a different way. For CY, the GES definition deviates significantly from COM DEC 2010/477/EU and seems more relevant for D1, whereas the other MSs define D6 in a close approximation to the COM DEC 2010/477/EU.

Criteria and Indicators applied

All MSs have defined GES at criteria level for D6; SP, FR, MT, SI and HR have defined GES for both criteria 6.1 and 6.2, while GR and CY have defined GES only for criterion 6.2 and IT for 6.1 Two Member States have indicated the assessment of GES will be based on multi-metric indices (CY, GR), whereas only CY specifically refers to the WFD good ecological status. In terms of indicators, GR, SP and FR have used 2 of the six indicators in the scope of their GES definitions, whereas IT and CY have used only 1, 6.1.2 and 6.2.2 respectively, as presented in Table 27. Criterion 6.2 is rarely specified further with the use of indicators. As a result, the most popular criterion is 6.2, with 7 out of the 8 MSs having approached them (all except IT), whereas 6.1 is approached by 6 out of the 8 MSs Overall, the level of coherence for the definition of GES for D6 is low.

Table 27: Use of Descriptor /Criteria/Indicators by Mediterranean MSs in Art 9 GES definition for D6.

| | Spain | France | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|------------------------|-------|--------|-------|-------|----------|---------|--------|--------|
| Descriptor 6 | √ | √ | √ | √ | √ | √ | √ | √ |
| Criterion 6.1 | √ | √ | √ | √ | √ | √ | - | - |
| Criterion 6.2 | √ | √ | - | √ | √ | √ | √ | √ |
| Indicator 6.1.1 | √ | √ | - | - | - | - | - | - |
| Indicator 6.1.2 | √ | √ | √ | - | - | - | - | - |
| Indicator 6.2.1 | - | - | - | - | - | - | √ | - |
| Indicator 6.2.2 | - | - | - | - | - | - | √ | √ |
| Indicator 6.2.3 | - | - | - | - | - | - | - | - |
| Indicator 6.2.4 | - | - | - | - | - | - | - | - |

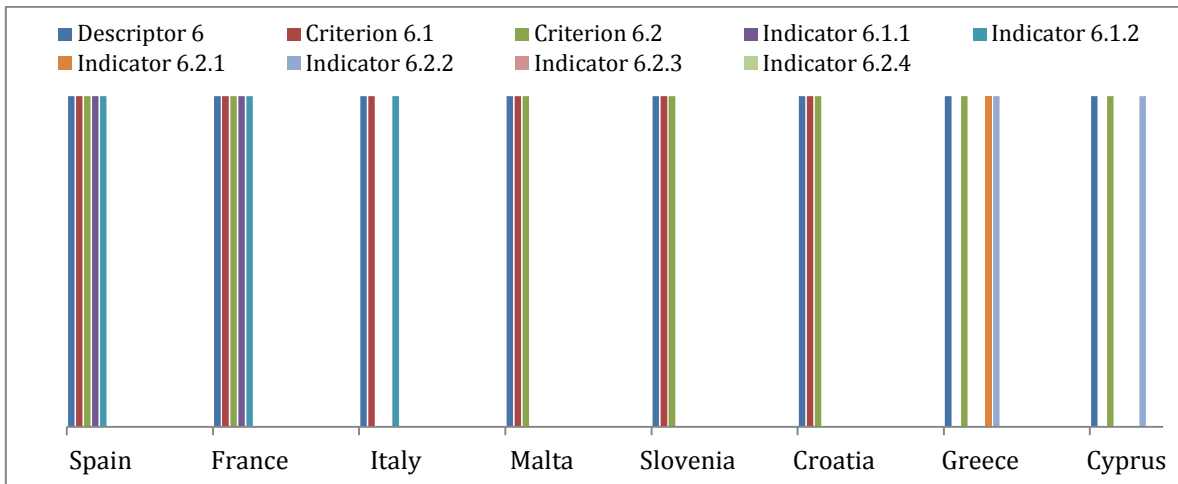


Chart 16: Use of Descriptor/Criteria/Indicators by Mediterranean MS in Art9 for D6.

Common element

Two MSs have indicated the assessment of GES will be based on multi-metric indices (CY, GR), whereas only CY specifically refers to the WFD good ecological status. Only CY, IT and HR have specified the substrate types covered by their GES definition. Four of the MSs (CY, GR, SP, SI) mention the need to maintain the status and integrity of the seafloor habitats to ensure their functioning. Finally, all MSs refer to the reduction of physical pressures from human activities on the seabed, either directly or indirectly (through reference to impacts).

Approach

All MSs, except FR have qualitatively approached D6. France made an attempt to quantify criterion 6.1 but no actual values were provided.

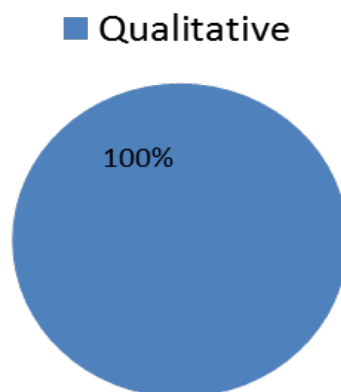


Chart 17: MS approach for D1



None of the MSs mention a baseline in their GES definition or use the WFD principle of ‘reference conditions plus acceptable deviation’.

Level of Integration with other Directives

Reference is being made to the WFD.

Regional/ International Cooperation

None of the MSs has included a reference to the Barcelona Convention, except France that has referred to OSPAR.

Article 12 Assessment

According to the results of Article 12 assessment conducted by the Commission the definition of GES for Descriptor 6 for each MS (except MT and HR) is considered:

- partially adequate for SP, FR, IT
- inadequate for CY, GR, SI

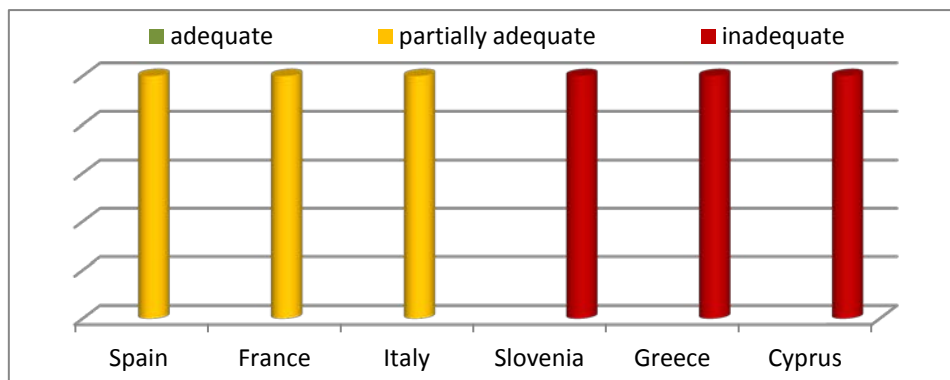


Chart 18: Art12 Assessment of MS GES Definition for D6 (except MT and HR).

Table 28: Synopsis for each MS regarding D6.

| | |
|----|--|
| SP | <ul style="list-style-type: none"> • GES Definition at Descriptor, Criteria and Indicator level • Adequate coverage of Criteria (2/2), but inadequate for indicators (2/6) • Qualitative approach • Lack of threshold values • Reference to relevant international, EU or regional legislation/agreements |
| FR | <ul style="list-style-type: none"> • GES Definition at Descriptor, Criteria and Indicator level • Partially adequate coverage of Criteria and inadequate coverage of indicators • Attempt to quantify criterion 6.1 but no actual values provided • Reference to relevant international, EU or regional legislation/agreements |
| IT | <ul style="list-style-type: none"> • GES Definition at Descriptor, Criteria and Indicator level • Inadequate coverage of Criteria (1/2) and indicators (1/6) • Qualitative approach • No threshold values • No reference to relevant international, EU or regional legislation/agreements |
| MT | <ul style="list-style-type: none"> • GES Definition at Descriptor and Criteria level • Adequate coverage of Criteria (2/2) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |
| SI | <ul style="list-style-type: none"> • GES Definition at Descriptor and Criteria level • Adequate coverage of Criteria (2/2) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |
| HR | <ul style="list-style-type: none"> • GES Definition at Descriptor and Criteria level • Adequate coverage of Criteria (2/2) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |
| GR | <ul style="list-style-type: none"> • GES Definition at Descriptor, Criteria and Indicator level • Inadequate coverage of Criteria (1/2) and indicators (2/6) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |
| CY | <ul style="list-style-type: none"> • GES Definition at Descriptor, Criteria and Indicator level • Inadequate coverage of Criteria (1/2) and indicators (1/6) • Qualitative approach • No reference to relevant international, EU or regional legislation/agreements |

D6_ARTICLE 10 ANALYSIS

The analysis of the reported information by MSs under D6 included environmental targets and associated indicators established by MSs and their nature. Among the MSs establishing targets for D6, Spain and France have addressed biodiversity descriptors as a group through one set of common targets, with FR grouping them by ecosystem component (e.g. habitats, fish, , mammals, birds), as presented in Table 6 and Table 7

ITALY

Italy has established three environmental targets to cover Descriptor 6. The targets are qualitative and thresholds are neither provided, nor are clear whether the results are measurable. The targets include components of state, pressure, impact and policy/legislation.

Table 29: Environmental targets and associated indicators set by Italy for D6.

| Environmental targets | |
|-----------------------|--|
| 1 | <p>Limitation of fishing on biogenic substrates</p> <p>By 2018 it is necessary to reinforce control and monitoring systems in order to avoid benthic-impacting fishing gears on biogenic substrates, also taking into consideration the limitations already prescribed by European Regulations (Reg. EC 1967/2006), and for the relevant aspects the EU Reg. N. 1224/2009. In order to assess the achievement of the target it is necessary to verify the increasing in controls on vessels using benthic impacting fishing gears (otter trawl, rapid trawl, hydraulic dredge). These controls should be substantially increased for ships with LOA <15 m.</p> |
| 2 | <p>Limitation of fishing on substrates currently exploitable</p> <p>By 2018, it is necessary to reach 10% of the area to be protected from benthic-impacting fishing gears (otter trawl, rapid trawl and hydraulic dredge). Given the fact that currently it is not known in detail the presence of biogenic substrates compared to substrates currently exploitable by benthic impacting fishing gears, the target of 10% of area to be protected is considered achieved even if this percentage, in addition to not biogenic substrates, includes areas of biogenic substrate currently not known. These areas may be identified in future monitoring (by 2018).</p> |
| 3 | <p>Limitation of the impacts resulting from physical loss of biogenic substrates.</p> <p>Implementation and adoption of Good Practice Handbooks aimed at limiting the impact of physical loss pressure (sealing) on biogenic substrates sensu MSFD.</p> |

MALTA

Malta has defined 6 qualitative environmental targets and 4 associated indicators to address Descriptor 6, set at indicator level. The targets set are state, impact/pressures, policy/ legislation. The EC regulation 1967, the Common Fishery Policy, the Habitats Directive and the Water Framework Directive are mentioned.

Table 30: Environmental targets and associated indicators set by Malta for D6.

| Environmental targets | | Associated indicators |
|-----------------------|--|--|
| 1 | Benthic habitats affected by currently regulated anthropogenic activities show signs of recovery. | <i>Community indicators (to be developed)</i> |
| 2 | Maintaining and enforcing regulations governing fishing activities within the 25 nautical mile Fisheries Management Zone. | Indicators on the distribution of fishing activities or on areas impacted by fishing activities (to be developed). |
| 3 | Localised or sensitive marine habitats are afforded legal protection by 2025. | protected areas |
| 4 | Efforts are undertaken, through implementation of conservation measures or existing permitting and licensing procedures, to ensure maintenance of the distributional range and extent of selected habitat types in selected areas. | Indicators for range and extent of selected habitat types OR Information on Conservation measures or permitting and licensing processes. |
| 5 | Species composition and/or abundance associated with selected marine habitats is stable based on definition of status through the implementation of the EU WFD. | <i>Community indicators (to be developed)</i> Relative abundance of selected key species |
| 6 | Health status of seagrass meadows is maintained (<i>Posidonia oceanica</i> meadows) | <i>Community Indicators (to be developed)</i> |

SLOVENIA

Slovenia has defined eight qualitative environmental targets for D6. These qualitative targets also refer to descriptors D1 and D3. The targets are state and impacts/pressures. None of the targets include a reference to existing legislation.

Table 31: Environmental targets and associated indicators set by Slovenia for D6.

| Environmental targets | |
|------------------------------|---|
| 1 | Achievement of good status and prevention of deterioration of the status regarding biomass, abundance and range of the biogenic substrate. |
| 2 | Achievement of good status and prevention of deterioration of status regarding the amount of the seabed (different types of substrates), which is highly influenced by human activities. |
| 3 | Achieving good status and preventing the deterioration of the status of benthic communities, which have been evaluated by using already developed and operational multi-metric indices for assessing the status and function of benthic communities, such as species diversity and richness, proportion of opportunistic and sensitive species. |
| 4 | Achievement of environmental targets 6.1 and 6.2 in relation to D1 and D3. |
| 5 | Identify the distribution, cover and biomass of biogenic substrates, with the aim to describe the status and determine good environmental status. |
| 6 | Identify the prevalence and extent of seabed (for different types of substrates), which is highly influenced by human activities |
| 7 | To reduce impacts due to physical damage of biogenic substrate - making recommendations and implementing best practices to reduce impacts. |
| 8 | To reduce impacts on the seabed due to fishing practices, so that 10% of the seabed for different types of substrates is protected against mechanical damage. |

CROATIA

Croatia has defined 6 environmental targets. The targets are set at Criterion and Indicator level being both quantitative and qualitative. The targets set by Croatia are state. Moreover, reference has been made to existing legislation (Habitats Directive, WFD).

Table 32: Environmental targets and associated indicators set by Croatia for D6

| Environmental targets | |
|--|--|
| Components: <i>Posidonia oceanica</i> / <i>Posidonia oceanica</i> meadow | |
| a) The area of distribution of <i>P. oceanica</i> meadow is not decreasing. | |
| b) Ecological quality of <i>P. oceanica</i> meadow is not decreasing. | |
| c) The area of distribution of <i>P. oceanica</i> meadow and its ecological quality are not decreasing due to anchoring (meadow). | |
| Components: Bottoms for trawling/Intertidal hard bottom and rocks/ Biocenosis of sublittoral algae/ Sublittoral fine sands with different amount of mud/ Sublittoral coarse sands with different amount of mud/ Circalittoral muds/ Circalittoral sands/ Bathyal muds | |
| a) Good ecological status of benthic communities on hard bottoms is not decreasing. | |
| b) Distribution of biocenosis is maintained. | |
| c) Species composition is maintained and in accordance with nature of substrate and environmental conditions. | |

GREECE

Greece has set two environmental targets for D6 and one associated indicator. Both targets are qualitative, with no threshold values or baselines defined. One of the targets is a monitoring target, related to the mapping of habitats (mapping the sensitive benthic habitats), while the other one is a state target (maintenance of the balance of benthic macrofauna). Reference is made to the Habitats Directive.

Table 33: Environmental targets and associated indicators set by Greece for D6.

| Environmental targets | | Associated indicators |
|------------------------------|--|---|
| 1 | Mapping of sensitive benthic habitats | |
| 2 | Maintenance of the balance of benthic macrofauna | Monitoring of the proportion of resistant/opportunistic species in relation to the total abundance of benthic macrofauna. |

CYPRUS

Cyprus has defined one quantitative environmental target which is verbatim copy of GES definition, calculated from 6 indicators and set at indicator level. The target covers criteria and indicators 6.2, 6.2.1, 6.2.2, 6.2.3, 6.2.4 as indicated in Table 34. Threshold values are defined, but no baselines were set.

This methodology sets as targets that univariate biotic indices and simple parameters where the observed variability is high should have a divergence from the reference conditions that is equal to or not greater than 50% and for multivariate biotic indices, qualitative indices and abiotic parameters, a divergence equal to or less than 25% should be achieved. It is stated that the quantitative targets most commonly relate to values from reference stations. However, Cyprus does not specify any reference conditions either.

Table 34: Environmental targets and associated indicators set by Cyprus for D6.

| The marine environment of Cyprus is considered to be in good environmental status by the year 2020, if the structure and function of the ecosystem are safeguarded and not adversely affected. Specifically, diversity and productivity are maintained, and any pressures do not hinder the ecosystem components to recover and/or retain their natural diversity, productivity and dynamic ecological processes. | | |
|---|--|--|
| Environmental targets | Associated indicators* | Relation to MSFD Descriptors, Criteria, Indicators |
| No target | Areal extent of <i>Posidonia</i> meadows | 6.1, 6.1.1, 6.1.2. 6.1 6.1.1, 6.2.1 |
| Divergence < 50 % from reference conditions | Abundance of perennial seaweeds (% Coverage) | 6.2 6.2.1 6.2.2 |
| Divergence < 50 % from reference conditions | Abundance of shade-adapted, slow growing calcareous species (% Coverage) | 6.2.3 6.2.4 |
| Divergence < 50 % from reference conditions | Abundance of opportunistic macroalgae (% Coverage) | 6.2 |
| Divergence < 25 % from reference conditions | Ecological Evaluation Index (EEI) | |
| Divergence < 25 % from reference conditions | PREI (Posidonia) | |
| Divergence < 25 % from reference conditions | BENTIX Index | |

*The term indicator is mostly used as parameter.

