



Deliverable D2.2

**“MSFD MONITORING PROGRAMS IN THE
MEDITERRANEAN”**

**REPORT ON ANALYSIS OF GAPS AND EVALUATION OF THEIR
COHERENCE AT REGIONAL LEVEL**

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

ActionMed

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EXECUTIVE SUMMARY

In order to contribute the convergence of national MSFD monitoring programs, DG ENV launched in November 2014 the project call “Best practices for action plans to develop integrated, regional monitoring programs, coordinated programs of measures and addressing data and knowledge gaps in coastal and marine waters”.

Considering this context, the strategic objective of one of the core activities carried out within the ActionMed project, one of the projects awarded under the aforementioned call, focusing on Mediterranean region, was to set the basis for a coherent design of future MSFD related monitoring programs, and facilitating their coordinated implementation during the ongoing MSFD cycle in this area.

The immediate objective was to provide the administrations in charge of MSFD implementation in the Mediterranean with information useful for revising, whenever necessary, the initial MSFD monitoring programs proposals in order to:

- ensure their regional coherence;
- guarantee their adequacy for GES evaluation, focusing on biodiversity descriptions at lower cost;
- achieve their maximum integration with EcAp monitoring plans.

The first step to achieve these objectives was to compile the relevant information on MSFD national monitoring plans from the files available from EIONET and include them in a relational data base, and then use this data base (DB) to:

- Detect remaining monitoring gaps, both regarding spatial and temporal coverage by descriptor;
- Carry out a coherence analysis, determining the similarities and dissimilarities in sampling strategies and methodologies, as well among the indicators applied;
- Evaluate the adequacy and sufficiency of such monitoring plans to MSFD sampling requirements.

This report summarizes the results of these tasks and the main conclusions and recommendations are:

The first general conclusion is that in spite that he analyzed national monitoring plans show a general resemblance, as expected since all of them have been elaborated taking into account or inspired by the same principles stated in the MSFD and subsequent guidance documents, there have not been in practice any international close coordination in the last phase of elaboration of the MSFD monitoring plans in the Mediterranean region, thus resulting in a high degree of heterogeneity in their structure and other formal aspects.

Regarding the contents of the MSFD monitoring plans reported by the Mediterranean MSs, the first conclusion it that there are also important differences among countries regarding the degree of coverage of criteria, the main gaps being those affecting Descriptor 4 on food webs and Descriptor 11 on marine noise.

However, at indicators level the main gaps affect D1 on biodiversity and D6 on seabed integrity, since several of the proposed indicators for these descriptors are covered by less than half of Mediterranean countries. **To overcome this heterogeneity a common list of elements to be monitored and the correspondent indicators should be agreed at regional level, to ensure the feasibility of a global GES assessment.** This action should take advantage of the already existing monitoring programs implemented in the region, as those related to Water Framework Directive, Common Fisheries Policy and MEDPOL program, whose associated indicators are on the other hand those showing higher level of consensus among Med countries.

Regarding geographical scope, most of monitoring efforts are concentrated in coastal areas, as expected, since most of pressures are located there, but there are other pressures much widely distributed, as for example microplastics in the water column, which require a wider geographical coverage than those envisaged in the actual monitoring plans. Thus, it should be recommended that the groups of experts **to propose the most adequate geographical coverage for any specific indicator.**

As regards the purpose of the monitoring, there is a general lack of monitoring on human activities causing the pressures and a total absence of monitoring on effectiveness of measures. It could be considered that the monitoring of the status of marine ecosystems can give cues on the effectiveness of measures. However, it would be recommendable **to define a set of specific indicators associated to the Programs of Measures** or, whenever appropriate, at least link explicitly in the PoMs the “Status and Impact” or “Pressure” indicators that could be useful for monitoring the effectiveness of a given measure.

Finally, it is obvious that **for achieving a reliable evaluation of the GES in the Mediterranean for most of descriptors is necessary to take into account the situation in non EU countries.** Thus, the MSFD monitoring plans should be closely linked to the UNEP MAP/EcAp/IMAP guidiness. In principle, the almost perfect match between descriptors, criteria and indicators and those envisaged under EcAp/IMAP facilitates this objective. However, it would be recommendable that the EU MSs MSFD monitoring plans mention explicitly the IMAP indicators addressed by each subprograms, as Cyprus did in its first reports.

1. INTRODUCTION

Article 11 of the Marine Strategy Framework Directive (2008/56/EC) provided legally-binding requirements for Member States to establish and implement monitoring programs for the ongoing assessment of the environmental status of marine waters. Such monitoring programs were described in Marine Strategy Framework Directive Annex 5, stating that monitoring programs should be compatible within marine regions or subregions and that Member States sharing a marine region or subregion should, in the interest of coherence and coordination, endeavor to ensure that monitoring methods are consistent across the marine region or subregion, in order to facilitate comparability of monitoring results. More specifically, the Directive highlighted the need to:

- aggregate the information on the basis of marine regions or subregions, in platforms that ensure interoperability of the information with the international aggregators (e.g. OBIS, GBIF);
- ensure comparability of assessment approaches and methods within and between marine regions and/or subregions;
- develop technical specifications and standardized methods for monitoring at Community level, so as to allow comparability of information.

However, the development of the first phase of the MSFD implementation, dealing with the Initial Assessment of marine ecosystems (Article 8 of the Directive), the determination of Good Environmental Status (GES - article 9) and on the establishment of environmental targets and associated indicators (Article 10), has shown that the requirements of adequacy, consistency and coherence in Member States' submissions have not been widely accomplished. This was recognized in the report from the Commission to the Council and the European Parliament on the first phase of implementation of the MSFD (COM(2014) 97), as well in the "In-Depth Assessment of the EU Member States' Submissions for the Marine Strategy Framework Directive under articles 8, 9 and 10" carried out by JRC (Palialexis *et al.*, 2014). Specifically, in the aforementioned Commission report is pointed out that in spite of regional cooperation through the RSCs protecting the EU's marine waters, which is well-developed, and that significant commitments were made by all RSCs to implement the ecosystem approach and support MSFD implementation, Member States' use of the results of regional cooperation within their marine strategies varies. This resulted in a lack of coherence among all the EU countries, even within the same marine region or subregion (required by Article 3(5) b and 5(2) of MSFD). This problem affects all MSs, but is especially worrying in the Mediterranean and the Black Sea, where the coherence has been proved to be lowest. In the relevant JRC report (Palialexis *et al.*, 2014) it was considered that a window of opportunity should be open to improve this situation ahead of the development of Monitoring Programs and Programs of Measures planned for 2014 and 2015, respectively. It was also stressed that better results will be delivered at lower cost, if they are coordinated or developed jointly across Member States. Unfortunately, the recent experience related to the elaboration of national MSFD monitoring programs, suggest that the low level of cooperation affecting the first phase of MSFD implementation

occurred again, affecting the actions towards the design and implementation of monitoring programs. Several actions were undertaken to solve this problem, as the elaboration by JRC of the “Technical guidance on monitoring for the Marine Strategy Framework Directive” (Zampoukas *et al.*, 2014) or the coordination meetings held with this aim. In the case of the Mediterranean regions is worth to mention those organized by UNEP/MAP in relation to EcAp monitoring implementation, designed to taking into account MSFD requirements, as well. However, the outputs of such actions were not fully considered for the design of national MSFD monitoring proposals by all MSs, which elaborated independently their national monitoring plans, without any formal direct coordination among the experts in charge.

In order to contribute the convergence of national MSFD monitoring programs, DG ENV launched in November 2014 the project Call “Best practices for action plans to develop integrated, regional monitoring programs, coordinated programs of measures and addressing data and knowledge gaps in coastal and marine waters.

Considering this context, the strategic objective of one of the core activities carried out within the ActionMed project, one of the projects awarded under the aforementioned Call, focusing on the Mediterranean region, was to set the basis for a coherent design of future MSFD related monitoring programs, and facilitating their coordinated implementation during the ongoing cycle in this area.

The immediate objective was to provide the administrations in charge of MSFD implementation in the Mediterranean with information useful for revising, whenever necessary, the initial MSFD monitoring programs proposals in order to:

- ensure their regional coherence;
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The first step to achieve these objectives was to compile the relevant information on MSFD national monitoring plans from the files available from EIONET and include them in a relational data base (DB), and then use such DB to:

- Detect remaining monitoring gaps, both regarding spatial and temporal coverage by descriptor;
- Carry out a coherence analysis, determining the similarities and dissimilarities in sampling strategies and methodologies, as well among the indicators applied;
- Evaluate the adequacy and sufficiency of such monitoring plans to MSFD sampling requirements.

This report summarizes the results of these tasks.

2. REVIEW OF NATIONAL MONITORING PLANS UPLOADED AT EIONET

2.1 Description of available information

Member States were committed under MSFD Article 11 to notify the Commission of their monitoring programs by 15 October 2014, so that the Commission could assess whether the elements notified constituted an appropriate framework to meet the requirements of the Directive. All data files (reports) should be uploaded to ReportNet (<http://cdr.eionet.europa.eu/>) (CDR). Under each Member State, a folder 'Marine Strategy Framework Directive: monitoring programs' was created, under the European Union (EU) obligations. Within each Member State folder, the following subfolders (sub-collections) were available to upload the files:

- a. One sub-collection folder for any text-based national 'paper' reports for Article 11 (to be submitted in pdf format) and if applicable the copy (snapshot) of information, held in a web-based data system or other website (if linked to in the tabular data);
- b. One sub-collection folder for geographic data if required (i.e. an updated MSFD4Geo ML file and the associated geographic data (spatial data in grid or non-grid polygon format));
- c. One sub-collection folder for each Marine region and/or sub-region, relevant to the Member State's marine waters, for uploading tabular data (i.e. the xml schemas for Article 11).