Comparative Analysis

For Descriptor 6, its criteria and indicators, all MSs of the Mediterranean marine region, have defined environmental targets, as indicated in Table 35.

Table 35: Targets for D6 set at Descriptor/Criteria/Indicator Level by Member States. *The targets for SP and FR apply to D1-D4-D6.

| | Spain | France* | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|------------------------|-------|---------|-------|-------|----------|---------|--------|--------|
| Descriptor 6 | √ | √ | √ | √ | √ | √ | √ | √ |
| Criterion 6.1 | √ | - | √ | √ | √ | √ | - | - |
| Criterion 6.2 | √ | - | - | √ | √ | √ | √ | √ |
| Indicator 6.1.1 | √ | - | - | √ | - | √ | - | - |
| Indicator 6.1.2 | √ | - | √ | √ | - | √ | - | - |
| Indicator 6.2.1 | - | - | - | √ | - | √ | √ | √ |
| Indicator 6.2.2 | - | - | - | - | - | √ | √ | √ |
| Indicator 6.2.3 | - | - | - | - | - | - | - | √ |
| Indicator 6.2.4 | - | - | - | - | - | - | √ | √ |

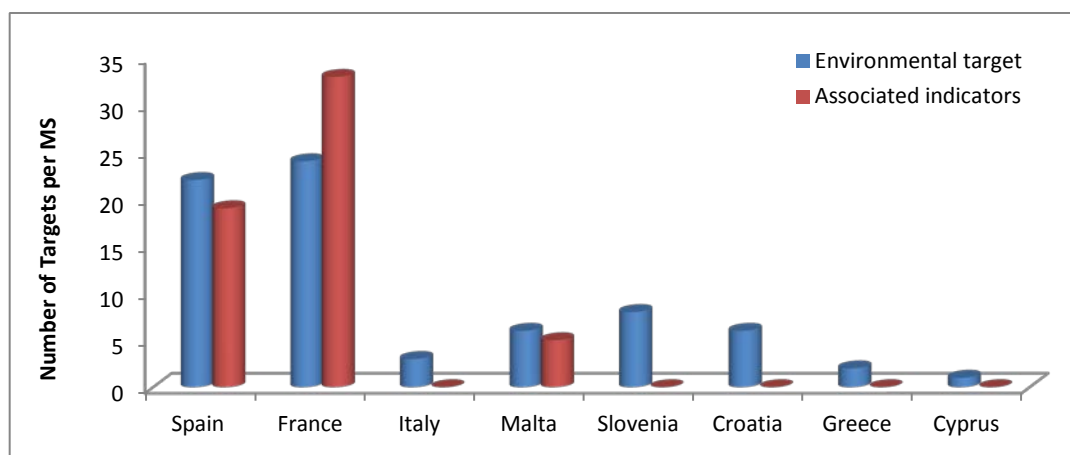


Chart 19: Number of environmental targets and associated indicators set by Mediterranean MS for D6.

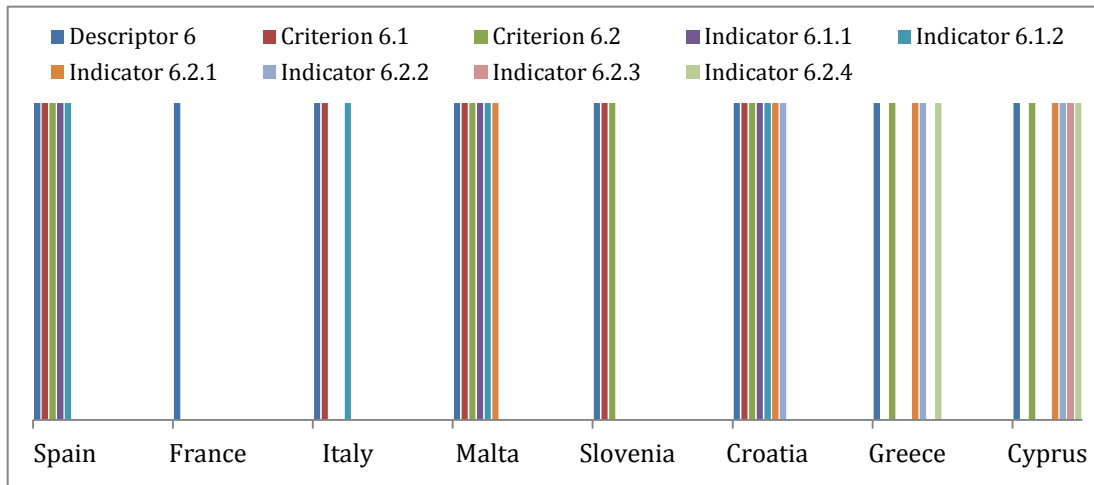


Chart 20: Use of Descriptor/Criteria Indicators by Mediterranean MSs in Art10 for D6.

As presented in Chart 19, all 8 MSs have approached D6. All MSs except FR have approached D6 at indicator level. Although the targets and associated indicators set by France are very close to criteria/indicators set by 2010/477/EU, they are characterized as “GES Other”, that’s why they do not appear in the table and charts. The most popular criterion is 6.2 with six out of the 8 MSs having approached it. Criterion 6.1 was approached by 5 out of 8 MSs. The most popular indicators are 6.1.2 and 6.2.1 with 4 out of 8 Member States having approach them. The most difficult indicator to be approached was 6.2.3 with only CY approaching it.

Approach

Three Member States (GR, SI, and MT) have qualitatively approached the targets set for Descriptor 6. IT and HR have set both qualitative and quantitative targets, and for the quantitative targets they have set thresholds and baselines. CY has quantitatively approached the target and they have set threshold values without baselines.

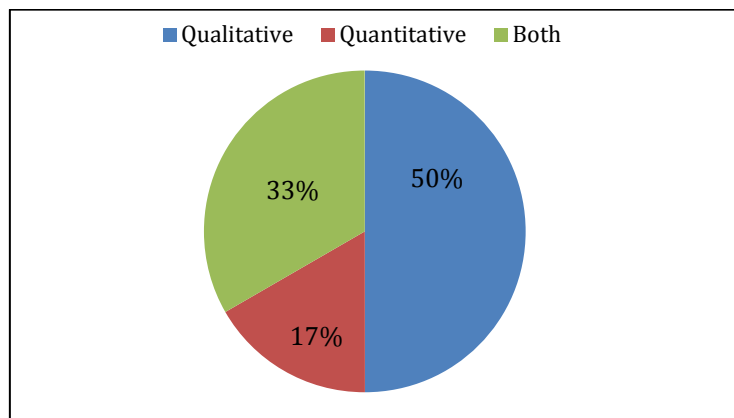


Chart 21: MSs’ approach for D4.

Level of Integration with other Directives

IT, HR and MT have mentioned several European Regulations (EC 1967/2006, EU Reg. N. 1224/2009, Good Practice Handbooks, Habitats Directive and Water Framework Directive's requirements for Biological Quality Elements) while CY, GR, SL have not referred specifically to any legislation.

Regional/ International Cooperation

HR makes a reference to the Barcelona Convention in the paper report, as well as to the GFCM.

Article 12 Assessment

According to the results of Article 12 assessment conducted by the Commission the targets for GES set for Descriptor 6 for Mediterranean MSs (except MT and HR) is considered:

- partially adequate for SP and FR (-D1-D4-D6)
- inadequate for IT, SI, GR, CY

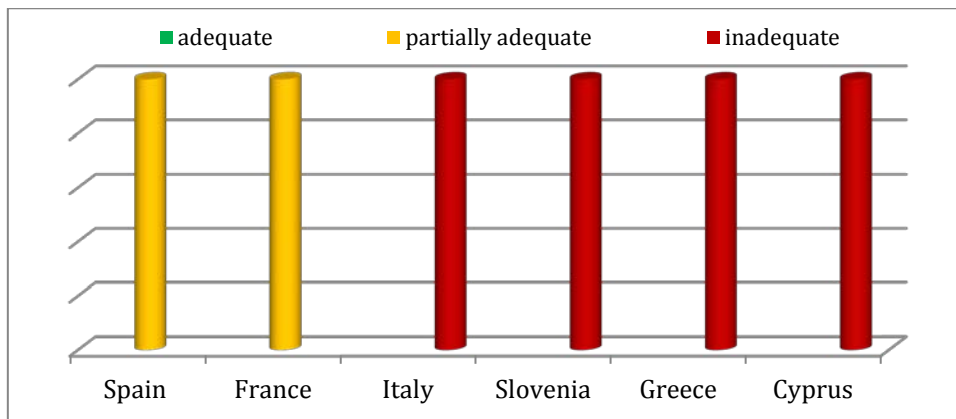


Chart 22: Characterization of targets set by Mediterranean MSs for D6 according to Art 12 Assessment (MT and HR excluded).

Table 36: Synopsis for each MS regarding D6.

| | |
|----|--|
| IT | <ul style="list-style-type: none"> • Targets set at Indicator Level • 3 environmental targets • The target are impact and pressure • Qualitative and quantitative targets • For the quantitative target, thresholds and baseline are defined • Reference to EU Regulation EC 1967/2006 and Good Practice Handbooks |
| MT | <ul style="list-style-type: none"> • Targets set at Indicator Level • 6 environmental targets and 5 associated targets • Four targets are state and one is related to the reduction of impacts/pressure • Qualitative targets • No holistic approach of targets • Reference to EC regulation 1967 of 2006 and Common Fishery Policy, Habitats Directive and Water Framework Directive |
| SI | <ul style="list-style-type: none"> • Targets set at Descriptor Level and one at Criteria level • 8 environmental targets • Four targets are state, 2 are research/data collection and two targets relate to the reduction of impacts/pressure • Qualitative targets • Semi-holistic approach of two targets (one target relates to all three biodiversity descriptors and another relates to D1-D3 and D6) • None of the targets include a reference to existing legislation |
| HR | <ul style="list-style-type: none"> • Targets set at criteria Indicator Level • 6 environmental targets • The targets are state • Qualitative and quantitative targets • Use of thresholds • No holistic approach • Reference to existing legislation (WFD, Habitats Directive) |
| GR | <ul style="list-style-type: none"> • Targets set at Indicator Level • 2 environmental targets and 1 associated indicator • The targets are state (one is monitoring) • Qualitative targets • No holistic approach of targets • Reference to Habitats Directive |
| CY | <ul style="list-style-type: none"> • Target set at criteria and Indicator Level • 1 environmental target • The target is state • Quantitative target • Threshold value set at 0,75, but no baseline defined • No holistic approach of target • No reference to relevant international, EU or regional legislation/agreements) |

D1, D4, D6, ARTICLE 8

D1, D4, D6, 8A FEATURES ANALYSIS

All MSS have carried out an initial assessment on biological features reporting on habitats and species/functional groups, but only SP, HR, CY and GR addressed ecosystems. The analysis of this article will be provided in the final report.

D1, D4, D6, 8B PRESSURES ANALYSIS

The pressures reported by MSs relevant to D1, D4 and D6 include physical loss, physical damage, NIS and eutrophication and they are presented in the tables that follow.

(i) *Physical loss/ Physical damage*

All MSs have carried out an initial assessment on physical loss and physical damage at different levels of detail. In addition, the main causes of pressure are mentioned in varying detail. The impacts of physical loss and physical damage are also always addressed, as presented in Table 37 and Table 38. MT, GR and CY refer to species under pressure such as *Posidonia oceanica*, Maerl beds, Cystoseira, benthic polychaetes, *Monachus monachus* and *Carreta carreta*. Regarding activities that cause pressure, SP, FR, MT, SI and CY mention ports whereas fisheries are mentioned by SP, IT, SI, HR, GR.

Table 37: Physical loss reported by MS under pressures impacting D1, D4, and D6.

| PHYSICAL LOSS | | | | | |
|----------------------|--|------------------------------------|--|------------------------------|--|
| MS | PRESSURES/ACTIVITIES | IMPACT | METHODOLOGY | THRESHOLDS | GAPS |
| SP | ports, land claim defence and dredging | changes to seabed/near-shore areas | The pressures are calculated for a grid of 5x5 miles | Not defined | The potential condition is as a measure of potential risk rather than a measure of actual impact |
| FR | ports, land claim defence, and offshore structures | on the littoral or coast | qualitative | Not defined | Not defined |
| IT | construction and maintenance of ports, land claim defense, cables, pipelines | changes to seabed | proposes to use “a trend status indicator” (2018) | % of lost biogenic substrate | lack of geospatial data related to substrate types |
| MT | construction at sea, ports | benthic habitats | AMBI index for soft bottom | Not defined | extent of habitats affected |

| | | | | | |
|-----------|---|---|---|---------------|--|
| SI | Urbanization, ports, land claim defense, tourism | Mediolittoral and upper belts | under development | 5-25% | spatial distribution of the altered surfaces/ depth of these alterations |
| HR | Urbanization and sealing, ports | coastal area has increased from 150 km to 873 km (1960-2000) | information soon available | Not defined | man-made structures |
| GR | constructions (seawall, breakwater, groins & jetties), tourism and recreation, underwater disposal, natural causes and other anthropogenic activities | <i>Posidonia oceanica</i> , benthic polychaetes and presence of opportunistic species | Not defined | Not defined | extent of habitats loss |
| CY | Construction, operation, maintenance of various structures on and along the coastline, coastal defense Land Claim Defense port operations | angiosperm, macroalgal, macrobenthic communities | Ecological Evaluation Index (EEI)/ <i>Posidonia oceanica</i> Rapid Easy Index (PREI)/ and BENTIX. | 50% deviation | Lack of spatial information on the extent of substrates as well as the areal percentage of these that is affected by human activities. |

Table 38: Physical damage reported by MS under pressures impacting D1, D4, D6.

| PHYSICAL DAMAGE | | | | | |
|------------------------|---|---|---|------------------------------|--|
| MS | PRESSURES/ACTIVITIES | IMPACT | METHODOLOGY | THRESHOLL | GAPS |
| SP | fisheries and ports, tourism | changes to seabed/ near-shore areas | The pressures are calculated for a grid of 5x5 miles | Not defined | The potential condition is as a measure of potential risk rather than a measure of actual impact |
| FR | pipelines, aquaculture, solid waste disposal, fisheries | on the littoral or coast | qualitative | Not defined | Not defined |
| IT | fisheries, construction and maintenance of ports and land claim defense | changes to seabed | proposes to use “a trend status indicator” (2018) | % of lost biogenic substrate | lack of geospatial data related to substrate types |
| MT | Discharges/ run-off/ dredging/ disposal of inert material and aquaculture | <i>Posidonia oceanica</i> / Maerl beds/ <i>Cystoseira</i> | Monitoring on a risk based approach as part of the MSFD monitoring programme. | Not defined | Quantification of the levels of pressure and impacts arising from physical damage |

| | | | | | |
|-----------|--|---|---|--|---|
| SI | fisheries (e.g trawling), maritime traffic and urbanization | Seafloor/ mediolittoral and upper infralittoral belt | Not defined | Not defined | Insufficient data on spatial extent and intensity of single pressures |
| HR | demersal towed gear as bottom trawls, beam trawls and dredges that operate on coastal and open sea sandy and muddy bottoms | benthic communities | Not defined | Not defined | No systematic investigations were conducted to assess the impact of physical damage |
| GR | fisheries, dredging and aquaculture | maerl beds/ <i>Posidonia</i> meadows/ <i>Monachus monachus</i> / <i>Carreta carreta</i> | Not defined | No decrease in the area occupied by <i>Posidonia oceanica</i> and Maerl beds | insufficient data |
| CY | Construction, operation, maintenance of various structures on and along the coastline. | angiosperm, macroalgal, macrobenthic communities | Ecological Evaluation Index (EEI)/ <i>Posidonia oceanica</i> Rapid Easy Index (PREI)/ and BENTIX. | 50% deviation | Lack of spatial information on the extent of substrates and areal percentage of affected. |

Therefore, as presented by MSs, the activities which are responsible for physical loss are those depicted in Chart 24 and for physical damage in Chart 23;

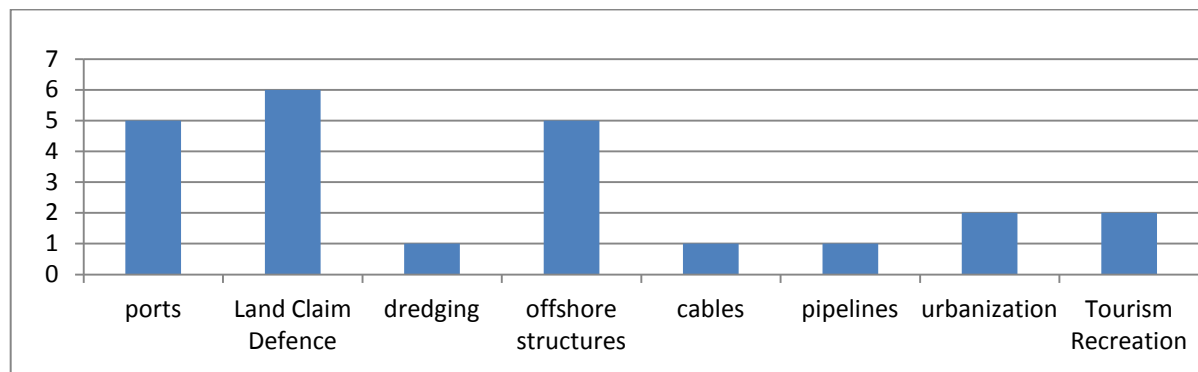


Chart 23: Activities reported by MS to cause physical damage impacting D1, D4, D6.