Further details of the types of reports and their content were given in MSFD Article 11 Reporting Package (<https://circabc.europa.eu/d/a/workspace/SpacesStor>).

Following these instructions, the MSs uploaded the required information during 2015.

As a first step for achieving the objective of analyzing the coherence of MSFD monitoring programs in the Mediterranean region, all the information uploaded at EIONET site was reviewed at the beginning of ActionMed project. A preliminary global review of these documents submitted to the Commission, showed the same heterogeneity among countries as the previous MSs submissions corresponding to the first phase of MSFD development, and also that as regards Mediterranean MSs, in most cases some of the folders that should contain relevant information remained empty.

The files effectively uploaded and available from EIONET are described in ANNEX 1 (<https://cloudfs.hcmr.gr/index.php/s/hLpboVOK499pWkA>).

2.2 Problems and gaps

Considering the precise instructions regarding reporting obligations about national MSFD monitoring plans, it was supposed that all relevant information would have been uploaded in EIONET by all the countries, included detailed descriptions of their monitoring programs, documents on regional coordination and documents on

economic aspects. Moreover, the uploaded information should have been structured in easily understandable standard tables included in html files. Unfortunately, the preliminary analysis carried out on the EIONET documents related to MSFD article 11 were not consistent to this requirement.

The first problem detected at this phase of information collection, which affected all the countries that had uploaded .xlm files describing in detail each monitoring subprogram, was that in spite the html display of such files was also available, in fact they could be opened only as original .xlm files. This happened because when one tried to open the .html file, the following error message (the example corresponds to one of the files uploaded by Croatia) appeared:

“Error in conversion. The operation could not be completed because of the following error:

eionet.gdem.GDEMException: Error transforming XML - it's not probably well-formed xml file: net.sf.saxon.trans.DynamicError: net.sf.saxon.trans.DynamicError: java.io.FileNotFoundException: http://webqdev.eionet.europa.eu/xml/msfdart11_labels.xml /convertPush 507 http://cdr.eionet.europa.eu/hr/eu/msfd mp/madhr/envvaccaw/MADHR MSFD1 I MonSub MADHR-D05-04 20141015.xml”

The problem was that in the original .xlm files, due to structure of such files, it is very difficult to found the relevant information. To overcome this problem several action were considered:

1. Contact the responsible of each subprogram (addresses available at the beginning of each .xlm file) and get the original file in a user friendly format;
2. Extract the information directly from text-based pdf report, translating it into English, in the case required information is there;
3. Try to get the relevant data from .xlm original files already available from EIONET;
4. Contact the national focal points in charge of uploading the info on monitoring plans to ask them to contact CDR, in order to solve the problem.

Finally, the fourth option was the one chosen, and during June 2016 the .html display of monitoring subprograms .xlm files was already operative.

In addition to this general technical problem, others affecting some countries were identified. Specifically, in the case of Spain, once the .html display describing monitoring subprograms could be opened, it was observed that part of the information, specifically the data that should had been reported selecting predefined options from a list –as “spatial scope” or “measured parameters”- was missing, due to errors during the uploading process. On the other hand, in the Slovenian folders there were detected inconsistencies in the coding of programs and subprograms. Moreover, two subprograms were found in the repository, both referring to seabed habitats, so the number of subprograms was in fact 7 and not 8.

However, the main difficulty encountered was that in many, or even all the cases, relevant documents were missing. The extreme case was Greece, since this

country did not submit any monitoring plan, during the envisaged reporting period.

Moreover, almost no one country, being Croatia the only exception, had uploaded something in the folder “Geographical data and regional cooperation_MSFD4Geo”. Only few countries, e.g. Spain, have included some reports on economic aspects.

Regarding the descriptions of national monitoring programs, a high degree of heterogeneity was observed, ranging from countries that had presented global plans not specified by marine demarcation, though they have under their jurisdictions several marine demarcations with rather different characteristics, as Italy, to others countries which included detailed descriptions of subprograms for each marine demarcation, as France or Spain. In fact, in the Mediterranean region only Spain has elaborated a specific plan for the two Mediterranean demarcations under its jurisdiction, and with minor differences between them.

On the other hand, for some countries only “National text-based reports” in .pdf format, as Italy or Cyprus, were available, and despite the fact that the required information could be retrieved, it was proven quite time consuming to identify and extract the relevant data, as they were not structured in concrete tables. Fortunately, the structure of the contents of these .pdf files, as regards subprograms description, followed DIKE recommendations and matched in high degree those of standard .html files, facilitating data selection and transfer. In other countries, those “National text-based reports” were missing, as Slovenia or Malta, which though would not be the best for getting specific data; they can be useful for getting a global view of the national programs. Only Croatia, Spain and France had submitted both “National text-based reports” and .xml files describing in detail each monitoring subprogram.

Moreover, an additional problem is that most of countries have reported the monitoring programs in national languages (Spanish, French, Italian, Croatian, and Slovenian) and not in English. Only Malta and Cyprus sent the reports in English.

All these problems made more difficult the creation of a common database, to be used as reference for the global assessment of the gaps and regional coherence among national monitoring programs.

The following table (Table I) summarizes the state of the art regarding the information on MSFD monitoring plans from Mediterranean countries uploaded at EIONET.

Table I. Summary of information on MSFD monitoring plans uploaded at EIONET by Mediterranean countries.

Country	Text based report as pdf	Xlm/html files describing each subprogram.	Docs on Regional Coordination/ Geographical info	Standard sheets describing Indicators	Language
Slovenia	No	Yes	No/No	No	Slovenian
Croatia	Yes	Yes	No/Yes	No	Croatian
Italy	Yes	No	No/No	No	Italian
France	Yes	Yes	No/No	No	French
Spain	Yes	Yes	No/No	Yes	Spanish
Greece	No	No	No/No	No	-
Malta	No	Yes	No/No	No	English
Cyprus	Yes	No	No/No	No	English

3. DATABASE ON MSFD MONITORING PLANS IN MEDITERRANEAN DEMARCATIONS

3.1 Basic data collection

Due to the heterogeneity both in the format and in the contents of the national MSFD monitoring plans uploaded at EIONET, which makes difficult to carry out a comparative analysis, an independent set of data was elaborated, with an homogeneous structure. This set data was created by gathering the relevant information from each country from the different files available from EIONET, which were transferred to Excel sheets using standardized templates, in order to build up a database useful for carrying out a detailed evaluation of their coherence. Such templates matched, as much as possible, the structure of the standard .html files from EIONET, to facilitate the process. In the case of Spanish and French files, the data were directly transferred to more complex templates, described in next paragraphs. To overcome the “language problem” the selected data, whenever they had been uploaded in other languages, were translated to English. The only elements that were left in the original languages, because of their extension, were the “Methodologies”. The filled templates are compiled under Annex 2 (<https://cloudfs.hcmr.gr/index.php/s/FalqF3Xb6eJj3pp>).

3.2 Preliminary data processing and analysis

In order to overcome some of the aforementioned problems and adapt, as much as possible, the available data to the structure and formats required by a relational database, the templates containing the collected basic information on national monitoring programs were revised and modified. Firstly, the nomenclature of the columns containing terms from closed lists was homogenized. Then, it was considered that the pair indicator/subprogram would be the most adequate basic unit for carrying out detailed comparative analysis. Actually, the information in the national MSFD monitoring plans is organized at a higher hierarchical level, the subprogram level. However, specific methodologies can be associated to several indicators that can be covered by a single subprogram, and hence for building up a database oriented to facilitate the methodological standardization of marine monitoring activities in a given region, it is more useful to design it at a lower hierarchical level, as the one proposed. Thus, new rows were added to organize the available information according to that, linking all the data to each indicator within a subprogram, whenever necessary. Therefore, this structure results now in repeated data among the rows corresponding to the same subprograms, but in the future will allow describing more precisely, and hence facilitating the standardization of the national monitoring programs, once they be revised in future MSFD cycles.

Finally, to deepen in the adaptation of these standardized files to the requirements of a relational database, new fields were added to allow splitting the different data clumped together in the same cells in the rough original templates into separate columns, facilitating the data analysis. Specifically, this action was carried out in relation to those types of data that had a limited number of possible values, as purpose of the monitoring subprogram, the spatial scope of such monitoring and the broad and specific categories of elements monitored. Other types of

information related to the different subprograms, as that referred to the temporal scope of the monitoring or the parameter measured, were in theory susceptible to being split in predefined categories, but it was not possible to do it because of the complexity of some subprograms, which included several monitoring schemes with different temporal scales, and also because some countries did not use as reference the closed lists included in the templates for defining the monitored parameters.