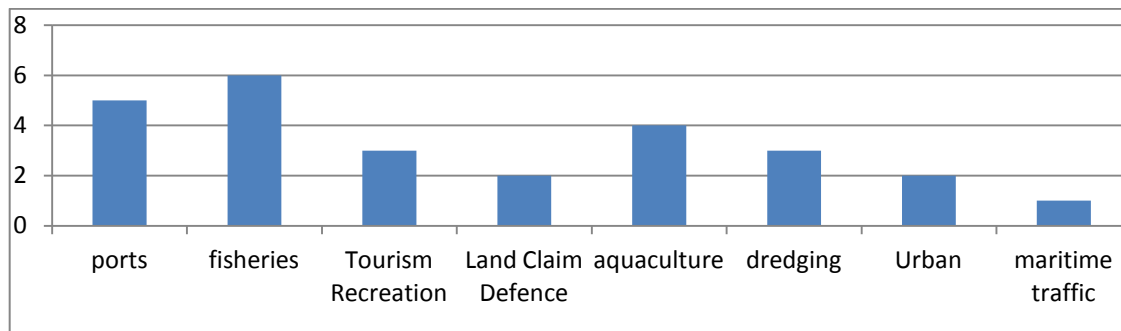


Chart 24: Activities reported by MS to cause physical loss impacting D1, D4, D6.

(ii) NIS

The numbers of NIS reported by MSs are presented on the table, where the information is classified in a subregional sense.

Table 39: Numbers of NIS reported by MS under pressures impacting on the descriptors D1, D4, and D6 in the Western Mediterranean Sea (WMS), Central Mediterranean Sea (CMS) and Eastern Mediterranean Sea (EMS).

| | <i>SP</i> | <i>FR</i> | <i>IT</i> | <i>MT</i> | <i>SI</i> | <i>HR</i> | <i>GR</i> | <i>CY</i> |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| WMS | 92 | 155 | 119 | | | | | |
| CMS | | | | 56 | | | | |
| EMS | | | | | 16 | 13 | 193 | 126 |

Concerning NIS, all MSs reported that:

- There is limited information on impacts.
- There are knowledge gaps; lack of data on distribution and frequency of occurrence; no quantitative data available; some species are very similar to common native species and hence difficult to identify; lack of projects and research, the lack of regular monitoring for established non-native organisms which would allow the interpretation of basic information on population growth and trends in colonization; no data on the relationship between invasive and native species.
- The pathways of NIS are shipping, culturing, aquarium trade, fishing bait, the Suez Canal.

(iii) Eutrophication

The activities identified leading to eutrophication phenomena are presented in Chart 25.

Table 40: Pressures that lead to eutrophication phenomena reported by MSs impacting D1, D4, and D6.

| MS | PRESSURES | IMPACT | METHOD | STATUS | THRESHOLDS | GAPS |
|-----------|---|--|-------------------------------------|------------------------------------|---|--|
| SP | water column and associated communities/ seabed habitats | Posidonia meadows | index TRIX | trophic status is currently 'good' | Not defined | Not defined |
| FR | water column / seabed habitats/ coastal waters | Not defined | modelling nitrogen deposition rates | Not defined | Not defined | Knowledge gaps |
| IT | Not defined | Not defined | Modelling | Not Assessed | Not defined | N and P load inputs/ off-shore waters/ |
| MT | water column and associated communities/ seabed habitats | Tuna penning cages/ benthic habitats | not defined | Not Assessed | Not defined | lack of long term trend data |
| SI | water column and associated communities/ seabed habitats | <i>Cystoseira/Posidonia</i> bed/ <i>Cymodocea nodosa</i> | Monitoring programs | Good | NO ₃ < 2.8 µM / PO ₄ < 0.15 µM / Chl-a < 1,5 µg/l / Transparency > 6,1m TN < 48.8 µM / TP < 1.4 µM / EEI-c > 5,84 | atmospheric deposition of Saharan dust |
| HR | nutrients & organic enrichment overall | Not defined | Not defined | Not Assessed | Not defined | Not defined |
| GR | water column and associated communities/ seabed habitats | Toxic dinoflagellate <i>Alexandrium minutum</i> (blooms) | Monitoring programs | Good | NO ₃ < 1 µM / PO ₄ < 0,5 µM / Chl-a < 1,5 µg/l Transparency > 5m DO > 80% | Organic matter data |
| CY | seabed and water column habitats | <i>Cladophora spp./</i> calcareous species/ seaweeds & seagrasses | Monitoring programs | Good | 50% deviation for Nutrients Enrichment | Saharan dust atmospheric deposition/ submarine ground water discharge |

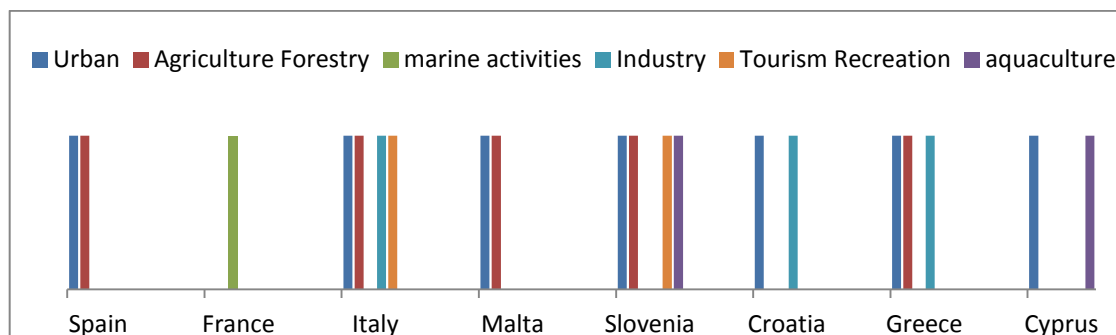


Chart 25: Activities reported by MSs that lead to eutrophication phenomena.

DESCRIPTOR 7

According to the Marine Strategy Framework Directive (2008/56/EC) and Commission Decision 2010/477/EU the definition for Descriptor 7 is:

Descriptor 7 (Hydrographical conditions): Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.

A list of criteria and indicators on permanent alterations and hydrographical changes, as indicated in Table 41, have been set in order that Member States can determine Good Environmental Status (GES) in marine regions and subregions.

Table 41: Criteria and indicators for Descriptor 7, according to Commission Decision 2010/477/EU.

| Criteria | Indicators |
|---|---|
| 7.1 Spatial characterization of permanent alterations | Extent of area affected by permanent alterations (7.1.1) |
| 7.2 Impact of permanent hydrographical changes | Spatial extent of habitats affected by the permanent alteration (7.2.1) |
| | Changes in habitats, in particular the functions provided (e.g. spawning, breeding and feeding areas and migration routes of fish, birds and mammals), due to altered hydrographical conditions (7.2.2) |

D7_ARTICLE 9 ANALYSIS

GES definition

All the Mediterranean MSs have reported under descriptor 7 and defined GES incorporating the definition provided by COM Decision 2010/477/EU quite generally. However, FR and SI have provided specific environmental elements and parameters to consider and linked D7 to D1, D4 and D6. As a result, the level of coherence across the Mediterranean for the definition of GES for Descriptor 7 is **moderate**.

Criteria and Indicators applied

Five MSs (SP, FR, IT, HR and CY) have incorporated at least one Commission Decision criteria for Descriptor 7, as presented in Table 42; SP has integrated the criteria in the descriptor definition, HR has provided specific definitions for both criteria, IT and CY have addressed only criterion 7.1, whereas FR defines criterion 7.1 and integrates 7.2 into the descriptor definition. Therefore, **the most popular criterion is 7.1**. Among the indicators **7.1.1 is the most popular** as it has been used for defining GES by FR, IT and CY. Thus, the level of coherence is low.

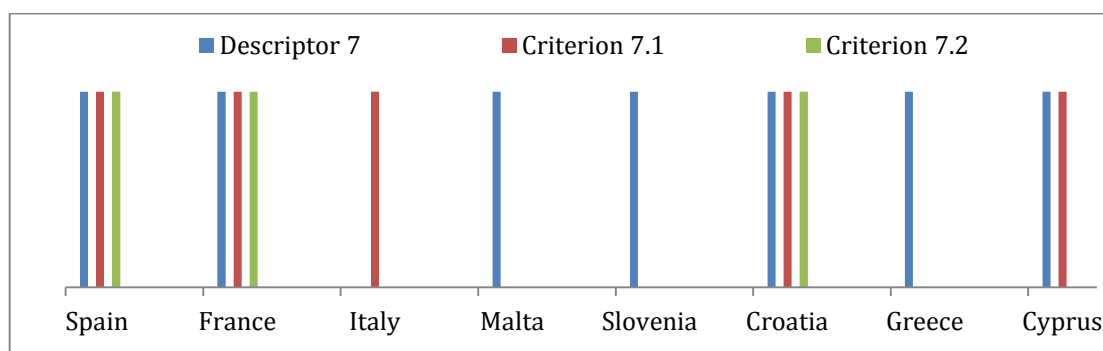


Chart 26: Use of Descriptor/Criteria by Mediterranean MS in Art9 for D7.

Table 42: Use of Descriptor/Criteria/Indicators in Art9 GES definition by Mediterranean MSs for D7.

| | Spain | France | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|------------------------|-------|--------|-------|-------|----------|---------|--------|--------|
| Descriptor 7 | √ | √ | - | √ | √ | √ | √ | √ |
| Criterion 7.1 | (√) | √ | √ | - | - | √ | - | (√) |
| Criterion 7.2 | (√) | (√) | - | - | - | √ | - | - |
| Indicator 7.1.1 | - | √ | √ | - | - | - | - | (√) |
| Indicator 7.2.1 | - | √ | - | - | - | - | - | - |
| Indicator 7.2.2 | - | √ | - | - | - | - | - | - |

Approach

Among reporting MSs, only IT incorporates a quantitative threshold in its definition of GES (...no more than 5% of the extension of coastal marine water bodies...), but it does not seem to be fully supported by the information provided so it is not clear how the value was selected. SP, FR, IT, MT have mentioned baselines (e.g. present state of impacts or a systematic modeling of coastal regions).

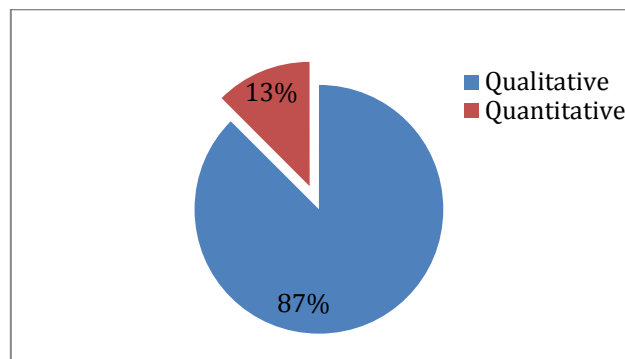


Chart 27: MSs approach to D7 GES definition

Level of Integration with other Directives

Only IT refers specifically to the Water Framework Directive, while FR incorporates the EIA and SEA Directives.

Regional/ International Cooperation

No reference of regional or international cooperation

Article 12 Assessment

According to the results of Article 12 assessment conducted by the Commission, the GES definition for Descriptor 7 provided by each MS (except MT and HR) is considered:

- adequate for FR
- partially adequate for SP, IT, CY
- inadequate for SI, GR

The Article 12 assessment is not available for MT and HR.

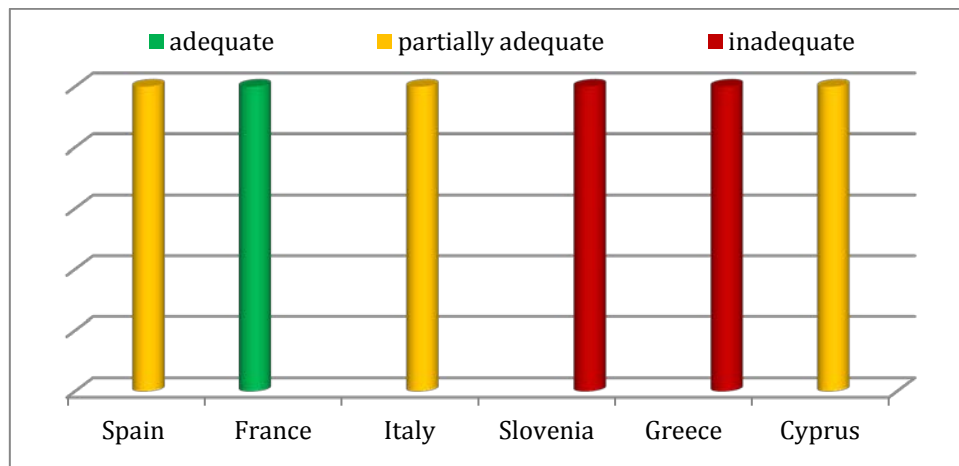


Chart 28: Art 12 Assessment of MSs' GES definition for D7 (MT and HR excluded).

Table 43: Synopsis for each MS regarding D7.

| | |
|-----------|--|
| SP | <ul style="list-style-type: none"> - GES definition at Descriptor level integrating the two criteria, applying to all Spanish subdivisions. - Adequate coverage of Criteria - Qualitative approach - Use of baselines (present systematic modeling of coastal regions) - No Integration of other Directives |
| FR | <ul style="list-style-type: none"> - GES definition at Descriptor/Criteria and Indicator Level - Adequate coverage of Criteria/Indicators - Holistic approach; reference to descriptors 1, 4 and 6. - Qualitative approach - No thresholds, use of baselines (systematic modeling of coastal regions) - Integration of EIA and SEA Directives (tools to monitor hydrographical change) - Reference to OSPAR |
| IT | <ul style="list-style-type: none"> - GES definition at Criteria and Indicator Level, applying to all Italian subregions. - Partially adequate coverage of Criteria and Indicators - Quantitative approach (the threshold of 5% of the coastal marine water bodies is set and a baseline is provided). - Use of thresholds (5%) and baselines (present state of impacts) - Integration of WFD |
| MT | <ul style="list-style-type: none"> - GES definition at Descriptor Level - Inadequate coverage of Criteria/Indicators - Qualitative approach - No use of thresholds. Current conditions are set as a baseline. - No Integration of other Directives |

| | |
|-----------|--|
| SI | <ul style="list-style-type: none"> - GES definition at Descriptor level - Inadequate coverage of Criteria/Indicators - Qualitative approach - No use of thresholds/ baselines - No Integration of other Directives |
| HR | <ul style="list-style-type: none"> - GES definition at Descriptor and Criteria Level - Adequate coverage of Criteria (2/2) and inadequate of indicators (0/2) - Qualitative approach - No use of thresholds/ baselines - No Integration of other Directives |
| GR | <ul style="list-style-type: none"> - GES definition at Descriptor Level - Inadequate coverage of Criteria and Indicators - Qualitative approach - No use of thresholds/ baselines - No Integration of other Directives |
| CY | <ul style="list-style-type: none"> - GES definition at Descriptor level, incorporating criterion 7.1 and indicator 7.1.1 - Partially adequate coverage of Criteria and Indicators - Qualitative approach - No use of thresholds/ baselines - No Integration of other Community legislation. |

D7_ARTICLE 10 ANALYSIS

The analysis of the reported information by MSs under D7 included environmental targets and associated indicators established by MSs and their nature. Cyprus and Italy have not defined environmental targets for Descriptor 7.

SPAIN

Spain has established 6 environmental targets and 6 associated indicators for Descriptor 7, as depicted in Table 44, which apply to all sub-divisions of the two Spanish marine regions. The targets are state, monitoring, pressure/impact, knowledge and policy/ legislation. The approach is qualitative as no values are provided or baselines set. In addition, there is a holistic approach of the targets as they are set in accordance with Descriptors 1, 4, 6.