The first analysis of the information clustered through these standard templates, revealed both gaps in data availability, as well as lack of standardization in the format and level of detail of some fields. Summing up, many of these problems derived from not using the standard templates for reporting on monitoring subprograms by some Member States, were:

- Lack of detailed geographical information;
- Lack of data on economic issues;
- Lack of detailed info about indicators (specific algorithms, units etc.) (Only Spain reported detailed descriptions of each indicator in standard sheets following DIKE recommendations);
- Differences in the list of considered indicators, since most of countries use directly the list of indicators from Decision 477, whereas two countries (Cyprus and Spain), have gone one step further and have defined explicitly their own list of indicators, relating them to those stated in Decision 477. In these cases, all the MSFD indicators are covered, but at least one national indicator, but usually several indicators, more precise and adapted to specific cases, have been defined, in relation to one of these indicators stated in MSFD (e.g. in Spain up to 12 different indicators have been proposed in relation to the MSFD indicator 1.6.1.Condition of the typical species and communities);
- In some cases, methodologies were not described in detail in the uploaded files, but included only as bibliographic references;
- Conceptual confusions between parameters, monitored elements and habitats, where the elements are monitored;
- Use of different nomenclature;
- Differences of criteria for defining the indicators addressed by a given subprogram (with similar monitoring schemes, the indicators that each country consider to be covered by such monitoring programs can be different);
- Differences of criteria for defining monitored elements and parameters measured in association to a given subprogram (some countries only report, within a given subprogram, the target monitored elements and related parameters, whereas others include additional monitored elements, which in the context of such subprogram only constitute complementary information);
- Heterogeneity in subprograms structure (some adapted to specific

and homogeneous monitoring programs, whereas others integrate very different monitoring schemes).

3.3 Access relational DB

The tables of data from the different MSs compiled in Annex 2 and modified, as described in the previous paragraph, were clumped together for elaborating the main table of the relational database on MSFD monitoring programs in the Mediterranean region. This main table contains all the relevant information extracted from EIONET, and constitutes itself a data set useful for carrying out an overall description of MSFD monitoring programs in the Mediterranean and a general comparison of these monitoring programs among countries. Its structure is not the optimal one, from the point of view of a relational database, since part of these data could be placed in different tables for avoiding some redundancies. However, since in this case the number of data is not a limiting factor and with the objective of permitting the stakeholders to use it as a single spreadsheet for more simple analysis, it was decided to maintain it, as a unique table.

Other tables containing complementary information, allowing to complete the data already included in the DB or linking them to other databases, were elaborated, as:

- Table for linking the DB on monitoring programs to the DB on indicators developed under ActionMed Activity 1;
- Tables for relating MSFD and UNEP-MAP IMAP descriptors, criteria and indicators;
- Tables for linking MSFD indicators and additional indicators defined by some of the MSs, as Spain and Cyprus;
- Table for linking MSFD descriptors, criteria and indicators with their complete definitions, as stated in Decision 477;
- Table for linking the monitored element short names to their complete definitions as stated in Annex 3 of MSFD.

Moreover, some complementary partial tables including some of the info already included in the main table but restructured for facilitating some of the queries, as a table including only the data at subprogram level or tables about monitoring subprograms purpose or about monitored elements.

The structure and contents of the DB is shown in Annex 3 (<https://cloudfs.hcmr.gr/index.php/s/9GtXjNdxBXqf5zc>).

4. OUTPUT FROM THE DATA BASE

General description and comparative analysis of MSFD monitoring plans in the Mediterranean

The total number of MSFD monitoring subprograms listed in the monitoring plans uploaded at EIONET by the seven Mediterranean countries, which reported them in 2015 (Croatia, Cyprus, France, Italy, Malta, Slovenia and Spain) was 375. However, 10 of the French subprograms were not developed, because they will be launched in the next cycle of MSFD implementation or because they are totally covered by the sampling carried out under other subprograms. These subprograms are listed in the next table:

Table II. French subprograms listed in French MSFD monitoring plans but not developed.

Program_code	Subprogram_ID
MOFR-D1-4-6_HabitatsBenthiques	MOFR-D1-4-6_HB-6-Repartition_Bathyal
MOFR-D1-4-6_HabitatsBenthiques	MOFR-D1-4-6_HB-7-Etat_Ecol_Bathyal
MOFR-D1-4-HabitatsPelagiques	MOFR-D1-4_HP-1-Météorologie
MOFR-D1-4-HabitatsPelagiques	MOFR-D1-4_HP-2-Hydrodynamisme et Hydrologie
MOFR-D1-4-HabitatsPelagiques	MOFR-D1-4_HP-3-Physico-chimie
MOFR-D1-4-HabitatsPelagiques	MOFR-D1-4_HP-4-Communautés microbiennes
MOFR-D5_Eutrophisation	MOFR-D5_Eutrophisation-8-Apports_Atmos
MOFR-D5_Eutrophisation	MOFR-D5_Eutrophisation-4-Macroalgues et
MOFR-D1-4_PoissonsCephal	MOFR-D1-4_Poissons-1-Poissons et cephalopodes
MOFR-D1-4_PoissonsCephal	MOFR-D1-4_Poissons-2-Poissons et cephalopodes

Thus, the total number of effective subprograms considered within this report is 365. Moreover, 28 Spanish subprograms and 4 Italian did not address, or were not linked explicitly, to any of the criteria and indicators listed in MSFD Decision 477, and only 6 of them were linked to a specific descriptor (2 to D8 and 1 to D7). Most of these subprograms are focused on the monitoring of human activities (18) and pressures (6). These 32 subprograms, which in the case of Spanish ones include their own specific indicators, have not been considered for the analysis carried out at indicator level, but details on these subprograms are included in the table “t22_subpr_indicatorsnotlinkedMSFD” of Annex 3 (<https://cloudfs.hcmr.gr/index.php/s/9GtXjNdxBXqf5zc>).

Decision 477 descriptors, criteria and indicators coverage

The complete list of MSFD descriptors, criteria and indicators is included in the table “t3_indicators_decision_477” of the Access relational DB (<https://cloudfs.hcmr.gr/index.php/s/MLghUH9zHmNr5cE>).

Descriptor level:

All the MSFD descriptors have been considered in the Mediterranean region, but the monitoring effort directed to each one is very heterogeneous, as shown in Figure 1, representing the percentage of subprograms addressing each descriptor.

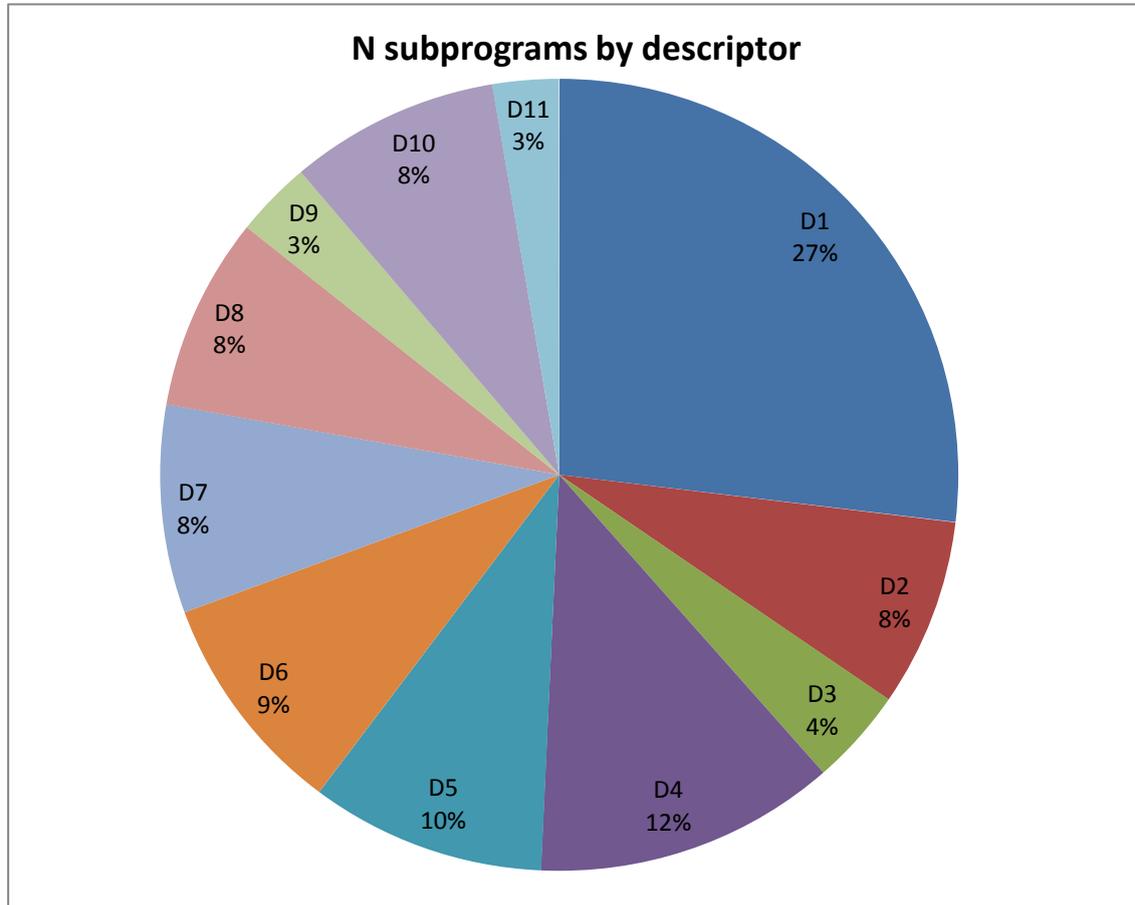


Figure 1. Percentage of subprograms addressing each descriptor (since each single subprogram can address different descriptors the total N=483).

More than the half (55%) subprograms are focused on the “Biodiversity descriptors”: D1, D2, D4 and D6 and mainly D1 (Biodiversity and habitats) (27%), whereas only 3% of subprograms address D11 (Submarine noise) and D9 (Contaminants in seafood).

Another way for comparing the monitoring effort among descriptors is that shown in Figure 2, representing the proportions among descriptors considering the sum of Decision 477 indicators under the different subprograms addressing a given descriptor.