Table 44: Environmental targets and associated indicators set by Spain for D7.

| | Environmental Targets | Associated Indicators |
|---|---|--|
| 1 | Ensure that the surface affected by permanent physical changes caused by human activities is a reduced proportion of the total area of the sub-region. | Area affected by permanent physical changes caused by human activities |
| 2 | Ensure that the localized and permanent physical changes caused by human activities do not threaten the sustainability and functioning of the biogenic and/or protected habitats, and do not threaten the achievement of GES for these habitats. | Habitats affected |
| 3 | Adopt mitigation measures in the coastal stretches in which physical permanent changes due to human activities have produced significant effects so that hydrographic and hydrodynamic properties are compatible with habitat conservation. | Habitat conservation status. |
| 4 | Ensure that the environmental impact assessments of the projects that may affect the marine environment are performed taking into account the potential impacts of the permanent changes in the hydrographic regime, including cumulative effects in the most appropriate scales in accordance with the guidelines developed to this end. | Percentage of environmental impact assessment studies of projects affecting marine environment contemplating hydrographical changes |
| 5 | To encourage that the marine ecosystems which are dependent of the plumes associated with river mouths are taken into account in the determination of ecological flows within the context of water plans. | Percentage of water plans that take into account marine ecosystems when defining ecological flow. |
| 6 | Promote a national monitoring system of hydrographic and hydrodynamic ocean variability and establish a warning system on the occurrence of climate anomalies that can pressure the different marine ecosystems. The system shall include a register of biologic and hydrographic variables, as well as occurrence of massive and extreme events in the marine ecosystems such as: unusual algal blooms, occurrence of non-common species in a given zone or at a given season, massive occurrence of species and processes (mortality, breeding), etc. | Existence of national system of surveillance for hydrographical changes and ocean hydrodynamics, and a warning and registration system for massive and extreme events. |

FRANCE

France has not defined specific targets for D7 however, the general targets A and B, as presented in Table 45 are provided as relevant for D7. These targets are state and are rather general. Furthermore, they are qualitative providing no thresholds.

Table 45: Environmental targets and associated indicators set by France for D7.

| Environmental Targets | |
|------------------------------|---|
| 1 | A. Maintain or restore biodiversity and ecosystem functioning of coastal seabeds (medio, infra and circalittoral) |
| 2 | B. Maintain a good status of conservation of habitats of deep submarine canyons |

MALTA

Malta has established 1 environmental target and 1 associated indicator for Descriptor 7, as depicted in Table 46. The target is of state, pressure/impact nature, involving policy components. The descriptor was approached in a qualitative way thus there are no thresholds. The baseline set is the current conditions where these are known. The target is reported to be partly in line with the WFD.

Table 46: Environmental targets and associated indicators set by Malta for D7.

| | Environmental Targets | Associated Indicators |
|---|--|--|
| 1 | Changes in hydrographical conditions from large-scale development proposals are adequately assessed through existing permitting and licensing procedures in line with the parameters stipulated by the Marine Strategy Framework Directive | Indicators in relation to proposals subject to assessment procedures (to be developed) |

SLOVENIA

Slovenia has established 3 environmental targets and no associated indicators for Descriptor 7, as depicted in Table 47. The targets are state, pressure, impact. The approach is qualitative as no actual values are provided or baselines set. In addition, there is a holistic approach of the targets are the third target set is in accordance with Descriptors 1,4,5. There is no reference to other European legislation.

Table 47: Environmental targets set by Slovenia for D7.

| Environmental targets | |
|------------------------------|---|
| 1 | The scope of the area with permanent changes may not be greater than x%, which will be determined by 2018. |
| 2 | Good environmental status is achieved when there is sufficient oxygen in the aquatic environment for the smooth growth and living of organisms (important are temporal and spatial scales); nutrients occurring do not exceed the amount that would lead to eutrophication; after the change of hydrographic conditions the circulation of water masses and streaming do not change the environmental conditions. |
| 3 | Environmental targets are in accordance with targets for D1, D4 and D6. |

CROATIA

Croatia has set 1 environmental target to address Descriptor 7, as presented in Table 48. The target is qualitative providing no thresholds and general. The target is impact and policy.

Table 48: Environmental targets and associated indicators set by Croatia for D7.

| Environmental Targets | |
|------------------------------|--|
| 1 | All developments must be in a way that ensures the full consideration of any potential impacts, including cumulative effects at the most appropriate spatial scales to ensure that GES is not compromised. |

GREECE

Greece has established 1 environmental target and two associated indicators under descriptor 7, as presented in Table 49, applying to all Greek subregions. The target is pressure/impact and is quite general. In addition, the target is qualitative providing no thresholds or baselines.

Table 49: Environmental targets and associated indicators set by Greece for D7

| | Environmental Targets | Associated Indicators |
|---|--|---|
| 1 | Prevention of environmental impact of permanent alterations in hydrographical conditions caused by local human activities. | Estimation of variations in vertical stratification with main indicators: a) Temperature b) Salinity c) Pressure d) Turbidity e) Chlorophyll– a concentration f) Dissolved oxygen g) Inorganic nutrients h) Phytoplankton i) Zooplankton |
| | | Indicators of renewal rates of marine waters |

Comparative Analysis

As mentioned above, IT and CY have not defined environmental targets under D7. SP, FR, MT, SI, HR and GR have established targets under D7 its criteria and indicators as depicted on Table 50. The targets reported by most MSs (FR, SI, GR, MT and HR) do not focus on the reduction of specific pressures or impacts and they are general. However, SP reported six pressure-based targets most of them related also to other Descriptors. GR, MT, SP has reported associated indicators with GR providing specific indicators. Overall, the level of coherence in the setting of **environmental targets** for D7 across the Mediterranean marine region is **low**.

Table 50: Targets set at Descriptor/Criteria/Indicator Level by Mediterranean MSs for D7.

| | Spain | France | Italy | Malta | Slovenia | Croatia | Greece | Cyprus |
|------------------------|-------|--------|-------------|-------|----------|---------|--------|-------------|
| Descriptor 7 | √ | √ | Not defined | √ | √ | √ | √ | Not defined |
| Criteria 7.1 | - | - | | √ | - | - | √ | |
| Criteria 7.2 | √ | - | | √ | - | √ | √ | |
| Indicator 7.1.1 | √ | - | | √ | - | - | √ | |
| Indicator 7.2.1 | - | - | | √ | - | - | √ | |
| Indicator 7.2.2 | - | - | | √ | - | - | √ | |

The number of targets to cover Descriptor 7 varies from one (MT, HR, GR) to 6 (SP), as shown in Chart 29. In general, the number of targets set by MSs is not large and in cases there are no associated indicators.

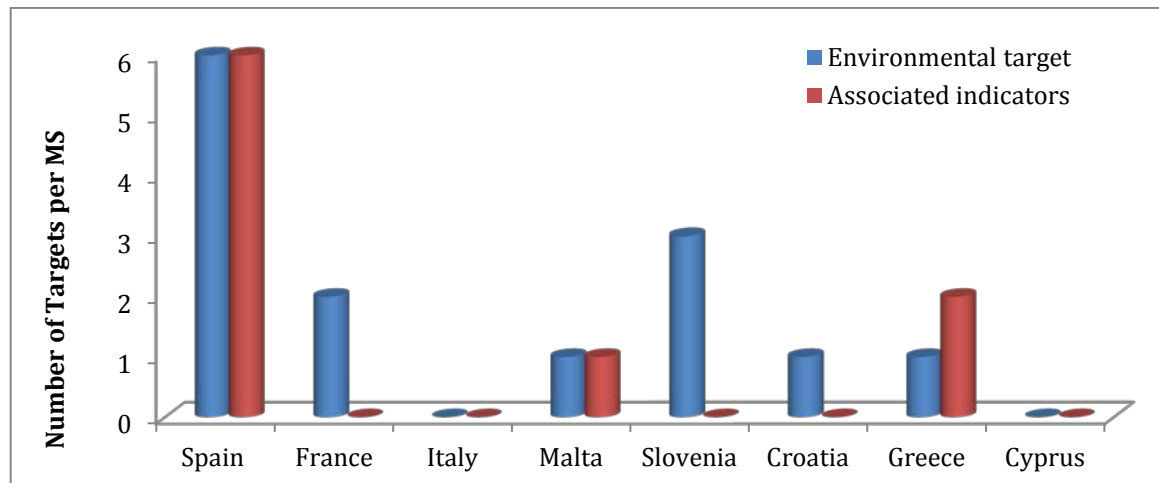


Chart 29: Number of environmental targets and associated indicators set by Mediterranean MSs for D7. (*IT and CY have not reported under D7).

Based on the information provided at criteria level, SP, MT, HR and GR have incorporated the Commission Decision criteria in setting targets for Descriptor 7;

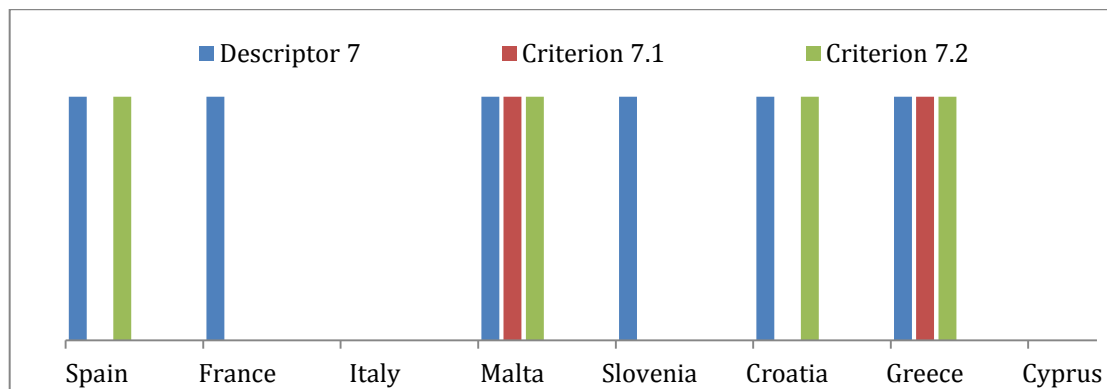


Chart 30: Use of Descriptor and Criteria in Art10 by Mediterranean MSs for D7.

Approach

SP, FR, MT, SI, HR and GR define environmental targets to address Descriptor 7 in a qualitative way without providing threshold values. SP and MT provide a quantitative baseline in their targets; however, it is not supported by the information provided. Thus, the baseline they give is “Current conditions/ Current assessment processes in place” (MT) or “a systematic modeling of coastal regions” (SP).

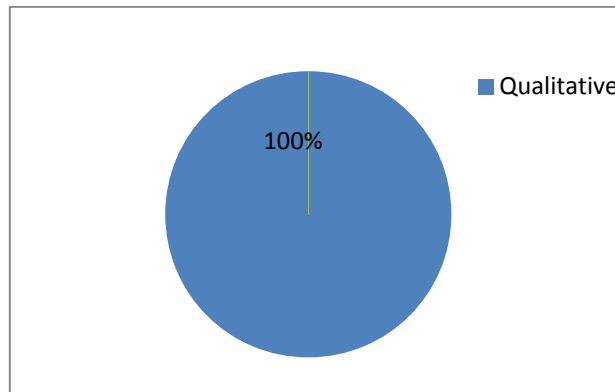


Chart 31: MSs' approach for D7 (IT and CY excluded)

Level of Integration with other Directives

Spain refers to the EIA, SEA and the WFD. No other MS has made a clear link to the WFD objectives or assessments relevant to D7.

Regional/ International Cooperation

Spain has included a reference to the Barcelona Convention and its protocol on integrated coastal areas of the Mediterranean.

Article 12 Assessment

According to the results of Article 12 assessment conducted by the Commission the targets set for Descriptor 7 by MSs (MT and HR excluded) in order to achieve GES are generally considered:

- adequate for SP
- inadequate for FR, SI, GR

IT and CY have not established targets for D7 whereas for MT and HR the reports are not available.

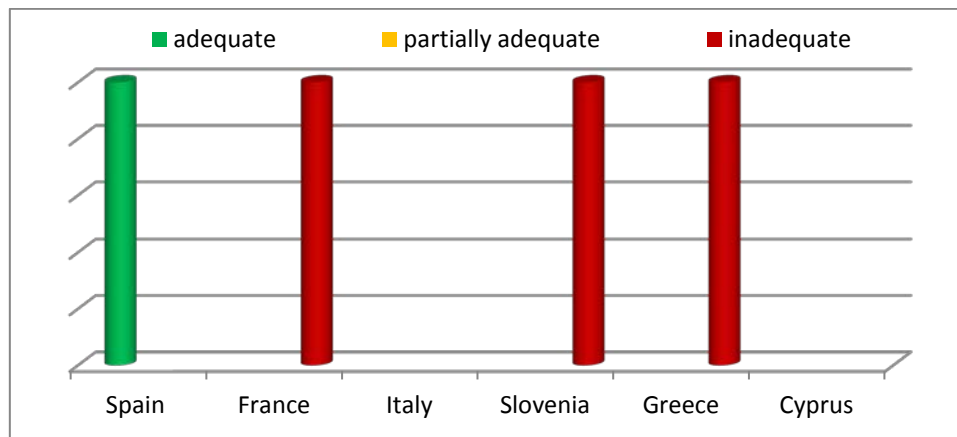


Chart 32: Characterization of targets set by Mediterranean MSs for D7 (MT and HR excluded) according to Art12 Assessment.

Table 51: Synopsis for MSs regarding the establishment of targets under D7.

| | |
|-----------|---|
| SP | <ul style="list-style-type: none"> - Six (6) environmental and five (6) associated targets set - Targets set at Descriptor/Criteria/Indicator Level - The targets are pressure and impact - Qualitative approach - Holistic approach of targets relating to Descriptors 1, 4 and 6. - Integration of other Directives (EIA, WFD) - Reference to the Barcelona Convention |
| FR | <ul style="list-style-type: none"> - two (2) environmental targets set - Targets set at Descriptor Level - The targets are state, pressure, impact - Qualitative approach - No holistic approach of targets - No Integration of other Directives |
| IT | <ul style="list-style-type: none"> - No environmental targets and associated indicators set |
| MT | <ul style="list-style-type: none"> - one (1) environmental target and one (1) associated indicator set - Targets set at Descriptor/Criteria/Indicator Level - The targets are state, pressure/impact - Qualitative approach - No holistic approach - Integration of the WFD |
| SI | <ul style="list-style-type: none"> - Three (3) environmental targets set - Targets set at Descriptor Level - The aims of the targets are state, pressure/ impact - Qualitative approach - Holistic approach of one target (used for more Descriptors 1,4,6) - No Integration of other Directives |
| HR | <ul style="list-style-type: none"> - Set one (1) environmental |

| | |
|-----------|--|
| | <ul style="list-style-type: none"> - Targets set at Descriptor/Criteria/Indicators level - The aims of the targets are state, pressure, impact - Qualitative approach - No Holistic approach of targets - No Integration of other Directives |
| GR | <ul style="list-style-type: none"> - Set one (1) environmental target and two (2) associated indicators. - Targets set at Descriptor/Criteria/Indicator Level - The aims of the targets are state, pressure, impact - Qualitative approach - No Holistic approach of targets (used for more than 1 Descriptors) - No Integration of other Directives |
| CY | <ul style="list-style-type: none"> - No environmental targets and associated indicators set |

ART8 (8C) ECONOMIC AND SOCIAL ANALYSIS

SOCIOECONOMIC DIMENSIONS OF MSFD

INTRODUCTION

Although the issues covered by MSFD mainly concern environmental conservation targets, socioeconomic issues also constitute an integral part of its implementation. More precisely, during the initial stage, a socioeconomic evaluation of the uses observed across the area under regulation is foreseen, while the costs of degradation of marine areas should also be evaluated (art 8). Moreover, economic issues should also be taken into account regarding the development and implementation of the Programs of Measures (PoM) (EC, 2008; EC-DG Environment, 2010).

Within MSFD rationale, the ecological and economic targets are not considered as mutually exclusive but rather as strongly complementary. Moreover, the socioeconomic dimension is evident through the entire directive and thus a comprehensive approach is essential for achieving the socioeconomic challenges of MSFD. In this sense, this analysis is seeking to entail the socioeconomic dimension during the evaluation of MSFD biodiversity descriptors/indicators developed for the Mediterranean Sea as a fundamental point of ActionMed project. Thus, in the next section, a general overview of the methods employed by each country, in order to conduct their socioeconomic Initial Assessments (IAs) is provided. Through the analysis the link between the IAs and the effective setting of environmental targets is highlighted. Furthermore, three Mediterranean countries, namely Greece, Cyprus and Malta are chosen as case studies, in order to illustrate how the socioeconomic analyses of IAs could be used as a valuable input for the setting of environmental targets. However, the results of these case studies will be presented in the final report of this Deliverable (D1.3). Based in these studies some recommendations towards a more effective integration of the environmental and socioeconomic issues under the global target of sustainability will also be presented in D1.3.

COMPARATIVE SOCIO-ECONOMIC ANALYSIS OF MSs INITIAL ASSESSMENTS

The progress of the Member States (MSs) in addressing the challenges within the MSFD implementation varies. As far as the initial assessment within Article 8 is concerned, all countries have finalized their socioeconomic reports. As it is clearly stated in the WG ESA guidance document (2010), the development of a comprehensive socioeconomic initial assessment is crucial for the successful implementation of MSFD in the MSs. A central aspect directly affecting the effectiveness of socioeconomic analyses is the degree through which each MS could link marine uses with pressures. For this purpose it is evident that WG ESA strongly supported a rationale of IAs in which the MS could be able to quantify the impacts of different sectors on the marine environment, while at the same time providing an

estimation of the costs imposed by the degradation of the environment on the sectors that are benefiting from the marine environment. This two-way analysis, which is presented graphically in Figure 2 is a prerequisite for the setting of robust environmental targets and, at the same time, is providing a documentation of the socioeconomic benefits that can be achieved through the maintenance of a Good Environmental Status.

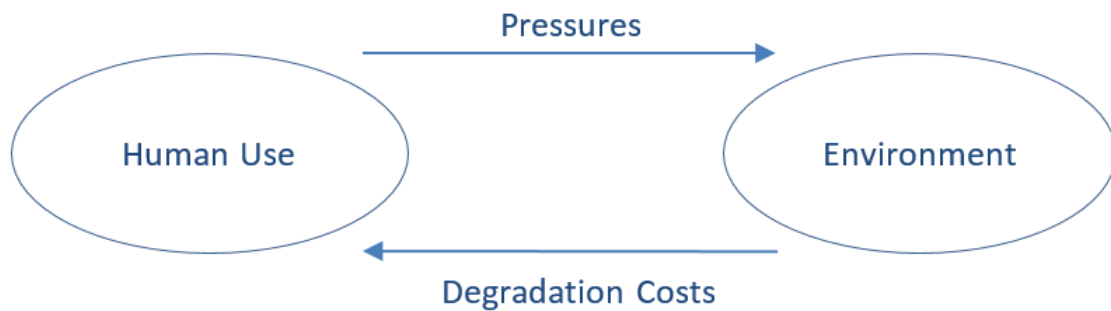


Figure 2: The Two Way Analysis Framework, Source: WG ESA, 2010, UTH elaboration

In order for this analysis to be feasible, WG ESA encouraged MSs to adopt an ecosystem based approach, while providing some alternative methods to be used by countries that face problems such as the lack of knowledge or data. Thus, despite the fact that nearly all MSs followed the methodological lines set by the WG ESA, several differences exist in terms of the methods employed by each MS while conducting their IAs. Table 52 summarises the main findings regarding the methods and data employed by each Mediterranean country, in order to complete their socioeconomic initial assessment.

Table 52: Key Characteristics of Socioeconomic Initial Assessments of Mediterranean Member States.

| | GR | HR | CY | SP | SI | MT | FR | IT |
|---|----|----|----|----|----|----|----|----|
| Number of Uses/ Activities | 5 | 8 | 6 | 7 | 4 | 13 | 18 | - |
| Overall Method | | | | | | | | |
| Ecosystem Services Approach | | | | | | | | |
| Marine Waters Accounts Approach | x | x | x | x | x | x | x | - |
| Degradation Costs Method | | | | | | | | |
| Ecosystem Services Approach | x | | x | | x | x | | |
| Thematic Approach | | | | | | | x | |
| Cost Based Approach | | x | | x | | x | | |
| Difficulties | | | | | | | | |
| Lack of Capacity/ Knowledge | x | - | x | | x | x | - | |
| Lack of Data | x | - | x | x | x | x | - | x |
| Problems in Allocating Value to Regional Seas | x | - | | x | | | - | x |

Source: WG ESA, no date; UNEP (DEPI)/MED, 2013; UTH and UOA elaboration

Initially, all Member States (except for Italy) provided data about economic activities. 20 different main marine activities were registered. France reported the highest number of activities (18), while Greece reported only five activities. In Figure 3 the frequency of uses' appearance within the IAs is recorded. As it can be seen from the chart, fisheries and aquaculture are the only uses reported in every of the IAs, while ports and shipping uses are following. The less reported use is this of mining/sand gravel, which is only reported in one IA.

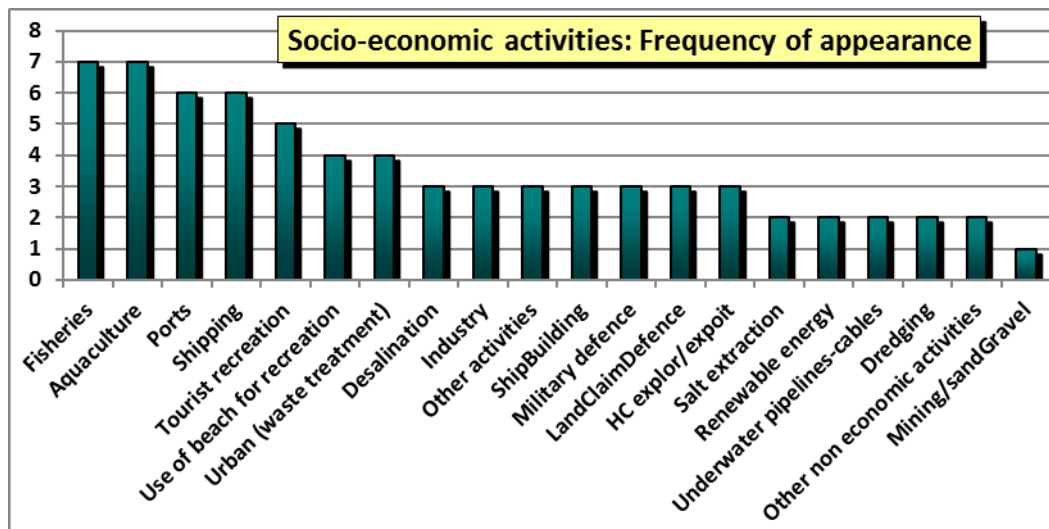


Figure 3: The Frequency of Appearance of Socioeconomic Activities in the Initial Assessments of Mediterranean Member States, Source: Mediterranean MSs National Reports and HTML files uploaded on EIONET CDR; UTH and UOA elaboration.

Regarding the basic method employed by the MS for setting up their socioeconomic IAs, the analysis revealed that all countries followed the second option proposed by the WG ESA, the Marine Waters Accounts Approach instead of the Ecosystem Based Approach, due to less data requirements. More specifically, the Ecosystem Based Approach calls for an estimation of the overall value of uses developed in the marine environment. This approach requires the full knowledge of marine uses developed in each country, including a series of computational estimations and assumptions, in order for the value of each use to be extracted. On the other hand, Marine Waters Accounts Approach is more simplistic as it focus only on uses with a direct socioeconomic value and the extraction of a value is based on data provided by statistical authorities and sectorial reports and surveys. Regardless of the method, all countries have managed to spot and provide a quantitative or qualitative description of the main socioeconomic uses evolving at their marine environment. The quantitative description of the uses was mainly based on socioeconomic figures such as employment, Gross Value Added and Gross Domestic Product share, while the outputs of the activities were expressed in quantities of production for each sector, at least for the majority of uses under IAs reports.

Regarding the method for estimating the degradation costs, the MSs followed the recommendations of WG ESA, still relying on different approaches. More precisely, Greece, Cyprus and Slovenia followed the ecosystem services approach, Croatia and Spain followed the cost based approach, France adopted a thematic approach and Malta used a hybrid method by combining both the ecosystem services approach and cost based approach. Finally, concerning the difficulties that the MSs encountered during the development of their IAs, it is becoming evident that the greatest issue was the lack of data. Additionally, Greece, Cyprus and Slovenia reported that a lack of capacity/knowledge in conducting similar analyses has been an obstacle for a more comprehensive approach, while in countries such as Spain, Italy and Greece a major issue turned up to be the difficulty in allocating the value of each use to a

regional/local scale, as the vast majority of the relevant data was available only at a national scale.

The foregoing analysis revealed that the Mediterranean countries have followed different paths in conducting their socioeconomic IAs. Although the IA is just a starting point towards the implementation of MSFD, its added value for the effective integration of MSFD general principles into national policies is significant, because specific aspects of MSFD, such as PoMs and Environmental targets, are directly or indirectly linked to the IA. Thus, a comprehensive IA could lead to a more effective MSFD adaptation at the national level.

CONCLUSION

Overall, the analysis conducted in the framework of subtask 1.1.1 showed that:

- GES determination among Mediterranean EU MSs varied considerably and often remained general despite application of the 2010/477/EU. Therefore, a consistent determination of GES, as required by the Directive, has not been achieved.
- Existing EU legislation and regional sea convention standards were not systematically integrated during the implementation of the Directive.
- The Commission Decision 2010/477/EC does not seem to have achieved to set the criteria and methodological standards in adequate detail for many descriptors as: D1, D2, D4, D6, D7, D10, D11. Certain criteria and indicators were not precise or detailed enough to be applied or were used by a limited number of MSs.
- The targets established by MSs differ considerably, quite often remaining too general.

It was attested that there are considerable gaps and needs;

GAPS

- Lack of methodological approach
- Lack of thresholds and baselines
- Lack of data or availability of fragmented data
- Lack of knowledge and/or full understanding of characteristics/compounds

NEEDS

- Need of regular and specific monitoring programs and impact assessment studies
 - Need of a regional approach in regards to monitoring
 - Need to determine common methodologies to empower comparability
 - Need to establish threshold values and determine baselines to enable consistency
 - Need of Initiatives at policy / legislation level to achieve or maintain GES.
 - Need to integrate EU legislation and Regional Agreements

- Need to collaborate in the framework of the Barcelona Convention
- Need to expand our knowledge about detected issues
- Need of research programmes

REVISION OF COMMISSION DECISION & ANNEX III of the MSFD

The revision of the Commission Decision and MSFD Annex III aims to clarify the Criteria for GES, methodological standards and specifications and standardised methods for monitoring and assessment. It allows also for making the relationship between Annex I and Annex III of the Directive more coherent by amending the latter.

| | Criteria | Indicators (primary + secondary) | Indicators (secondary) |
|---------------------------------|---|--|---|
| 2010 Decision | 29 | 56 | 3 (3.1.2, 3.2.2, 3.3.4) |
| 2014-15 technical review | Unchanged 16 Changed 10 Deleted 3 (criteria 1.4, 1.7, 4.2) Added 2: D1 species group diversity D3 size distribution - pressure Total = 28 | Unchanged 23 Changed 24 Deleted 9 (indicators 1.3.2, 1.5.2, 1.6.3, 1.7.1, 2.2.1, 3.3.2, 6.1.1, 9.1.2, 10.1.3) Added 13: For D1 species group diversity For D2.1 new introductions For D3.3 selectivity pattern (+3) For D3.3 size distribution - state For D3.3 genetic effects (+1) For D5.2 plankton shifts For D5.3 benthic invertebrates For D6.1 extent of pressure For D8.2 acute pollution impacts Total = 56 (+4) | 9 (3.1.2, 3.2.2, 5.1.2, 5.2.2, 5.2.3, 5.2.4, 5.2.5, 5.3.1, 5.3.3) |

REFERENCES

EC (2008) Directive 2008/56/EC of the European parliament and of the council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF>

European Commission (2010) DG Environment Scoping study on the requirements for economic assessment in the Marine Strategy Framework Directive - Final report, http://www.dredging.org/documents/ceda/downloads/2010-12-cowi_final_report_scoping_study_2010-esa-2011.pdf

[UNEP\(DEPI\)/MED \(2013\) STATE OF PLAY OF ECONOMIC AND SOCIAL ANALYSIS](http://planbleu.org/sites/default/files/upload/files/WG%20380.4_StateOfPlay_COR_E_SA.pdf)
http://planbleu.org/sites/default/files/upload/files/WG%20380.4_StateOfPlay_COR_E_SA.pdf

Working Group on Economic and Social Assessment (2010) ECONOMIC AND SOCIAL ANALYSIS FOR THE INITIAL ASSESSMENT FOR THE MARINE STRATEGY FRAMEWORK DIRECTIVE: A GUIDANCE DOCUMENT, http://www.dredging.org/documents/ceda/downloads/2010-12-final_report_wg_esa_guidance_document_no_1.pdf

Working Group on Economic and Social Assessment (no date) Evaluation of lessons learned from the socioeconomic analyses for the EU MSFD: What went well and what could be better?, <http://www.bsbd.org/UserFiles/File/Final%20version%20of%20Evaluation%20of%20lessons%20learned%20from%20the%20socioeconomic%20analyses%20for%20the%20EU%20MSFD.doc>

European Commission, 2010a. Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (notified under document C(2010) 5956)(2010/477/EU). Official Journal of the European Union L232: 12-24

European Commission, 2014a. Commission Staff Working Document. Annex Accompanying the document. Commission Report to the Council and the European Parliament. The first phase of implementation of the Marine Strategy Framework Directive (2008/56/EC) - The European Commission's assessment and guidance {COM(2014) 97 final}

European Commission, 2014b. Report from the Commission to the Council and the European Parliament. The first phase of implementation of the Marine Strategy Framework Directive (2008/56/EC). The European Commission's assessment and guidance. Brussels, 20.2.2014 COM(2014) 97 final

Article 12 Technical Assessment of the MSFD 2012 obligations, Spain, 7 February 2014.Contract No 070307/2012/634823/SER/D2 – Task F.

Article 12 Technical Assessment of the MSFD 2012 obligations, France, 7 February 2014.Contract No 070307/2012/634823/SER/D2 – Task F.



Article 12 Technical Assessment of the MSFD 2012 obligations, Italy, 7 February 2014. Contract No 070307/2012/634823/SER/D2 – Task F

Article 12 Technical Assessment of the MSFD 2012 obligations, Slovenia, 7 February 2014. Contract No 070307/2012/634823/SER/D2 – Task F.

Article 12 Technical Assessment of the MSFD 2012 obligations, Greece, 7 February 2014. Contract No 070307/2012/634823/SER/D2 – Task F.

Article 12 Technical Assessment of the MSFD 2012 obligations, Cyprus, 7 February 2014. Contract No 070307/2012/634823/SER/D2 – Task F.

Article 12 Technical Assessment of the MSFD 2012 obligations, Mediterranean, 7 February 2014. Contract No 070307/2012/634823/SER/D2 – Task F.

Palialexis A, Tornero V, Barbone E, Gonzalez D, Hanke G, Cardoso AC, Hoepffner N, Katsanevakis S, Somma F, Zampoukas N, 2014. In-depth assessment of the EU Member States' submissions for the Marine Framework Strategy Framework Directive under articles 8, 9 and 10 JRC Scientific and Technical Reports. Publications Office of the European Union. Available at: <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC88072/lbna26473enn.pdf>

UNEP/MAP, 2013. Draft decision on the Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and targets. UNEP (DEPI) / MED WG.387/CRP.1.Rev1, endorsed and agreed to be forwarded to COP18 by the UNEP MAP Focal Points at their Meeting in September 2013. Athens 2013.

Anagnopoulos N., Anastasakis G, Bourdaniotis N. , Dassenakis Em., Demetriou P., Karakassis I., Margaritis O., Meleas G., Moraitis Em., Paramana Th., Theodorou L., Tragou E., Tsikopoulou I., Vakkas Th., Zervakis V., 2012 TECHNICAL REPORT FOR THE PREPARATION STAGE OF ACTION PLAN FOR MARINE STRATEGIES IN GREECE, FOR THE IMPLEMENTATION OF MARINE STRATEGY FRAMEWORK DIRECTIVE 2008/56/EC, in the framework of the project 'Technical Advisor of the Special Secretariat for Water for the implementation of MSFD (2008/56/EC) (Ministry of Environment, Energy and Climate Change).

<http://cdr.eionet.europa.eu/>

**PART II: AN INTEGRATED BIODIVERSITY ASSESSMENT IN
THE MEDITERRANEAN: CASE STUDIES FOR ESTABLISHING
GES BASELINES, TARGETS AND PROPOSALS ON COMMON
SETS OF INDICATORS**

INTRODUCTION

Commission Decision Criteria and Indicators for Biodiversity Descriptors have a significant amount of overlap, therefore it is important to deal the three Biodiversity Descriptors together and develop targets and Indicators on the basis of the biological components.

An integrated assessment of biodiversity in coastal and open sea areas was conducted in 4 case studies across Greek waters (coastal to open) using a variety of benthic indices and tools in an effort to test, analyse and compare biodiversity indicators used by Member States in their Initial Assessments (IAs), their coherence with the common indicators in the context of UNEP/MAP-Barcelona Convention and in EU research projects. This work has been performed within the ActionMed framework (subtasks 1.1.2 and 1.2.1) dedicated to provide a catalogue of biodiversity indicators/indices, the scientific considerations and documentation for defining GES, and where possible, targets for the Mediterranean ecoregion, .