Figure 2 shows also striking differences between the number of indicators used under different monitored subprograms for assessing the GES in relation to each descriptor, with 35% of them focused on Descriptor 1 (Biodiversity and habitats) and only 2% and 1%, respectively, for Descriptors 9 (Contaminants in seafood) and 11(Submarine noise).

It must be mentioned that this Figure 2 is partially biased by the fact that the number of indicators proposed for each Descriptor is variable, from 14 related to Descriptor 1 to only 2 in the case of Descriptors 9 and 11.

Thus, weighing the previous Figure 2, taking into account this variability, the proportions should be those shown in Figure 3.

However, even introducing this correction, the results are in line with those shown in the previous figures, because biodiversity indicators are those covered by a higher number of indicators, whereas D9 and D11 are those covered by less indicators within different subprograms. This is not surprising, if the variety of monitored elements (groups of species and habitats) is considered, which must be tackled by “Biodiversity” descriptors, in relation to more “homogeneous” descriptors, as D9 or D11, and because of that, these differences must not be necessarily interpreted as global gaps or insufficiencies in the monitoring efforts. To do so, is necessary to analyse the data per country firstly.

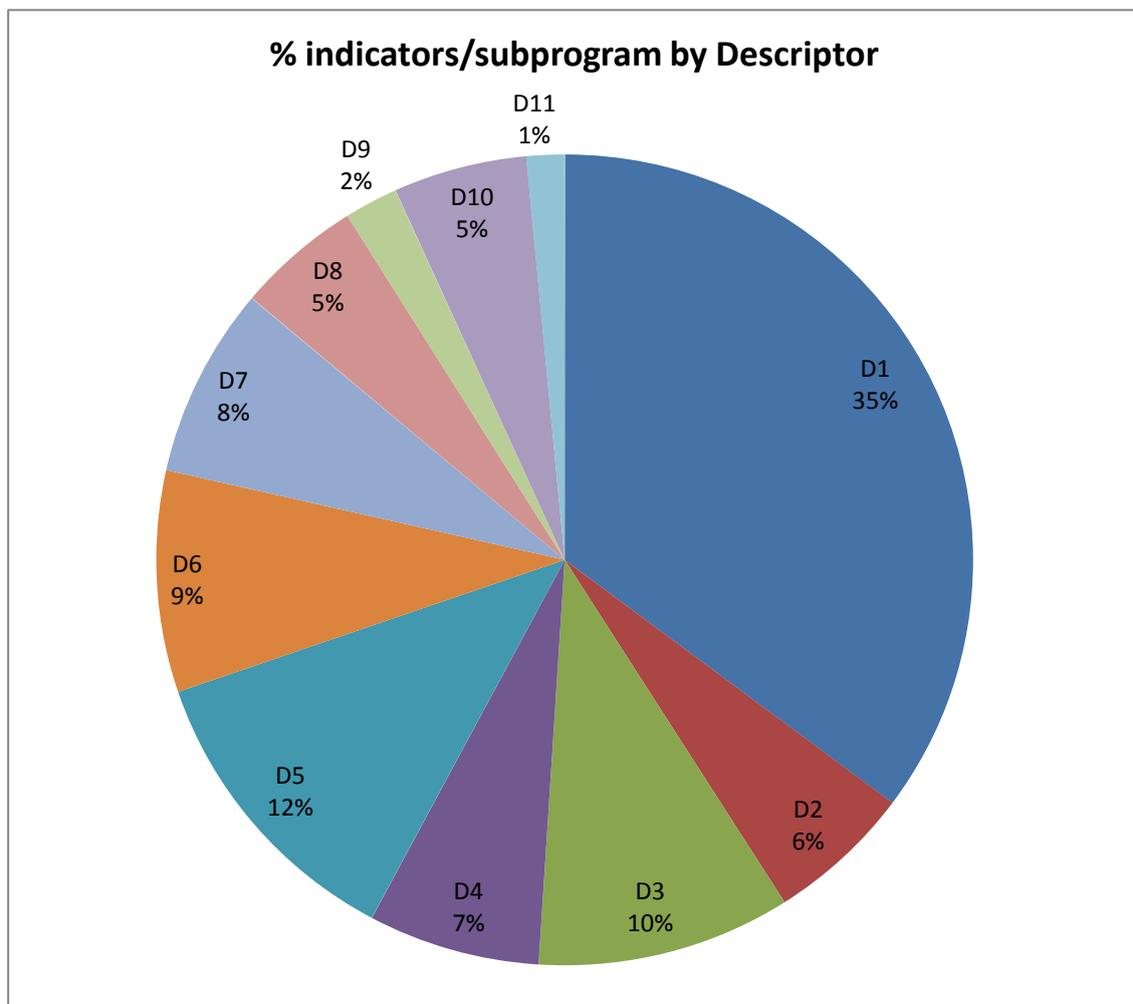


Figure 2. Proportions of monitoring effort, measured as number of sum of indicators from the different subprograms addressing a given descriptor (N=1133).

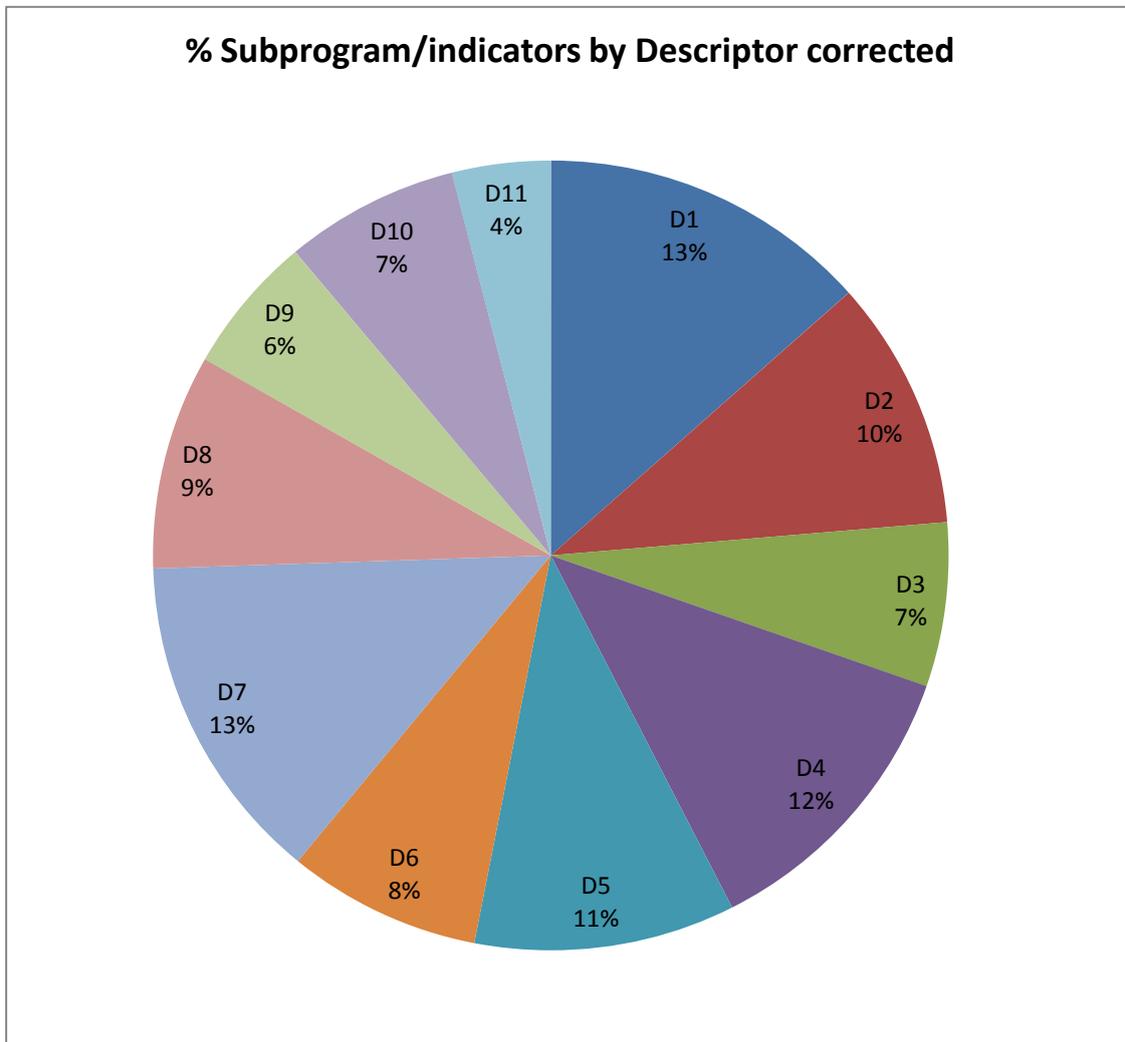


Figure 3. Proportions of monitoring effort, measured as number of sum of indicators from the different subprograms addressing a given descriptor weighed considering the number of MSFD indicators defined for each Descriptor.

The following tables show, the number of subprograms and indicators in different subprograms addressing each MSFD descriptor.

Table III. Number of subprograms addressing each MSFD descriptor by country.

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	Total
Croatia	9	3	5	9	6	4	4	6	3	4	2	55
Cyprus	13	2	1	4	4	3	1	3	1	4	1	37
France	19	9	4	13	6	11	10	9	5	7	3	96
Italy	14	5	1	15	8	3	13	5	1	4	2	71
Malta	15	3	3	9	6	3	4	4	1	4	1	53
Slovenia	4	1	1	1	4	1	1	1				14
Spain (ESAL)	28	7	2	4	6	10	4	5	2	9	2	79
Spain (LEBA)	28	7	2	4	6	9	4	5	2	9	2	78
Total	130	37	19	59	46	44	41	38	15	41	13	483

Table IV. Number of Decision 477 indicators addressing each MSFD descriptor by country.