The case studies herein, developed within the framework of projects collaborating with ActionMed (namely PERSEUS and DEVOTES) were presented, further developed and discussed in the workshop “Identify gaps and settings targets for biodiversity indicators in the Mediterranean Sea” held in Athens from 22-24 February 2016. During this workshop some general conclusion have been drawn and presented in this Deliverable 1.1., but will be fully discussed and recommendations will be formulated within the frame of the final Deliverable D1.3

The case studies are:

1. Testing the relationship of benthic indices to stressors by using correlations and multivariate visualization tools – Saronikos Gulf (coastal study).
2. Testing the relationship of benthic indices to stressors by using Signal Detection Theory (SDT) and Gold Standard (GS) - Saronikos Gulf (coastal study).
3. Application of the NEAT high level integration biodiversity assessment tool - Saronikos Gulf (coastal study).
4. Applying benthic Indicators From the coast to the open sea (N. Aegean Open Sea Case study).

A. COASTAL CASE STUDIES

INTRODUCTION

The area for three out of the four cases studies presented herein is Saronikos Gulf. Saronikos Gulf (Eastern Mediterranean, Greece) is the natural marine gateway of the city of Athens and Piraeus harbour (Figure 4). It is divided into a deeper western sub-basin and an eastern part. The northern area of the eastern part is called the “Inner Gulf” and is relatively flat, with a mean depth of 90 m. The Inner Gulf can be further divided into a deeper western sector with homogeneous muddy sediments and an eastern sector with more heterogeneous sediments and averagely lower depths. The gulf receives the effluents of the central sewage outfall of Athens through a deep underwater outlet situated on Psittalia Island, in the inner part of Saronikos Gulf, discharging treated urban sewage through two 1870 m long submarine pipelines at a depth of approximately 65 m. The Waste Water Treatment Plant (WWTP) receives an average wastewater flow of approximately 730,000 m³ day⁻¹. It has been in operation since 1994, through a stage-wise construction that involved three phases: phase A (primary treatment) completed in 1994, phase B (advanced secondary biological treatment using activated sludge processes) completed in 2004 and phase C (tertiary treatment, comprising the sludge thermal drying unit) completed in 2007. Currently, wastewater treatment achieves suspended solids and organic load reduction of about 93% and total nitrogen reduction of about 80% in comparison with influent loads.

Other anthropogenic pressures over the study area include: industrial units (refinery, shipyard, other), ports, marinas, maritime transport, and fishing.

A core network of 10 stations located in Elefsis Bay and inner Saronikos Gulf are monitored regularly from 2000 (Simboura *et al.*, 2014) and these data have been used for benthic Indicators’ case studies, run also under PERSEUS FP7 and DEVOTES projects.

Good ecological status (GEcS-WFD) and Good Environmental status (GES-MSFD)

As recommended by EEA’s last report on state of European seas (EEA, 2015), a status classification that meets the directives’ objectives (regardless whether it is 'at GES' under the MSFD, or 'at FSC-favourable conservation status' under the HD, or 'at GEcS' under the WFD) is categorized as a 'pass'. Benthic habitats and communities are addressed under several Descriptors and Indicators for MSFD and WFD Directives and have been adopted as operational Indicators for the EcAP approach of UNEP. Benthic communities are used as Indicator element in several water policy aspects, specifically:

- Benthic macro-invertebrates (WFD biological quality element)
- Condition of the typical species and communities (MSFD - D1.6.1)
- Condition of benthic community (MSFD - D6.2)
- Condition of the habitat-defining species and communities (UNEP/EcAP Annex I 1.4.3.)

This 'pass' would mean a 'positive' contribution to ecosystem status and thus towards a 'good' potential for services' delivery. Thus, all biotic or multimetric/multivariate indices used for WFD can also be used for MSFD for relevant Descriptors/Indicators

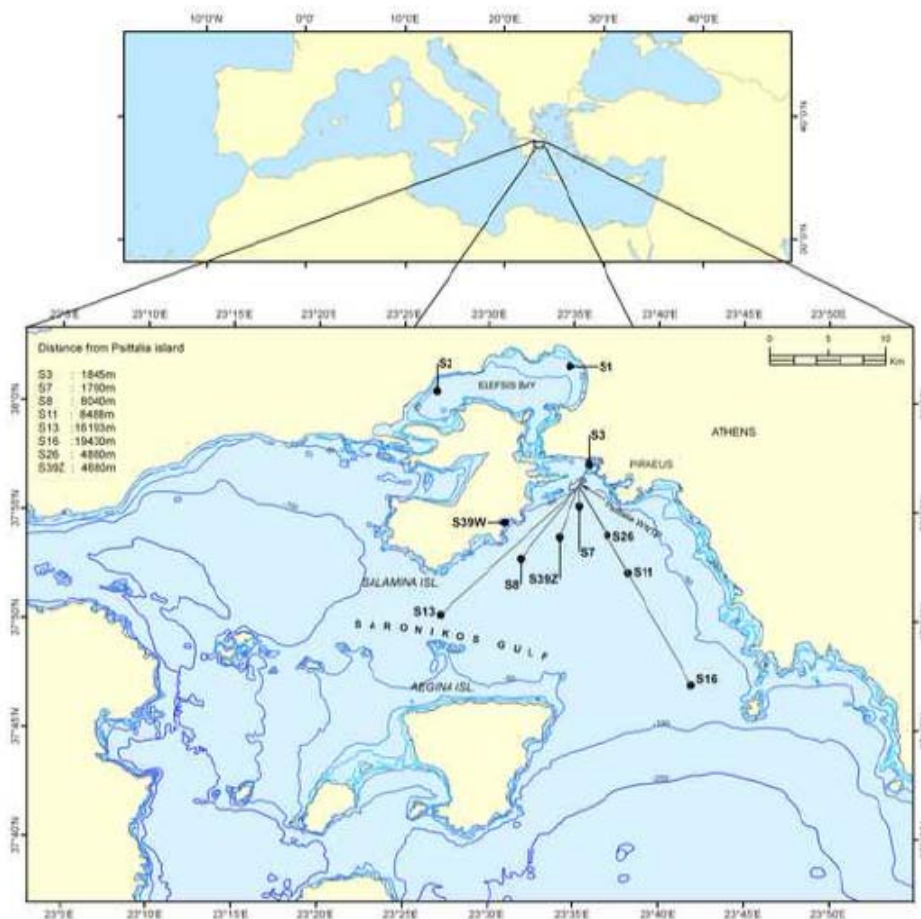


Figure 4: Saronikos gulf including treated stations (from Simboura *et al.*, 2014).

QUESTIONS posed

Following the outcomes from intercalibration of benthic indices under the WFD Common Implementation Strategy (CIS) and the WFD implementation experience, some key issues are raised:

PERFORMANCE OF INDICES: Why the performance of benthic indices is different among ecoregions?

INTEGRATION ISSUES: Is there a way to integrate approaches in a harmonized way?

RELATION TO STRESSORS-THRESHOLDS: How should benthic indices be related to stressors and their thresholds?

CONNECTION BETWEEN WFD & MSFD: Are all benthic indices developed under the WFD also valid for MSFD implementation in the respective elements?

In an attempt to answering those questions three coastal case studies, all from Saronikos Gulf were presented and included herein.

COASTAL CASE STUDY 1

Testing the relationship of benthic indices to stressors by using correlations and multivariate visualization tools – Saronikos Gulf

By: Simboura, N., S. Reizopoulou, K. Sigala, M.A. Pancucci, N. Streftaris, I. Hatzianestis, E. Kaberi, A. Karageorgis, M. Triantaphyllou, M. Dimiza

Introduction & Methodology

The following benthic indices were applied and the ecological quality status assessed was plotted in Figure 5:

- MULTIMETRIC BENTIX (Simboura *et al.*, 2015)
- BENTIX (Simboura and Zenetos, 2002)
- ISD (Index of Size distribution, Reizopoulou & Nikolaidou, 2007)
- FSI (Foram Stress Index, Dimiza *et al.*, 2016)

The multimetric BENTIX is an aggregation scheme proposed as an adaptation of a similar method applied across MSFD Descriptors in the Basque country (Borja *et al.*, 2011). The proposed scheme is a modular formula assigning weighting scores to each one of the components of a formula including: one “biotic” component, two “diversity” components and one “size” component. Each component in the formula is expressed by EQR or equivalence values weighted accordingly and the sum of all weighted values correspond to the final Environmental Status. The weighting scores were selected taking into account a) the conclusion that at least in the Mediterranean Sea the Shannon diversity shows a non-monotonic response to pressure gradients and that the biotic indices are more efficient to assess the EQS (Subida *et al.*, 2012a, b) the species richness is a highly variable Indicator and shows a weaker correlation with EQS than the Shannon index (Simboura *et al.*, 2012); c) the level of maturity of the size Indicators for status assessment of marine benthic communities.

The derived formula is as follows:

| |
|--|
| $\text{Bentix EQR} \times 0.6 + \text{Shannon EQR} \times 0.2 + \text{Species richness EQR} \times 0.1 + \text{Size component EQR} \times 0.1 = \text{ES}$ |
|--|

or

| |
|---|
| $\text{Bentix EQR} \times 0.6 + \text{Shannon EQR} \times 0.2 + \text{Species richness EQR} \times 0.2 = \text{ES}$ |
|---|

The final ES is expressed as an EQR value and classified according to a standard scale: 1-high; 0.8-good; 0.6-moderate; 0.4-poor; 0-bad.

Specifically for the indices used in this work:

$0,6 (\text{Bentix EQR}) + 0,2 (\text{Shannon EQR}) + 0,1 (\text{species richness EQR}) + 0,1 (\text{ISD index}) = \text{ES}$

or: $0,6 (\text{Bentix EQR}) + 0,2 (\text{Shannon EQR}) + 0,2 (\text{species richness EQR}) = \text{ES}$

Results

Figure 5 shows the resulting ecological status of Saronikos Gulf based on the four core benthic indices. The ecological quality benthic indices BENTIX, AMBI, M-AMBI, the size spectra ISD and the FSI foraminifera index all (except AMBI that showed only moderate and good classes) showed three classes of ecological quality ranging from: “poor”, mostly in Elefsis Bay stations, to “moderate” close to Psittalia island and the adjacent stations of the inner Saronikos gulf and good in the most distant stations from Psittalia. Among BENTIX, AMBI, M-AMBI applied in the whole network of stations, BENTIX assessed the highest percentage of moderate class (57%) followed by m-Ambi (35%) and Ambi (18%). All indices interrelate. Highest class agreement was between BENTIX-FSI and BENTIX-M-AMBI.

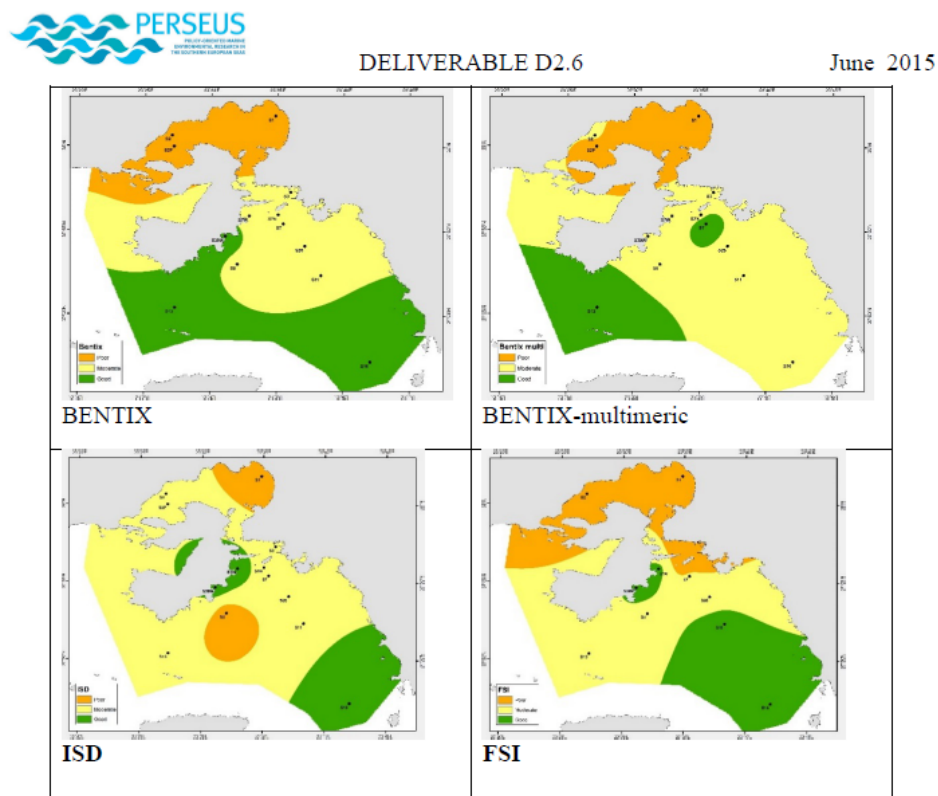


Fig. B.4.1.1. Assessment of ecological status of Saronikos gulf by four tested indices

Figure 5: Ecological status of Saronikos Gulf assessed by 4 different benthic indices (from the PERSEUS deliverable 2.6: “Response of benthic ecosystems under the influence of coastal pressures in different sub-regions of the South European Seas (SES)”; PERSEUS, 2015).

Biotic indices performance

Under PERSEUS subtask 2.3.2.b, was shown that the differential performance of each biotic index tested in Mediterranean and Black Sea areas was due to the structural differences demonstrated as differences in the patterns of ecological groups' percentages, along the gradient of pressure. The critical ecological group was shown to be the “tolerant” ecological group III for all areas. Thus, in Saronikos Gulf and other Eastern Mediterranean areas with high diversity and low species dominance, this group was related closely to the disturbed side of the gradient (Figure 6). In Black Sea areas tested under Perseus it is either fluctuating all along the gradient likes in Constanta coastal area or is highly dominant in the relatively undisturbed part of the gradient in Burgas Bay. The BENTIX index weights equally tolerant and opportunistic groups relating them more closely than the other indices and showed a high sensitivity in detecting disturbance in the Eastern Mediterranean basin, where it seems that the tolerant and opportunistic groups play an equally significant role in the response of benthic communities to stressors (Simboura & Argyrou, 2010).

Salinity is an important factor for macroinvertebrates, as it affects the distribution and dominance of tolerant species (Pearson and Rosenberg, 1978; Rosenberg *et al.*, 2004). In lower-salinity benthic environments with significant freshwater input, diversity is lower, and there exists a core of euryhaline-tolerant species, which may tolerate the natural stress of salinity variations. Thus, the succession model of ecological groups seems to be largely related to hydrological factors, such as freshwater inputs and salinity levels.

The high salinity Eastern Mediterranean coastal benthic communities are characterized by high natural diversity, an even distribution and low dominance of species and a close relationship among the tolerant and the opportunistic ecological groups, which, along with the dominance of either one or both of these groups, signifies a moderately polluted ecosystem.

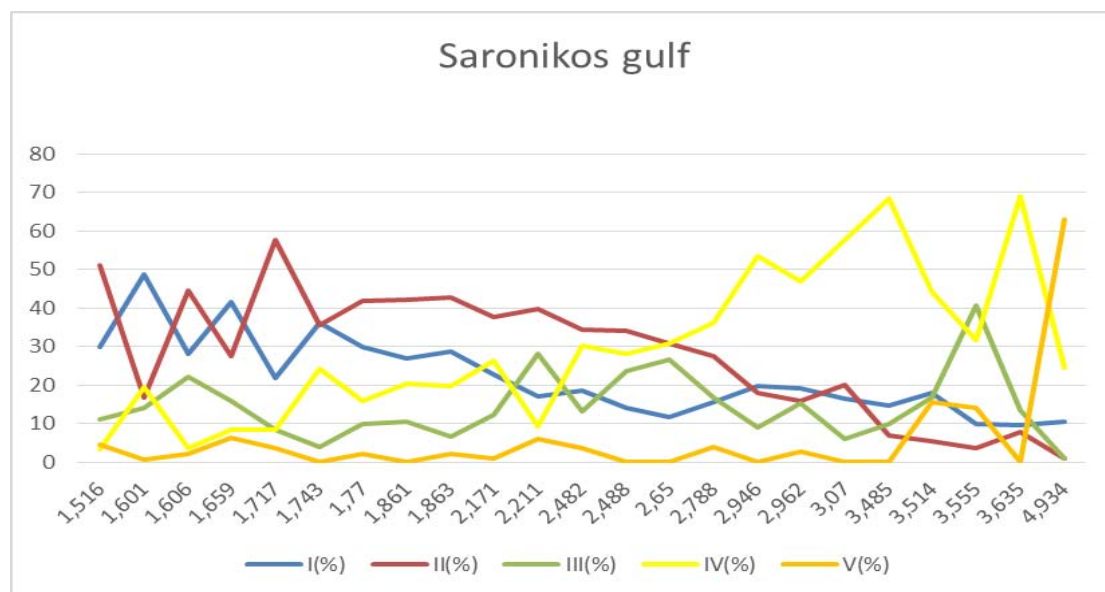


Figure 6: Ecological groups' percentages along the pressure gradients and AMBI values.

Since the structure and response of benthic communities is different across regions, the performance and suitability of the biotic indices would be different at each region/sub-region. Thus, a comparison among benthic indices was attempted by using Spearman correlations, gradients with contaminants, relevance to thresholds and classification results in relation to pressures. Figure 7 shows the performance of each benthic index in relation to sediment contaminants values and gradients, showing the highest relevance for BENTIX, an index fitted for oligotrophic Mediterranean waters.

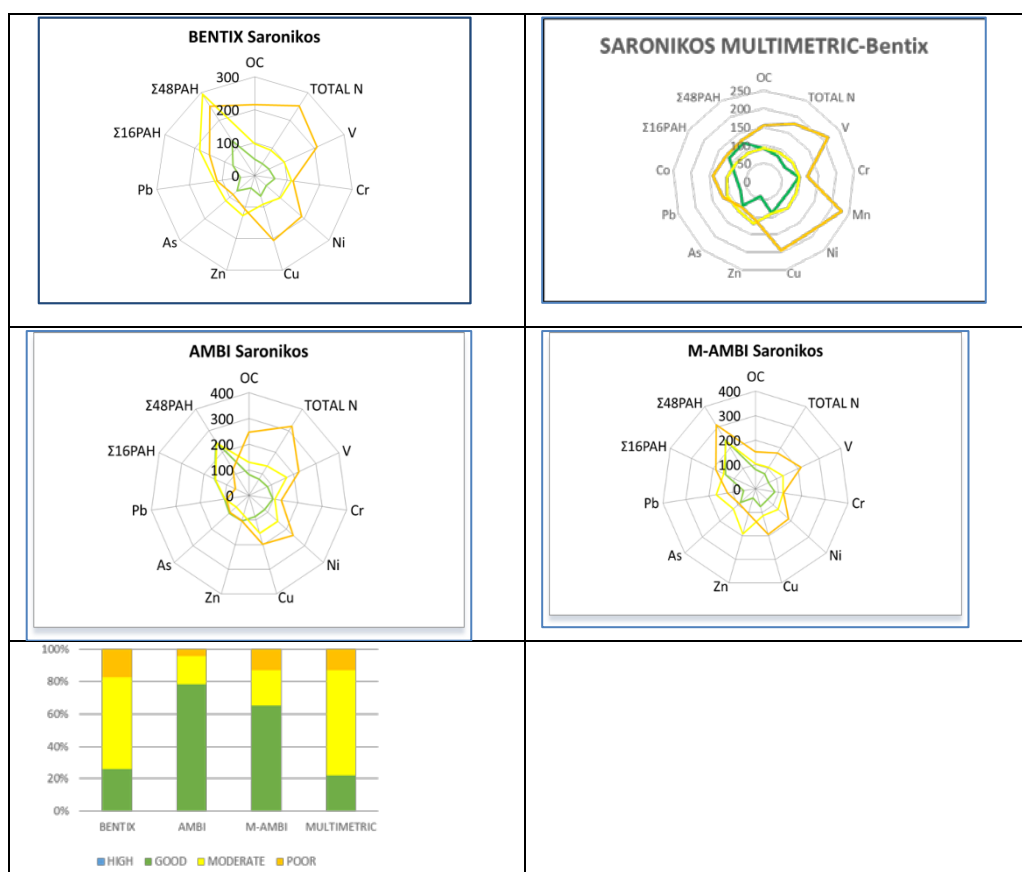


Figure 7: Visualization plots of indices classification in relation to contaminants and status assessment.

Main overall conclusions

- All biotic indices demonstrated gradients of good-moderate-poor and significant correlations with most trace metals (Cu, Ni, Cr, Mn, Zn, Pb), TOC and TN.
- BENTIX showed the stronger correlation (highest P-value) for TOC, and TN and also correlated with PAHs
- In BENTIX plot the respective line of Good is drawn at around 0.5% TOC, below the threshold of 1% for impacted and non-impacted sites (Hyland *et al.*, 2005) (AMBI and M-AMBI show good class at concentrations such as 1%).

- Among Biotic indices BENTIX is the more strongly correlated with abiotic factors and renders a classification assessment linked with “gold standard” TOC threshold.
- Multimetric BENTIX is an integrated metric using the most suitable biotic index for a given area, combined with structural diversity indices in a weighted formula.

COASTAL CASE STUDY 2

Testing the relationship of benthic indices to stressors by using Signal Detection Theory (SDT) and Gold Standard (GS) - Saronikos Gulf

By: Pantazi M., N. Simboura, C. Smith & N. Papadopoulou

Introduction & Methodology

The Signal Detection Theory (SDT) was developed to distinguish noise from true planes in radar equipment (World War II); however nowadays is widely used by environmental managers, dealing with ecological Indicators, in order to decide about a rational threshold guided by probabilities. Within the DEVOTES project, the SDT was implemented to calculate the accuracy (in terms of sensitivity and specificity) of specific benthic indices. Moreover, ROC curves (Receiver Operating Characteristic) were plotted and each area under the curve (AUC) was calculated, in order to assess the discriminating ability of each of the indices. The method is based on a surrogate (the most accurate available measurement of the real condition), called Gold Standard, according to which, samples are classified as impacted and non-impacted. Four benthic indices: BENTIX & multimetric BENTIX, AMBI, M-AMBI were tested in Saronikos gulf using as gold standard TOC values for Impacted: TOC>0.7% and for Non-impacted: TOC<0.7%.

The calculated parameters were the following:

- Accuracy: percentage of samples correctly classified by the Indicator
- Prevalence: proportion of impacted samples to total samples
- Sensitivity: probability of classifying an impacted sample as such
- Specificity: probability of classifying a non-impacted sample as such
- Positive Predictive Value (PPV): probability of having an impacted sample when such is said by the Indicator
- Negative Predictive Value (NPV): probability of having a non-impacted sample when such is said by the Indicator

Results

Figure 8 and Figure 9 show the results of the SDT application for the four tested indices in Saronikos gulf.

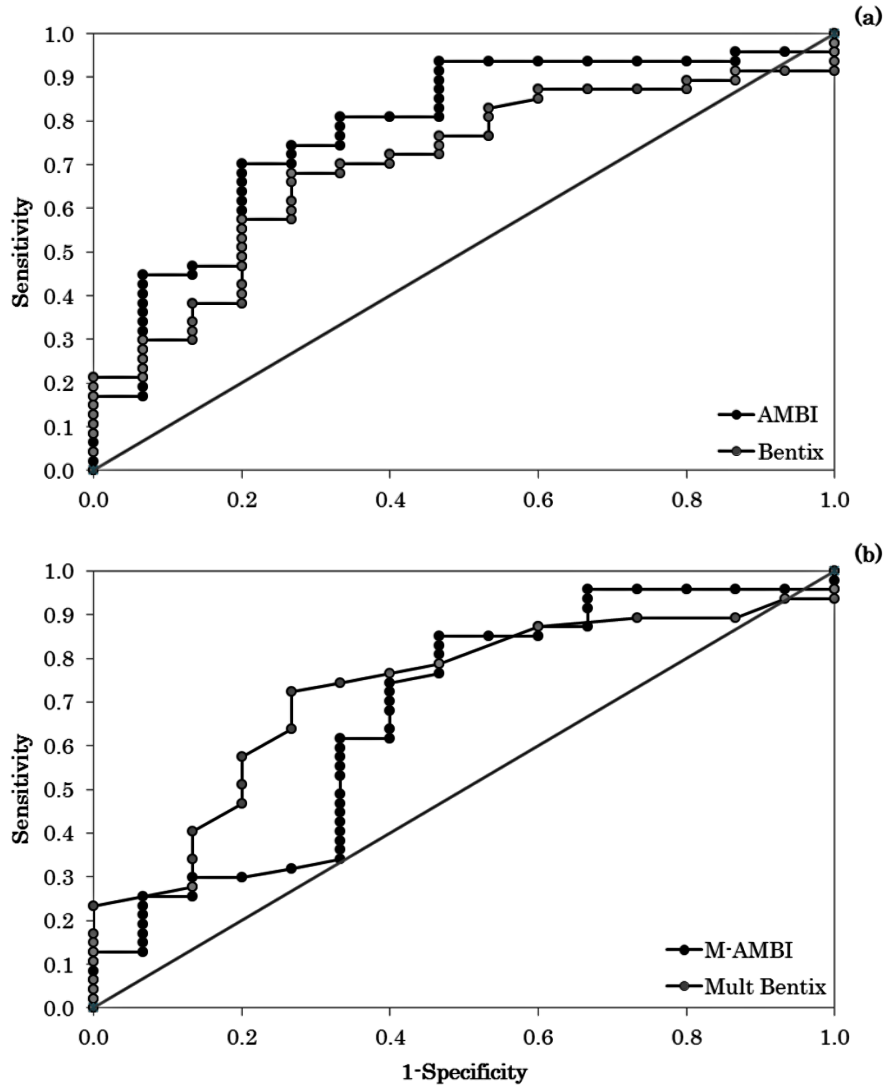


Figure 8: Receiver operating characteristic (ROC) curves for AMBI, BENTIX, M-AMBI Multimetric BENTIX in Saronikos Gulf.

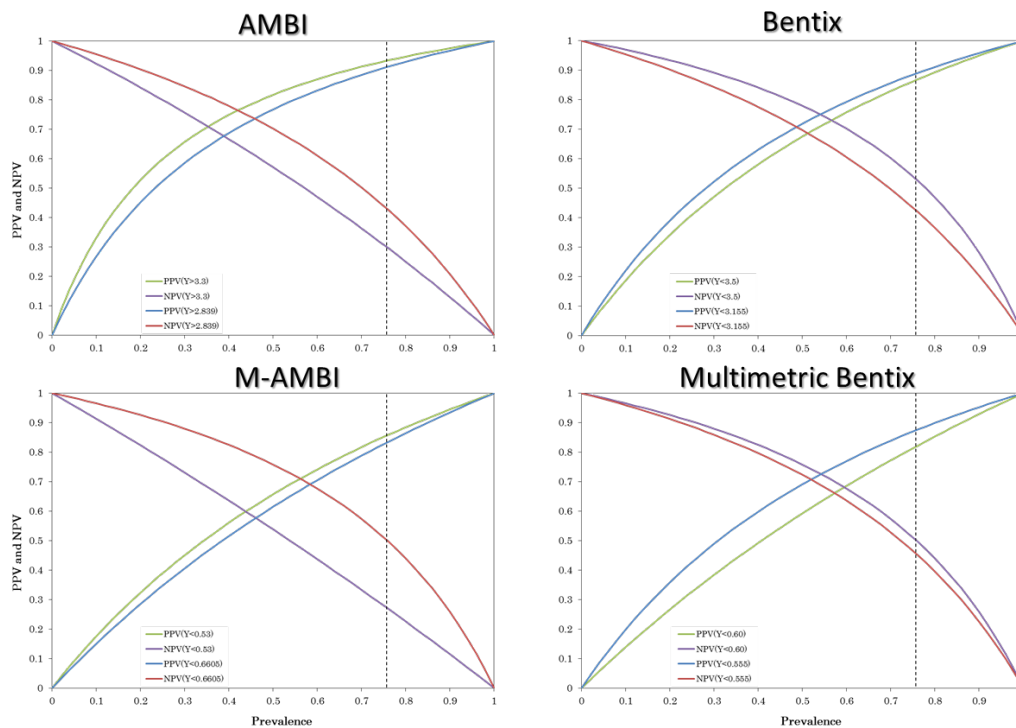


Figure 9: Positive Predictive Value and Negative Predictive Value curves for AMBI, BENTIX, M-MAMBI and Multimetric BENTIX for Saronikos gulf.

- For Saronikos Gulf, ROC curves show that the association between the four studied indices and the environmental quality, assessed by the gold standard, is relatively strong and statistically significant ($p < 0.05$).
- In Saronikos Gulf, the prevalence of impacted samples is 0.758, which means that from the 62 stations 47 are considered impacted based on the gold standard.
- In these conditions, for the boundaries suggested from legislation and publications, the accuracy of AMBI and M-AMBI is 45% and 40% accordingly (due to their low sensitivity: impacted stations were classified as non-impacted), whereas the accuracy of BENTIX and Multimetric BENTIX is 77% and 76% respectively.
- In Saronikos gulf, PPV and NPV curves show that the performance of AMBI and M-AMBI is much better when using the best boundaries (those which maximize the sum of sensitivity and specificity) rather than using the original boundaries (from publications and legislation). More specifically, their sensitivity (NPV curves) improved in high prevalence conditions. For BENTIX and Multimetric BENTIX the best boundaries are quite close to the original ones (BENTIX: 3.155 instead of 3.5 and Multimetric BENTIX: 0.555 instead of 0.6).

General outcomes

Best boundaries (those maximizing sensitivity+specificity) improved the average performance of the indices for the full gradient of prevalence. However, it should be taken into account that the performance of the indices is sensitive to:

- Setting of gold standards
- prevalence
- Biogeographic area

COASTAL CASE STUDY 3

Application of the NEAT high level integration biodiversity assessment tool - Saronikos Gulf

By: Pantazi M., N. Simboura, A. Pavlidou, P. Panayiotidis, G. Assimakopoulou, N. Papadopoulou, C. Smith & C. Vassilopoulou

Introduction & Methodology

Within DEVOTES project a high level integration tool was applied for the Saronikos gulf case study: the NEAT biodiversity assessment tool.

The main/key habitats of the study area were taken into consideration. The Indicators used for the analysis were well developed and widely implemented with already established boundaries. These Indicators were:

- MULTIMETRIC BENTIX (Simboura *et al.*, 2015)
- BENTIX (Simboura and Zenetos, 2002)
- Shannon's diversity index H
- Total number of species in the community (richness) S
- EEI (Orfanidis *et al.*, 2001)
- Physicochemical Status: FA (Bald *et al.*, 2005)
- Eutrophication index: EI (Primpas *et al.*, 2010)

The Indicators were selected, based on data availability and Indicators used in previous assessments for the WFD and MSFD policy projects (PERSEUS FP7), in order to compare results with DEVOTES approaches.

The Indicators used in this assessment, do not represent the overall biodiversity components of the area, however they constitute well monitored metrics (9 year monitoring during 2000-2012) and constitute key/solid Indicators for the under study area. The boundaries and thresholds for benthic Indicators used are shown below (Figure 10) for the different ecotypes, set as: ecotype A=coastal muds, ecotype B=coastal mixed, ecotype C=deep muds, ecotype D= deep mixed.

| | INDEX | Unit | Parameter |
|-------------|------------|------|---------------|
| | H | BITS | Benthic fauna |
| | BOUNDARIES | H | HEQR |
| ECOTYPE B | Bad | 0 | 0 |
| | Bad/poor | 1,2 | 0,20 |
| | Poor/Mod | 2,4 | 0,40 |
| | Mod/Good | 3,6 | 0,60 |
| | Good/High | 4,8 | 0,80 |
| | High | 6 | 1,00 |
| ECOTYPE A,C | BOUNDARIES | H | HEQR |
| | Bad | 0 | 0 |
| | Bad/poor | 1 | 0,20 |
| | Poor/Mod | 2 | 0,40 |
| | Mod/Good | 3 | 0,60 |
| | Good/High | 4 | 0,80 |
| | High | 5 | 1,00 |
| ECOTYPE D | BOUNDARIES | H | HEQR |
| | Bad | 0 | 0 |
| | Bad/poor | 1,2 | 0,20 |
| | Poor/Mod | 2,4 | 0,40 |
| | Mod/Good | 3,6 | 0,60 |
| | Good/High | 4,8 | 0,80 |
| | High | 6 | 1,00 |

| | INDEX | Unit | Parameter |
|-------------|------------|--|---------------|
| | S | number of species per standard sampling unit | Benthic fauna |
| | BOUNDARIES | S | S EQR |
| ECOTYPE B | Bad | 0 | 0 |
| | Bad/poor | 16 | 0,20 |
| | Poor/Mod | 32 | 0,40 |
| | Mod/Good | 48 | 0,60 |
| | Good/High | 64 | 0,80 |
| | High | 80 | 1,00 |
| ECOTYPE A,C | BOUNDARIES | S | S EQR |
| | Bad | 0 | 0 |
| | Bad/poor | 8 | 0,20 |
| | Poor/Mod | 16 | 0,40 |
| | Mod/Good | 24 | 0,60 |
| | Good/High | 32 | 0,80 |
| | High | 40 | 1,00 |
| ECOTYPE D | BOUNDARIES | S | S EQR |
| | Bad | 0 | 0 |
| | Bad/poor | 12 | 0,20 |
| | Poor/Mod | 24 | 0,40 |
| | Mod/Good | 36 | 0,60 |
| | Good/High | 48 | 0,80 |
| | High | 60 | 1,00 |

| BOUNDARIES | BENTIX | BENTIX EQR |
|------------|--------|------------|
| Bad | 0 | 0 |
| Bad/poor | 2 | 0,33 |
| Poor/Mod | 2,5 | 0,42 |
| Mod/Good | 3,5 | 0,58 |
| Good/High | 4,5 | 0,75 |
| High | 6 | 1,00 |

| BOUNDARIES | BENTIX MULTIMETRIC |
|------------|--------------------|
| Bad | 0 |
| Bad/poor | 0,2 |
| Poor/Mod | 0,4 |
| Mod/Good | 0,6 |
| Good/High | 0,8 |
| High | 1 |

Figure 10: Benthic Indicators boundaries and thresholds used in the NEAT tool.