Country	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	Total
Croatia	50	6	32	11	10	12	15	16	6	16	4	178
Cyprus	55	6	6	4	23	9	2	3	1	6	2	117
France	87	13	19	27	14	24	15	17	10	7	3	236
Italy	36	13	7	17	23	7	39	5	2	6	2	157
Malta	23	3	14	9	16	6	4	4	1	4	2	86
Slovenia	7	1	4	1	5	2	1	1				22
Spain (ESAL)	70	9	16	4	22	20	5	5	2	10	2	165
Spain (LEBA)	71	14	16	4	22	20	5	5	2	11	2	172
Total	399	65	114	77	135	100	86	56	24	60	17	1133

From these tables the most obvious gap detected is that in Slovenia Descriptors 9, 10 and 11 are not addressed by any subprograms and hence by any indicator. The number of monitoring subprograms and indicators is in general low in this country, but this is expectable taking into account the small size of the marine demarcation under its jurisdiction.

The proportions of subprograms and indicators addressing the various descriptors within each country are different among them. However, when considering the variability observed in the internal structure of the subprograms among countries, starting with those that tend to merge different monitoring activities, covering various descriptor within the same subprogram, towards to others that define more homogeneous and specific subprograms, is concluded that these numbers are difficult to interpret, in terms of gaps for comparing the monitoring efforts directed to the different descriptors by country. For example, Italy is the only case in which the number of indicators addressing D7 on hydrological conditions is higher than those focusing on D1 - biodiversity, but this results because Italy has defined different subprograms for D7 considering the source of data, as remote

sensing, modeling or fixed platforms, whereas others, as Spain for examples, have defined the subprograms according mainly to the spatial scale, local scale or large scales, independently of the source of data. Moreover, these differences in the criteria for defining subprograms occur also within countries. This fact constitutes a good proof of the lack of coordination both at international and even national levels.

Criteria level:

All the 29 criteria for evaluation GES defined in MSFD decision 477 have been addressed in the Mediterranean region. The majority have been considered by all the countries (11) or by almost all except one (3 criteria non addressed only by Italy and 9 non addressed only by Slovenia). The other six have not been considered by 2, 3 or even 4 countries (2 in each category), being the criteria 1.7. Ecosystem structure, 2.2. Environmental impact of invasive non-indigenous species, 4.1. Productivity (production per unit biomass) of key species or trophic groups, 4.2. Proportion of selected species at the top of food webs, 7.2. Impact of permanent hydrographical changes and 11.2. Continuous low frequency sound, those showing fewer consensuses. Thus, the main gaps in monitoring as regards criteria addressed are those affecting Descriptors 4 on food webs and Descriptor 11 on marine noise.

The criteria addressed by country are shown in Table V.

Two countries, Croatia and France, cover all the proposed MSFD criteria, Cyprus address 28, Spain and Malta 26, Italy 24 and Slovenia only 14. The main gap at national level is that of Slovenia, which covers less than 50% of criteria, but at regional level is more worrying the case of Italy, considering the extension of its marine demarcations, since in these areas three of the seven criteria of Descriptor 1 are not taken into account, including relevant ones as 1.4.Habitat distribution and 1.5. Habitat extent.

Table V. Number of indicators from different subprograms addressing each one of the MSFD criteria by country.

Country	Croatia	Cyprus	France	Italy	Malta	Slovenia	Spain	Spain
Criteria	MADHR	MALCY	MWEFR	MWEIT- MICIT- MADIT	MICMT	MADSI	MWEES- ESAL	MWEES- LEBA
1.1.	11	18	24	17	7		16	17
1.2.	8	12	9	10	6	2	14	14
1.3.	8	5	12	5	6	1	7	7
1.4.	8	6	6		1	1	10	10
1.5.	4	3	6		1	1	5	5
1.6.	10	8	20	4	2	2	14	14
1.7.	1	3	10				4	4
2.1.	3	2	11	5	3	1	6	7
2.2.	3	4	2	8			3	7
3.1.	7	2	6	2	3		4	4
3.2.	7	2	6	2	2		4	4
3.3.	16	2	7	3	9	4	8	8
4.1.	4		11	13	3			
4.2.	1	1	5	2	1			
4.3.	6	3	11	2	5	1	4	4
5.1.	1	8	6	19	2	1	5	5
5.2.	6	10	6	4	8	3	14	14
5.3.	3	5	2		6	1	3	3
6.1.	8	3	12	6	2		9	10
6.2.	4	6	12	1	4	2	11	10
7.1.	5	1	6	13	4	1	1	1
7.2.	10	1	9	26			4	4
8.1.	6	2	4	3	3	1	2	2
8.2.	10	1	13	2	1		3	3
9.1.	6	1	10	2	1		2	2
10.1.	12	3	4	5	3		7	8
10.2.	4	3	3	1	1		3	3
11.1.	2	1	2	2	1		2	2
11.2.	2	1	1		1			

Indicator level:

The level of coverage regarding Decision 477 indicators, is summarized in Table VI.

Table VI. MSFD Decision 477 indicators addressed by country.

Croatia MADHR	Cyprus MALCY	France MWEFR	Italy MWEIT- MICIT- MADIT	Malta MICMT	Slovenia MADSI	Spain MWEES- ESAL and LEBA
1.1.1.	1.1.1.	1.1.1.	1.1.1.	1.1.1.	1.2.1.	1.1.1.
1.1.2.	1.1.2.	1.1.2.	1.1.2.	1.1.2.	1.3.1.	1.1.2.
	1.1.3.	1.1.3.	1.1.3.			
1.2.1.	1.2.1.	1.2.1.	1.2.1.	1.2.1.		1.2.1.
1.3.1.	1.3.1.	1.3.1.	1.3.1.	1.3.1.		1.3.1.
		1.3.2.	1.3.2.			
1.4.1.	1.4.1.	1.4.1.		1.4.1.	1.4.1.	1.4.1.
1.4.2.	1.4.2.	1.4.2.				1.4.2.
1.5.1.	1.5.1.	1.5.1.		1.5.1.	1.5.1.	1.5.1.
		1.5.2.				
1.6.1.		1.6.1.	1.6.1.	1.6.1.	1.6.1.	1.6.1.
1.6.2.	1.6.2.	1.6.2.		1.6.2.		1.6.2.
	1.6.3.	1.6.3.				1.6.3.
1.7.1.	1.7.1.	1.7.1.				1.7.1.
2.1.1.	2.1.1.	2.1.1.	2.1.1.	2.1.1.	2.1.1.	2.1.1.
2.2.1.	2.2.1.	2.2.1.	2.2.1.			2.2.1.
	2.2.2.	2.2.2.	2.2.2.			2.2.2.
3.1.1.	3.1.1.	3.1.1.	3.1.1.	3.1.1.		3.1.1.
3.1.2.	3.1.2.	3.1.2.	3.1.2.			3.1.2.
3.2.1.	3.2.1.	3.2.1.	3.2.1.	3.2.1.		3.2.1.
3.2.2.	3.2.2.	3.2.2.	3.2.2.	3.2.2.		3.2.2.
3.3.1.	3.3.1.	3.3.1.	3.3.1.	3.3.1.	3.3.1.	3.3.1.
3.3.2.		3.3.2.	3.3.2.	3.3.2.	3.3.2.	3.3.2.
3.3.3.	3.3.3.	3.3.3.	3.3.3.	3.3.3.	3.3.3.	3.3.3.
3.3.4.		3.3.4.			3.3.4.	3.3.4.
4.1.1.		4.1.1.	4.1.1.	4.1.1.	4.3.1.	
4.2.1.	4.2.1.	4.2.1.	4.2.1.	4.2.1.		
4.3.1.	4.3.1.	4.3.1.	4.3.1.	4.3.1.		4.3.1.
5.1.1.	5.1.1.	5.1.1.	5.1.1.	5.1.1.	5.1.1.	5.1.1.
	5.1.2.	5.1.2.	5.1.2.	5.1.2.		5.1.2.
5.2.1.	5.2.1.	5.2.1.	5.2.1.	5.2.1.	5.2.1.	5.2.1.
	5.2.2.	5.2.2.	5.2.2.	5.2.2.	5.2.2.	5.2.2.
5.2.3.	5.2.3.	5.2.3.		5.2.3.	5.2.3.	5.2.3.
5.2.4.	5.2.4.	5.2.4.		5.2.4.		5.2.4.
5.3.1.	5.3.1.	5.3.1.		5.3.1.		5.3.1.
5.3.2.	5.3.2.	5.3.2.		5.3.2.	5.3.2.	5.3.2.
6.1.1.	6.1.1.	6.1.1.	6.1.1.	6.1.1.		6.1.1.
6.1.2.		6.1.2.	6.1.2.	6.1.2.		6.1.2.
6.2.1.	6.2.1.	6.2.1.		6.2.1.	6.2.1.	6.2.1.
	6.2.2.	6.2.2.		6.2.2.	6.2.2.	6.2.2.
		6.2.3.		6.2.3.		
		6.2.4.	6.2.4.			
7.1.1.	7.1.1.	7.1.1.	7.1.1.	7.1.1.	7.1.1.	7.1.1.
7.2.1.	7.2.1.	7.2.1.	7.2.1.			7.2.1.
7.2.2.		7.2.2.	7.2.2.			7.2.2.
8.1.1.	8.1.1.	8.1.1.	8.1.1.	8.1.1.	8.1.1.	8.1.1.
8.2.1.		8.2.1.	8.2.1.			8.2.1.
8.2.2.	8.2.2.	8.2.2.		8.2.2.		8.2.2.
9.1.1.	9.1.1.	9.1.1.	9.1.1.	9.1.1.		9.1.1.
9.1.2.		9.1.2.	9.1.2.			
10.1.1.	10.1.1.	10.1.1.	10.1.1.	10.1.1.		10.1.1.
10.1.2.		10.1.2.	10.1.2.	10.1.2.		10.1.2.
10.1.3.		10.1.3.	10.1.3.			10.1.3.
10.2.1.	10.2.1.	10.2.1.	10.2.1.	10.2.1.		10.2.1.
11.1.1.	11.1.1.	11.1.1.	11.1.1.	11.1.1.		11.1.1.
11.2.1.	11.2.1.	11.2.1.		11.2.1.		

From the 56 indicators defined in the Decision 477, only 8 have been considered by all the Mediterranean countries whose monitoring plans have been analyzed. Other 22 have been addressed by most of countries (19 by 6 and 13 by 5). However, 1 indicator was only applied by one country, 3 by only two countries, 3 by three countries and 9 by four (see details in Table VI). Most of descriptors are affected by these gaps, since among these indicators covered by less than half of Mediterranean countries there are 7 belonging to D1, 2 to D6, and 1 to descriptors 3, 7, 8, 9, 10 and 11.

The number of non addressed indicators by country is detailed in Table VII. The country whose monitoring plans cover more indicators is France (55), followed by Spain and Croatia (47 and 46 respectively). Cyprus, Malta and Italy did not cover around ¼ of indicators (14, 16 and 17, respectively). The lowest coverage, as expected taking into account that this country has not planned any monitoring program for descriptors 9, 10 and 11, is that of Slovenia, which do not address 36 of the 56 indicators.

Table VII. Number of none addressed indicators by country.

Croatia MADHR	Cyprus MALCY	France MWEFR	Italy MWEIT- MICIT- MADIT	Malta MICMT	Slovenia MADSI	Spain MWEES- ESAL and LEBA
10	14	1	17	16	36	9

Purpose

Regarding the purpose of the subprograms, as shown in Figure 4, at regional scale there is a strong bias towards monitoring activities focused on determining environmental state and impacts, which represent more than fifty percent (55%) of the total, followed by those addressing pressures (33%) and human activities causing these pressures (13%). In the other hand, no one country proposed one monitoring subprogram oriented to data gathering on effectiveness of measures. This represents an important gap, but it is not surprising, taking into account that the program of measures were not yet defined, when the monitoring plans were elaborated. Moreover, most of indicators listed in Decision 477 are centered in the general evaluation of the environmental status, not being conceived for measuring the effectiveness of any specific action. However, it could be considered that the positive evolution of previously degraded environments, measured by “Environmental state” indicators, reflects the “Effectiveness of measures”.

At national level, as can be seen in Table VIII, there is some heterogeneity among countries. Thus, most of countries follow the general pattern of prioritizing environmental state and impacts monitoring, but Croatian and French plans are more directed to pressures.

However, for interpreting these figures it must be taken into account that there can be differences of criteria among, and even within countries between different monitoring programs if they have been elaborated by different teams, for assigning a purpose to a given monitoring program or subprogram. For examples,

regarding monitoring programs addressing alien species, for similar monitoring activities some countries consider that the purpose of the subprogram is determining the environmental status and impacts; others stated that they are measuring pressures and others that they are addressing both status/impacts and pressures monitoring.

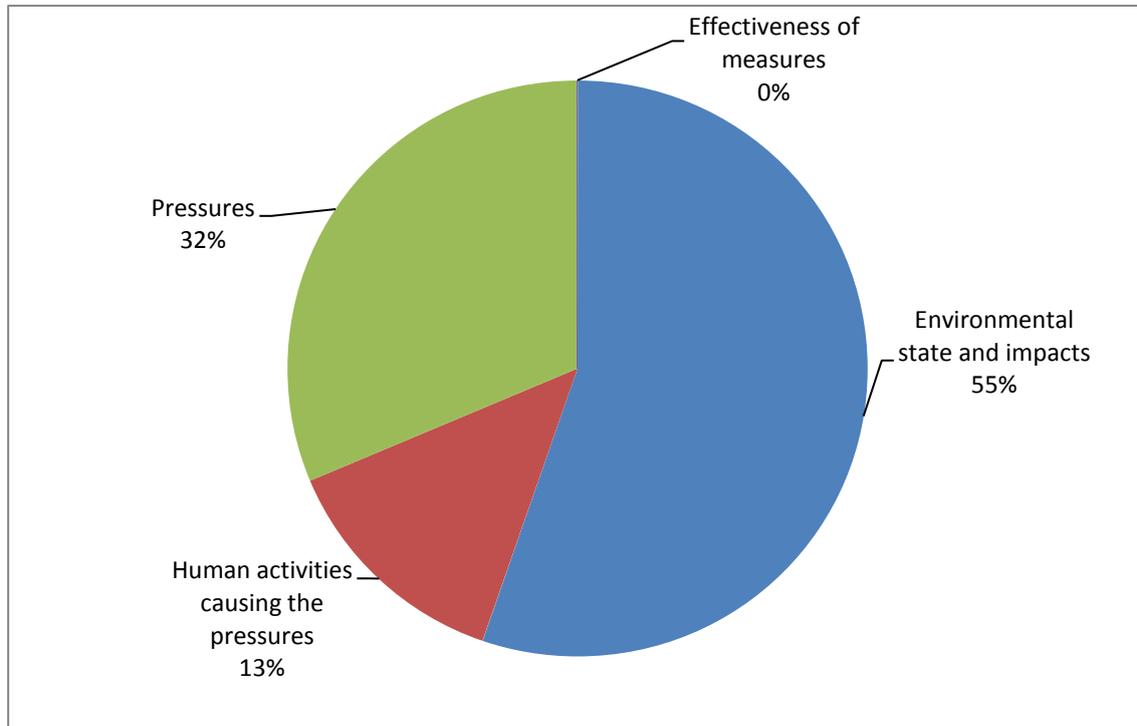


Figure 4. Proportion of subprograms addressing each of the potential purposes under MSFD in the Mediterranean region.

Table VIII. N of subprograms addressing each type of monitoring purpose by country.

Country	Demarcation	Total	Environmental state and impacts	Human activities causing the pressures	Pressures	Effectiveness of measures
Croatia	MADHR	42	10	14	18	0
Cyprus	MALCY	28	16		12	0
France	MWEFR	70	25	10	35	0
Italy	MWEIT-MICIT-MADIT	62	39	11	12	0
Malta	MICMT	41	21	2	18	0
Slovenia	MADSI	16	9	1	6	0
Spain	MWEES-ESAL	73	52	8	13	0
Spain	MWEES-LEBA	73	52	8	13	0
		405	224	54	127	0

Geographical scope

The majority of monitoring activities within MSFD are planned to be carried out within the coastal areas of marine demarcations, since 38% of monitoring subprograms will be carried out exclusively in transitional waters and within the first mile from coastline (WFD monitoring), and 19% of subprograms will cover also neighboring territorial waters, up to 12 miles offshore. This, besides 3% of monitoring special areas and 4% in terrestrial part of MSs, makes that monitoring subprograms covering offshore areas to represent only 36% of total. Moreover, taking into account that in the Mediterranean Sea there are not continental shelf areas beyond the EEZ, it seems that some mislead have been produced, when some countries have assigned monitoring subprograms to this category, since in fact probably they were referring to monitoring carried out on continental shelves in general, not exclusively those beyond EEZ, as specified in the note in brackets. Thus, the final figure would be even more biased towards coastal areas, since only 26% of monitoring activities should cover really also offshore waters far out from continental shelves.

This represents a certain bias, but it could be expected since most of pressures occur in coastal areas.