Results

Based on the assessment results, the status of the Inner part of Saronikos Gulf was ranked as Moderate (0,5716), whereas the status of the Psittalia island water body as Poor (0,3071). Concerning the habitats' status in the overall case study, both Pelagic and Benthic were ranked as Moderate (0,5292 and 0,5361 accordingly). Likewise, Benthic fauna and Benthic vegetation components' status were also ranked as Moderate (0,5553 and 0,4884 respectively).

The assessment results correspond to the experts' opinion of the biodiversity in the study area. The results also correspond to the ecological quality assessment derived from the implementation of WFD monitoring in Hellenic coastal waters for the Inner Saronikos Gulf, as well as the environmental condition based on sea floor integrity and benthic communities' condition assessed in the framework of Perseus FP7 project.

A difference in the overall status of the Psittalia island water body assessed as in moderate status from 2012 onwards, is attributed to the efficiency of management measures (treatment plant advances), as described in Simboura *et al.*, 2014.

B. OPEN SEA CASE STUDY

CASE STUDY 4

Applying benthic Indicators From the coast to the open sea - N. Aegean

By : Simboura N., S. Reizopoulou, N. Streftaris, K. Sigala, N. Katsiaras, G. Arvanitakis

Introduction & Methodology

A case study area located in the Northern Aegean Sea, off Limnos Island (Figure 11) was selected, in order to apply benthic Indicators used also in coastal areas and test their performance in open sea areas.



Figure 11: Benthos stations in the North Aegean experiment.

The depth and substrate characteristics are shown below (Table 53).

Table 53: Depth and substrate characteristics of the study area

| | stations | Depth m | Ntotal % | Corg% | biological zone | mud % | substrate description |
|------------|----------|---------|----------|-------|-----------------|-------|---|
| 15 samples | PNA2 | 77 | 0,04 | 0,39 | upper circa | 33,81 | muddy sand with biogenic detritus |
| | PNA8 | 325 | 0,12 | 1,00 | bathyal | 98,59 | mud with biogenic detritus |
| | PNA10 | 1585 | 0,14 | 1,32 | bathyal | 98,51 | mud with phytal (<i>Posidonia</i>) detritus |
| | PNA14 | 220 | 0,08 | 0,71 | deep circa | 82,60 | mud with biogenic detritus |
| | PNA16 | 66 | 0,03 | 0,32 | upper circa | 22,47 | muddy sand with biogenic detritus |

The Indicators tested and their relevance to MSFD Indicators are:

- BENTIX (Simboura & Zenetos, 2002) (6.2.1, 6.2.2., 1.6.1)
- ISD (Reizopoulou & Nikolaidou, 2008) (6.2.3., 6.2.4, 16.2)
- Shannon Diversity H' (6.2.2)
- Species Richness S (6.2.2.)
- Multimetric (Simboura *et al.*, 2013, 2014 a,b) (6.2.1.,6.2.2,1.6.1,1.6.2.,6.2.3,6.2.4)
- AMBI (Borja *et al.*, 2000), M-AMBI (Muxica *et al.*, 2007)

Results

Results of the indices application and status assessment are shown below (Table 54).

Table 54: Results of the indices application and status assessment.

| | S/0,1m ² | N/m ² | J | H | BENTIX | EcoQ BENTIX | AMBI | EcoQ AMBI | M-AMBI | EcoQ M-AMBI | ISD | ISD EQR | EcoQ ISD | Integrated Environmental Status (ES) | |
|-------|---------------------|------------------|------|------|--------|-------------|-------|-----------|--------|-------------|------|---------|----------|--------------------------------------|---|
| PNA2 | 28 | 67 | 0,90 | 4,30 | 3,13 | M | 2,540 | G | 0,66 | G | 2,57 | 0,29 | M | 0,51 | M |
| PNA8 | 12 | 23 | 0,91 | 3,21 | 3,12 | G | 2,228 | G | 0,77 | G | 1,60 | 0,48 | G | 0,55 | G |
| PNA10 | 21 | 74 | 0,74 | 3,22 | 3,12 | G | 2,595 | G | 0,76 | G | 2,07 | 0,39 | G/M | 0,57 | G |
| PNA14 | 13 | 21 | 0,93 | 3,36 | 3,27 | G | 2,707 | G | 0,67 | G | - | - | - | 0,53 | G |
| PNA16 | 49 | 106 | 0,90 | 5,01 | 3,62 | G | 1,958 | G | 0,85 | G | 1,59 | 0,48 | G | 0,63 | G |

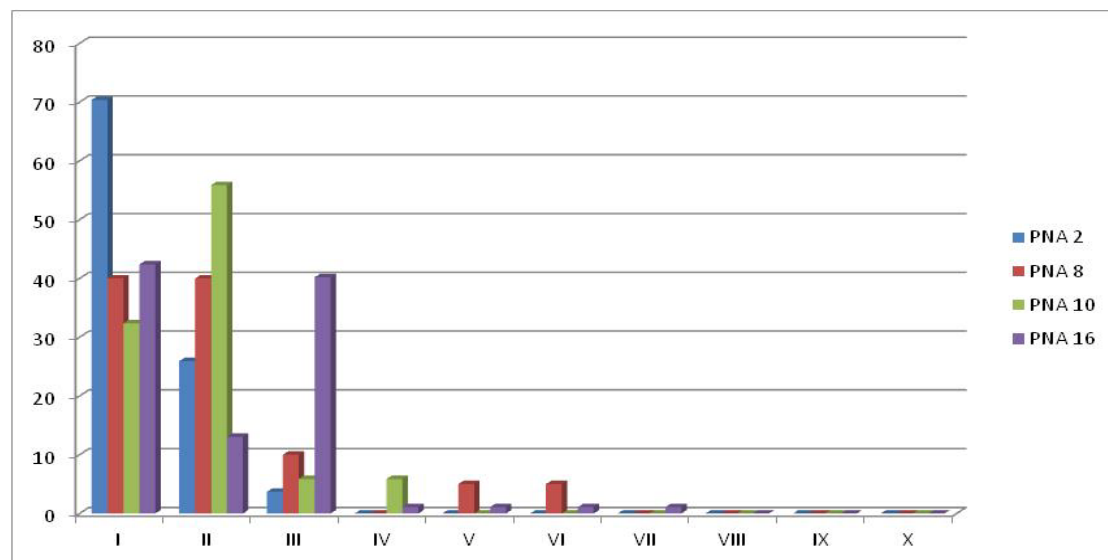


Figure 12: The frequency distribution of geometric size (biomass) classes in stations sampled.

Figure 12 shows the frequency distribution of geometric size (biomass) classes in stations sampled.

BENTIX correlated significantly with sediment organic carbon and nitrogen content in sediment. Highest OC, TN values were found at station PNA10 (1.32%), indicated also by ISD, as in marginally moderate status, as shown also in the frequency distribution of size classes.

It is noted that for the translation of the Ecological quality ratio scale of the final integrated status, the standard scales suggested by Borja *et al.*, 2011 (0.8, 0.6, 0.4, 0.2, 0) and adopted in Simboura *et al.* (2014) was used for PNA2 and PNA16 belonging to ecotype B (coastal, mixed sediments).

For the other stations belonging to ecotype C (PNA14) and the bathyal zone (PNA10, 16), due to the specific substrate of especially muddy sediments, which is a naturally stressed biotope, the scale used for assessing the environmental status was not the standard, but the one derived from the European intercalibration exercise (Borja *et al.*, 2007): 0.77, 0.53, 0.38, 0.20, 0.

The integration scheme classified only station PNA2 at moderate status or non GES and all the rest including the bathyal stations PNA10 at good status. The moderate status at station PNA2 may be is due to disturbance from bottom trawling, as the number of species is low for that type of sediment. In the case of station PNA10 it was demonstrated by ISD index to present an uneven distribution and was thus classified by this index in the border of good to moderate. This situation is also reflected in the maximum organic carbon and nitrogen content (Table 53) of the sediment at that station and is attributed to the accumulation of drifted phytal detritus on the spot. Bathymetric gradients are associated with increasing pressure and decreasing food availability in the deeper sediments, and thus benthic populations develop adaptive mechanisms to extreme conditions. Adaptations may occur at physiological and structural organization levels, thus further investigation is needed in order to incorporate the effect of natural variability in functional indices based on body-size spectra such as ISD.

The ISD index is not strongly affected by natural stress, as seen by the fact that it renders good status in most naturally stressed sites and only in excessive stress (deepest bathyal station) it is assessing borderline moderate status. That means that the index incorporates the natural stress. Indeed, it is an index developed and applied in transitional water systems, where a strong natural stress is prevailing. In these systems the strong natural (temporal and spatial) variability often overlaps anthropogenic disturbance and indices are expected to demonstrate human disturbance and not natural stress. A slight modification (reduction) of its good to moderate boundary could also incorporate extreme cases of natural stress. On the other hand, biotic index BENTIX is affected by natural stress and gets lower values than the typical border between good and moderate classes, normally classifying naturally stressed stations in moderate status. To accommodate these cases of natural stress, the method is providing a modified adapted boundary (3 instead of 3.5). Regarding the other biotic index AMBI and its multivariate M-AMBI they also (like ISD) do not seem to be strongly affected by natural stress, not changing status in naturally stressed stations. However, they don't seem in this case to be affected neither by

anthropogenic disturbance, since in the case of station PNA2 they do not differentiate the status to moderate like the BENTIX and ISD.

The Benthic indices used in the N. Aegean experiment:

- reflected in an efficient way:
 - ✓ the anthropogenic stress (PNA2 station)
 - ✓ benthic hot spot area-natural accumulation of organic matter (PNA 10 station)
- Results showed that the indices performed sufficiently in both water categories (coastal and open sea), with the condition that suitable reference values and interpretation scales are used.
- Due to the extreme oligotrophy of the deep Aegean environment, the use of a natural stressed areas' scale is suggested for the interpretation of the status by biotic and multimetric benthic indices, in the bathyal.

GENERAL CONCLUSIONS FROM ALL CASE STUDIES

- The performance of the different biotic indices is due to differences in the structure of the benthic communities across ecoregions being related to ecological group percentages' composition, diversity levels and dominance of specific species. These in turn, are assumed to be related to salinity differences.
- Optimal indices for each region-subregion are those designed on the basis of the benthic communities' model of evolution across pressures gradient.
- Integration methods are possible either on the level of metrics (between Indicators) or on the level of Indicators (across Indicators). Examples are multimetric BENTIX and the NEAT biodiversity assessment tool.
- Benthic indices should be related or optimized using abiotic thresholds as for example the Gold standard (TOC) used in the SDT and probability statistics. Other methods of association between benthic indices and abiotic stressors and their thresholds are graphical (visualization) or statistical tools.
- Natural stress is reflected also to benthic indices, although size distribution indices incorporate natural stress.
- Benthic indices developed under the WFD can be used also for the assessment of open seas benthic communities (MSFD), in some cases by using specific reference values and boundaries (ex. multimetric).

REFERENCES

Bald, J., Borja, A., Muxika, I., Franco, J., Valencia, V., 2005. Assessing reference conditions and physico-chemical status according to the European Water Framework Directive: a case-study from the Basque Country (Northern Spain). *Mar. Pollut. Bull.*, 50 (12),1508-1522.

Borja, A., J. Franco and V. Pérez. 2000. Marine Biotic Index to establish the ecological quality of soft bottom benthos within European estuarine and coastal environments. *Mar. Poll. Bull.*, 40 (12): 1100-1114.

Borja, A., & B.G. Tunberg, 2011. Assessing benthic health in stressed subtropical estuaries, eastern Florida, USA using AMBI and M-AMBI. *Ecological Indicators*, 11: 295-303.

Borja, A., I. Galparsoro, X. Irigoien, A. Iriondo, I. Menchaca, I. Muxika, M. Pascual, I. Quincoces, M. Revilla, J. German Rodriguez, M. Santurtun, O. Solaun, A. Uriarte, V. Valencia and I. Zorita (2011). Implementation of the European Marine Strategy Framework Directive: a methodological approach for the assessment of environmental status, from the Basque Country (Bay of Biscay). *Mar. Poll. Bulletin*, 62: 889-904.

EEA 2015. State of Europe's Seas. European Environmental Agency, *EEA Report No 2/2015*

Muxika I., Borja A., Bald J., 2007. Using historical data, expert judgement and multivariate analysis in assessing reference conditions and benthic ecological status, according to the European water framework Directive. *Mar. Poll. Bull.*, 55: 16-29.

Orfanidis, S., Panayotidis, P., Stamatis, N., 2001. Ecological evaluation of transitional and coastal waters: a marine benthic macrophytes model. *Mediterranean Marine Science*, 2(2), 46-65.

Pearson, T., Rosenberg, R., 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. *Oceanography and Marine Biology Annual Review* 16, 229–311.

Primpas, I., Tsirtsis, G., Karydis, M., Kokkoris, G.D., 2010. Principal component analysis: Development of a multivariate index for assessing eutrophication according to the European water framework directive. *Ecological Indicators*, 10, 178-183.

Rosenberg, R., Blomqvist, M., Nilsson, H.C., Dimming, A., 2004. Marine quality assessment by use of a benthic species-abundance distributions: a proposed new protocol within the European Union Water Framework Directive. *Mar. Poll. Bull.*, 49 (9-10), 728-739.

Simboura, N. & Argyrou, M. 2010. An insight into the function of benthic classification indices tested in Eastern Mediterranean coastal waters. *Mar. Poll. Bull.*, 60(5): 701-709.



Simboura, N., Zenetos, A., Pancucci-Papadopoulou, M.A., Reizopoulou, S., Streftaris, N., (2012). Hellenic Seas Indicators for Sea-floor integrity under the European Marine Strategy Framework Directive: setting the thresholds and standards for Good Environmental Status. *Mediterranean Marine Science*, 13(1), 140-152.

Simboura, N., S. Reizopoulou, M.A. Pancucci-Papadopoulou, K. Sigala, N. Streftaris. 2014. Schemes of integrating the Indicators of the benthic community condition (Sea floor integrity-MSFD): an application in Saronikos Gulf. Perseus 2nd Scientific Workshop oral presentation, Athens, Greece, 29-30 Jan. 2014. Book of Abstracts p.24

Simboura, N., Oros, A., Dumitrache, C., Karamfilov, V., Filimon, A., Klayn, S. Response of benthic communities to human pressures: an integrative assessment. Scientific Conference “Integrated Marine Research in the Mediterranean and the Black Sea” Perseus FP7, Conference Proceedings, E. Papathanassiou, N. Streftaris & L. Giannoudi (Eds). Brussels, 7-9 December, 2015.

Simboura, N., M. Tsapakis, A. Pavlidou, G. Assimakopoulou, K. Pagou, H. Kontoyiannis, Ch. Zeri, E. Krasakopoulou, E. Rousselaki, N. Katsiaras, S. Diliberto, M. Naletaki, K. Tsiamis, V. Gerakaris, P. Drakopoulou, P. Panayotidis. 2015. Assessment of the environmental status in Hellenic coastal waters (Eastern Mediterranean): from the Water Framework Directive to the Marine Strategy Water Framework Directive. *Mediterranean Marine Science*, 16/1: 46-64.

Dimiza, M. Triantaphyllou M., Koukousioura O., Hallock, P., Simboura N., 2014. Assessing the Coastal Ecosystem Quality Using Benthic Foraminifera Assemblages: The ForumStress Index. Perseus Scientific Workshop oral presentation, 29-30 Jan. 2014. Book of Abstracts p.80.

DEVOTES FP7. Reporting template for the DEVOTES biodiversity assessment case studies HCMR Case Study, 2015: Saronikos Gulf (Inner Saronikos Gulf): Maria Pantazi, Nomiki Simboura, Panos Panayiotidis, Alexandra Pavlidou, Georgia Assimakopoulou, Nadia Papadopoulou, Chris Smith & Celia Vassilopoulou. DEVOTES project.

PERSEUS FP7. Oros, A., & N. Simboura 2015. DELIVERABLE 2.6: “Response of benthic ecosystems under the influence of coastal pressures in different sub-regions of the South European Seas (SES)”. Sub-task 2.3.2.b: “Impact of the coastal development and urbanization on shallow water habitats”, Perseus FP7 EU project.

Simboura, N., S.Reizopoulou, N.Streftaris, K.Sigala, E.Voutsinas, 2015. The Benthic communities in the AEGEX experiments (North and South Aegean). 2nd Scientific Workshop Marrakesh, 2-4 December, 2015. Perseus FP7 EU project.