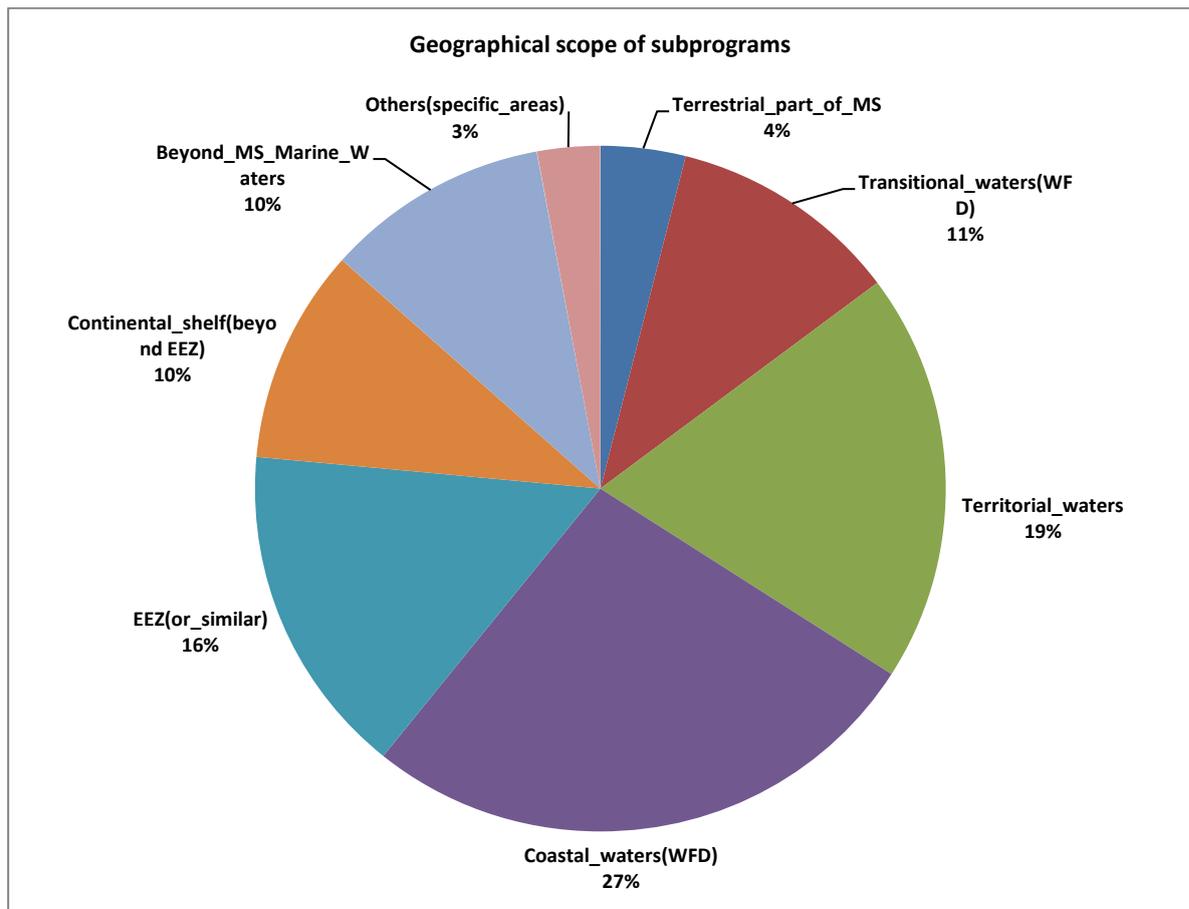


Figure 5. Proportion of subprograms addressing the different geographical areas considered under MSFD in the Mediterranean region.

The number of monitoring subprograms addressing each geographical area per country is detailed in Table IX. These figures are in part logically conditioned by the geographical characteristics of the MSs (e.g. relative importance of transitional waters) and extension of their marine demarcations, with some countries, whose marine waters are located in confined seas, as Adriatic, not planning monitoring activities in offshore waters.

It must be pointed out that the analysis of monitoring subprograms assigned to the category “Continental shelf beyond EEZ” reveals that in fact, they include the monitoring of the whole continental shelf.

Table IX. N of subprograms addressing each geographical area by country.

Country	Demarcation	Terrestrial part of MS	Transitional waters(WFD)	Territorial waters	Coastal waters (WFD)	EEZ (or_similar)	Continental shelf (beyond EEZ)	Beyond MS Marine Waters	Others (specific areas)
Croatia	MADHR	1	0	33	38	8	0	0	0
Cyprus	MALCY	6	3	15	17	7	0	0	0
France	MWEFR	9	14	37	34	32	8	5	0
Italy	MWEIT-MICTI	0	22	22	57	27	27	22	0
Malta	MICMT	3	0	17	7	0	0	8	10
Slovenia	MADSI	0	0	8	8	0	0	1	0
Spain	MWEES-ESAL	8	28	19	37	32	27	28	8
Spain	MWEES-LEBA	8	28	19	37	32	27	28	8
	Total	35	95	170	235	138	89	92	26

Broad category

Considering the broad category of the monitored elements –as defined in Annex 3 of MSFD–by each indicator within the proposed monitoring subprograms, most of monitoring activities deal with biological features, since this category is addressed by almost 50% of applied indicators within the different subprograms, as shown in Figure 6.

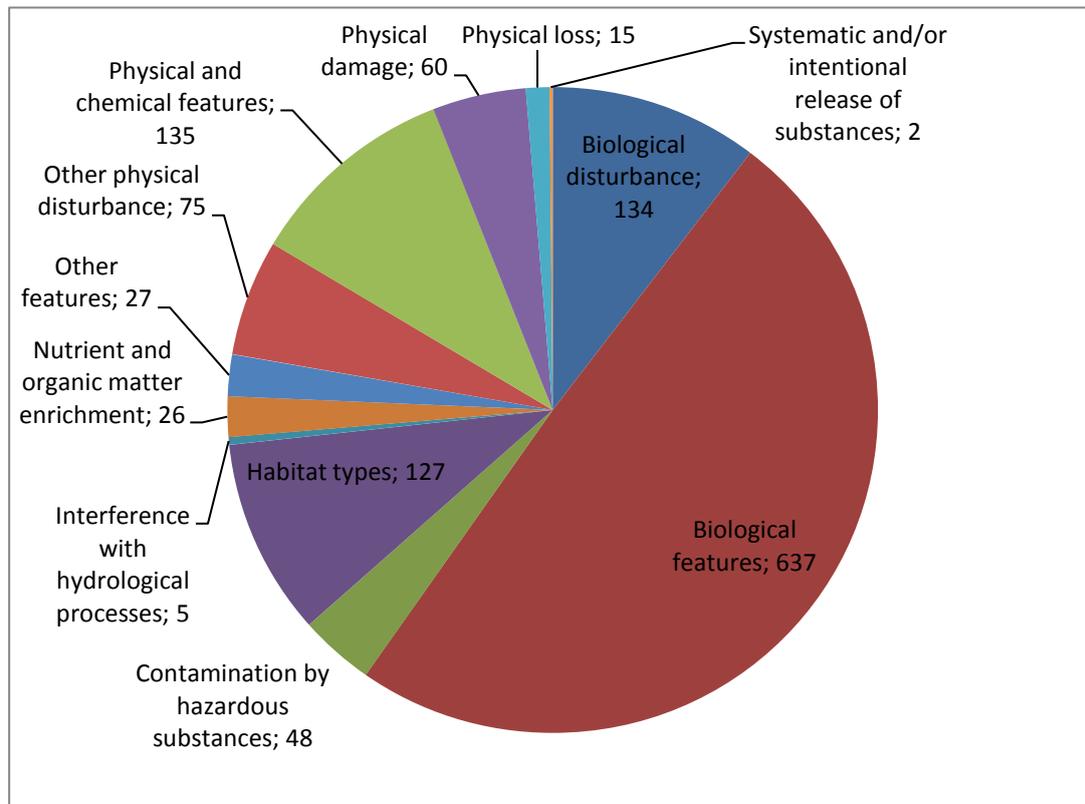


Figure 6. Number of indicator/subprogram by monitoring elements broad category.

Contrastingly, very few indicators cover the intentional release of substances and the interference with hydrological processes. These gaps are more evident analyzing these data by country. The number of indicators covering each broad category of monitored elements by country is detailed in Table X.

Table X. N of indicators within subprograms addressing each broad category of monitored elements (Annex 3 MSFD) by country.

Country	Croatia	Cyprus	France	Italy	Malta	Slovenia	Spain	Spain
Demarcation	MADHR	MALCY	MWEFR	MWEIT- MICIT- MADIT	MICMT	MADSI	MWEES- ESAL	MWEES- LEBA
Biological disturbance	32		22	16	4	4	26	30
Biological features	87	83	170	50	58	13	90	86
Contamination by hazardous substances	15	1	15	2	2	1	6	6
Habitat types			67	17	4		17	22
Interference with hydrological processes					1		2	2
Nutrient and organic matter enrichment			10	8	8			
Other features	6	5		6	4		3	3
Other physical disturbance	20	8	7	9	6		12	13
Physical and chemical features	17	20	30	45	5	4	7	7
Physical damage			55	1			2	2
Physical loss			10	3			1	1
Systematic and/or intentional release of substances	1				1			
Total	176	117	236	157	86	22	165	172

The main gaps are those mentioned above on intentional release of substances and interference with hydrological processes, since only 2 countries have some subprograms on these topics. Other important gap is the lack of monitoring on habitat types and nutrient and organic matter enrichment. Finally, only 3 countries address physical damage and physical loss. However, for interpreting these results, as occurs with other information from this DB, probably part of differences among countries are attributable to differences of criteria for assigning a monitoring program to a given category of monitored element.

Monitored elements

The number of indicators within subprograms addressing the different specific monitored elements listed in MSFD Annex 3, detailed in Table XII, reveal important gaps in several of these elements. Thus, from the 34 defined elements, there are 20 which are explicitly monitored by less than half of Mediterranean MSs. From those, the main gaps are habitats in special areas, which is not monitored at all, and smothering, siltation, selective extraction, other species under international legislation and organic matter, which are monitored only by 1 country. Other 7 elements are only monitored by 2 countries and 7 only by 3 countries (see Table XII).

Contrastingly, 4 elements (fish/cephalopods/crustaceans exploited populations, non indigenous species, synthetic and non-synthetic substances and compounds and nutrient and oxygen), which are mostly elements historically covered by other policies (Barcelona Convention and CFP) are monitored by all the countries, or one of the main pressures in the Mediterranean region, as NIS. Other elements, whose monitoring coverage is acceptable, since only one country do not monitor them, are those related to the pressures specifically addressed by MSFD as main descriptors, as marine litter and underwater noise, and macrofauna as marine mammals and reptiles or seabirds. Angiosperms, macroalgae and macroinvertebrates, as well hydrodynamics, are also monitored by all countries except one.

Table XII. Number of indicators within subprograms addressing the different specific monitored elements.

Country	Croatia	Cyprus	France	Italy	Malta	Slovenia	Spain	Spain	
Demarcation	MADHR	MALCY	MWEFR	MWEIT- MICIT- MADIT	MICMT	MADSI	MWEES- ESAL	MWEES- LEBA	TOTAL
Abrasion	0	0	54	4	0	0	3	3	64
Angiosperms, macro-algae and	54	36	0	7	4	6	15	16	138
Any other features	0	2	0	6	0	0	3	3	14
Biological communities in	5	10	81	28	14	4	30	29	201
Chemicals	6	3	6	2	4	0	0	0	21
Fish (and cephalopods or	7	13	64	11	18	2	13	13	141
Fishing	32	0	6	7	0	4	16	16	81
Habitats in special areas	0	0	0	0	0	0	0	0	0
Marine litter	16	6	21	7	4	0	10	11	75
Marine mammals and reptiles	10	12	17	2	5	0	12	12	70
Microbial pathogens	0	0	4	0	0	1	2	2	9
Nitrogen and phosphor	0	0	10	0	8	0	0	0	18
Non indigenous species	6	6	27	6	2	1	9	14	71
Non-indigenous species (as	0	0	3	3	1	0	0	0	7
Synthetic and/or non-synthetic	10	3	15	2	2	2	12	11	57
Nutrients and oxygen	2	19	11	11	2	2	7	7	61
Organic matter	0	0	0	8	0	0	0	0	8
Other species under international	0	0	0	0	3	0	0	0	3
Other substances intentional	1	0	0	0	1	0	0	0	2
ph and CO2	0	2	6	7	1	0	0	0	16
Radio-nuclides	5	1	0	0	0	0	0	0	6
Salinity	3	2	23	0	1	0	0	0	29
Salinity regime	0	0	0	15	0	0	2	2	19
Seabed or water column	0	0	66	9	0	0	21	21	117
Seabirds	5	6	22	2	8	0	14	15	72
Sealing	0	0	11	3	0	0	3	3	20
Selective extraction	0	0	0	4	0	0	0	0	4
Siltation	0	0	0	0	0	0	3	3	6
Smothering	0	0	15	0	0	0	0	0	15
Special habitat types (recognized	0	0	0	8	4	0	0	0	12
Temperature and hydrodynamics	12	2	24	36	3	2	0	0	79
Thermal regime	0	0	0	15	1	0	2	2	20
Topography and bathymetry	0	0	5	3	0	0	0	0	8
Underwater noise	4	2	3	2	2	0	2	2	17

5. CONCLUSIONS AND RECOMMENDATIONS

The analysis of the information on the MSFD monitoring plans uploaded by the Mediterranean MSs to EIONET allowed to detect several general problems, not only gaps but also differences in their structure, that make difficult to evaluate in detail their coherence at regional level. The first and more obvious is that Greece did not reported such monitoring plans in due time, and hence could not be included in this analysis. Apart of that, no Mediterranean country uploaded all the information required by MSFD Article 11 Reporting Package to the various folders envisaged. The main gaps in this sense are the total lack of documents on regional coordination, as well of geographical data (with the only exception of Croatia). As regards the description of the monitoring programs and subprograms, only Croatia, France and Spain uploaded both text-based national plans as .pdf files and the standard .xml files corresponding to each subprograms. Thus, it can be concluded that there is a high heterogeneity among countries already at formal level. In consequence, **the first recommendation should be that all the countries should elaborate and make available all the required files.**

An additional formal problem is that most of countries reported the information in their respective national languages, which makes more difficult the comparison among national plans and their coordination. Therefore, it would be **highly recommended to elaborate English versions of all the national MSFD monitoring plans.**

Regarding the structure of these plans, there is also a certain degree of heterogeneity among and within countries, since in some cases the monitoring subprograms correspond to very specific and homogeneous monitoring activities, whereas in others clump together various sampling schemes, which difficult their analysis and standardization. To overcome this problem it would be **recommended to provide clear instructions for defining properly the different monitoring subprograms within a given program, which should be as much homogeneous as possible.**

The differences in criteria do not only affect the structure of programs and subprograms, but also the way in which such activities are related to specific purposes, indicators or monitored elements, which can bias any comparative analysis. Moreover, in the actual plans, mainly in those corresponding to countries that have not used the standard templates for reporting each subprogram, there are also some conceptual misleads between the monitored elements, the habitats in which these elements are monitored and the parameters measured, which blur the comparative analyses. A first step to solve some of these problems should be to **follow the aforementioned recommendation of reporting all the required documents in the proposed formats, in this case the standardized templates for each monitoring subprogram.** However, it would be also **recommended to elaborate guidelines proposals, defining clearly these concepts and stating criteria for linking monitoring programs and covered indicators, and then held *ad hoc* meetings, at regional level, among the direct responsible of MSFD monitoring plans reporting, to agree on these criteria and ensure that they**

have been applied properly in each country.

Another important difference regarding general structure of national plans is that among the countries having more than one Mediterranean marine demarcation under its jurisdiction, only Spain have reported specific plans for each one. Considering that in some cases the environmental conditions can be very different among demarcations (e.g. Adriatic Sea vs. Tyrrhenian Sea), it **would be recommended to elaborate specific plans for each marine demarcation**, which is on the other hand the obligation stated by MSFD article 11.

On the other hand, there are also striking differences among Mediterranean MSs regarding the level of detail in describing the applied indicators, which constitute the core of the monitoring programs and the basic information for carrying out any really practical technical analysis of the regional coherence of the programs. The origin of the problem is that most of indicators proposed in Decision 477 were defined in a too general way, without specifying metrics or algorithms. Thus, it was necessary that the MSs went one step further in defining more precisely the applied indicators. However, only two Mediterranean MSs (Cyprus and Spain) have proposed explicitly their own indicators developing in more detail, whenever necessary, those listed in Decision 477, and only Spain reported the description of these national indicators using standardized templates. In other countries the more precise descriptions could be included in the paragraphs on methodologies associated to each subprogram, but in many cases the reported information is also too general or consists only on bibliographic references, sometimes available only in national languages. To overcome this important problem **it should be asked from all MSs within the Mediterranean region to fill in standard templates describing precisely the metrics, algorithms and field sampling strategies and methodologies, as well as any analytical procedures, associated to each indicator. To ensure the coherence at regional level, all these elements should be discussed and agreed within the framework of groups of nominated specialists created *ad hoc* for each descriptor or relevant monitored element.**

Summing up, the general conclusion is that in spite the analyzed national monitoring plans show a general resemblance, as expected since all of them have been elaborated taking into account or inspired by the same principles stated in the MSFD and subsequent guidance documents, there have not been in practice any international close coordination in the last phase of elaboration of the MSFD monitoring plans in the Mediterranean region, resulting in a high degree of heterogeneity in their structure and other formal aspects.

Moving from these formal aspects to the contents of the MSFD monitoring plans reported by Mediterranean MSs, the first conclusion it that there are also important differences among countries regarding the degree of coverage of criteria, the main gaps being those affecting Descriptor 4 on food webs and Descriptor 11 on marine noise. However, at indicators level the main gaps affect D1 on biodiversity and D6 on seabed integrity, since several of the proposed indicators for these descriptors (7 and 2 respectively) are covered by less than half of Mediterranean countries. This imply also that some of the monitored elements listed in the Annex 3 of MSFD are not well covered in all the Mediterranean region. **To overcome this heterogeneity, a common list of elements to be monitored and the correspondent indicators should be agreed at regional**

level, to ensure the feasibility of a global GES assessment. This action should take advantage of the already existing monitoring programs implemented in the region, as those related to Water Framework Directive, Common Fisheries Policy and MEDPOL program, whose associated indicators are on the other hand those showing higher level of consensus among Med countries.

From a global perspective some biases can be observed affecting both the geographical scope and the purpose of the MSFD monitoring program in the Mediterranean. Regarding geographical scope, most of monitoring efforts are, focused in coastal areas. This is expectable since is the zone were most of pressures are located, but there are other pressures much widely distributed, as for example microplastics in the water column, which require a wider geographical coverage than those envisaged in the actual monitoring plans. **Thus, it should be recommendable that the groups of experts created for agreeing on common monitoring methodologies proposed above, to propose also the most adequate geographical coverage for any specific indicator.**

As regards the purpose of the monitoring, there is a general lack of monitoring on human activities causing the pressures and a total absence of monitoring on effectiveness of measures. It could be considered that the monitoring of the status of marine ecosystems can give cues on the effectiveness of measures, but in any case it **would be recommendable to define a set of specific indicators associated to the Programs of Measures or, whenever appropriate, at least link explicitly in the PoMs the “Status and Impact” or “Pressure” indicators that could be useful for monitoring the effectiveness of a given measure.**

Finally, it is obvious that for getting a reliable evaluation of the GES in the Mediterranean for most of descriptors is necessary to take into account the situation in non EU countries.

Thus, the MSFD monitoring plans should be closely linked to the UNEP MAP EcAp IMAP ones. In principle, the almost perfect match between descriptors, criteria and indicators and those envisaged under EcAp IMAP facilitates this objective. However, it would be recommendable that the EU MSs MSFD monitoring plans mention explicitly the IMAP indicators addressed by each subprogram, as Cyprus did in its first reports. It would be also recommendable that the proposed group of experts, in charge of agreeing on the standardization of monitoring methodologies, in relation to the different descriptors or monitoring elements integrate representatives of non EU countries, or at least that the same EU experts involved in MSFD implementation participate actively in the EcAp IMAP related activities. To prevent duplication of efforts, obviously the national MSFD monitoring plans should address in parallel the EcAp IMAP requirements, whenever possible.

6. REFERENCES

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