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Agenda Item 9: Science-Policy Interface: achievements and challenges for the implementation of IMAP

Science-Policy Interface (SPI) to support monitoring implementation plans as well as sub-regional and regional policy developments. EcAp clusters on: pollution, contaminants and eutrophication, marine biodiversity and fisheries, coast and hydrography

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PLAN BLEU - UN Environment/MAP Regional Activity Centre

SCIENCE-POLICY INTERFACE

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Science-Policy Interface (SPI) to support monitoring implementation plans as well as sub-regional and regional policy-developments

EcAp clusters on:
pollution, contaminants and eutrophication, marine biodiversity and fisheries, coast and hydrography

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TABLE OF CONTENTS

Implementation of the Ecosystem Approach (EcAp) in the Mediterranean: concept, objectives and means

Authors: Elen Lemaitre-Curri, Antoine Lafitte (Plan Bleu)

For the past forty years, UN-Environment/Mediterranean Action Plan and the Barcelona Convention[1] have provided a unique political and legal framework for environmental protection, with all Mediterranean riparian countries and the European Union as Contracting Parties. Pursuant to several decisions of the Contracting Parties, specific efforts were made during the past decade to implement the ecosystem approach (EcAp; see box 1) with the objective to achieve the good environmental status (GES) of the Mediterranean.

Successive decisions to implement EcAp and Integrated Monitoring and assessment Programme (IMAP)

At the 15th Meeting of the Contracting Parties to Barcelona Convention - COP15, held in Almeria, Spain in January 2008, Parties agreed to progressively apply the ecosystem approach (EcAp) to the management of human activities that may affect the Mediterranean marine and coastal environment for the promotion of sustainable development. With the adoption of the EcAp strategy, and its roadmap for implementation, Contracting Parties have committed to implement EcAp in the Mediterranean with the ultimate objective of achieving the Good Environmental Status (GES) of the Mediterranean Sea and its coastal zone by 2020. The GES has been defined through eleven Ecological Objectives (EO) (see box 2) and corresponding twenty-eight operational objectives.

Operational objectives' achievement is being monitored with the help of 61 indicators (27 common and 34 candidate indicators) for the Mediterranean, providing the framework for the development on an Integrated Monitoring and Assessment Programme (IMAP) as a way to evaluate the status and achievement of GES through regular assessments of the Mediterranean Sea and coastal environment.

The first Quality Status Report prepared in 2017[2] builds on the structure, objectives and data collected under EcAp roadmap / IMAP Decision implementation (see box 3).

1 The UN Environment/MAP's Barcelona Convention, set up in 1976 and amended in 1995, represents the only legally binding set of instruments for addressing common issues and challenges of environmental degradation and protecting marine and coastal ecosystems of the Mediterranean Sea. The MAP, as the first Regional Seas Programme under UN Environment auspices, represents a relevant and efficient framework for regional cooperation. It is the unique institutional cooperation and environmental governance framework gathering the 21 Mediterranean countries and the European Union, which are the Contracting Parties of the Barcelona Convention.

2 http://www.medqsr.org/

Box 1: The Ecosytem Approach (EcAp) in the Mediterranean

- ***What is EcAp?***

EcAp is "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is based on the application of appropriate scientific methodologies focused on levels of biological organization which encompass the essential processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems" (Convention on Biological Diversity COP 5, CBD 2000).

- ***What is the main goal of EcAp in the Mediterranean?***

The Contracting Parties to the Barcelona Convention agreed to progressively apply the Ecosystem Approach to manage human activities in the Mediterranean, with the ultimate objective to achieve a Good Environmental Status (GES) (Decision IG.17/6; 2008).

- ***How EcAp is developed?***

Successive decisions under the Barcelona Convention allowed the implementation of EcAp, its roadmap and its Integrated Monitoring and Assessment Programme. Successive EU funded projects supported the implementation of EcAp in the Mediterranean. The implementation of the EU Marine Strategy Framework Directive (MSFD, 2008/56/EC) by the EU Member States in the region also presents crucial opportunities for the application of EcAp for all the Mediterranean region ensuring that the MSFD and EcAp mutually strengthen and build on each other, without duplication of activities and obligations.

- ***What is the governance of EcAp?***

The governance of EcAp in the Mediterranean is structured around an EcAp Coordination Group (EcAp CG) and three Correspondence Groups (on Good Environmental Status and Targets; Monitoring; Economic and Social Analysis).

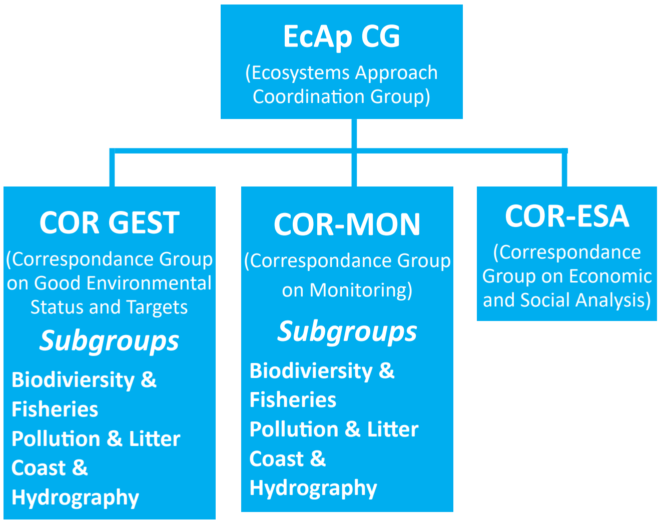
- ***Who is represented in the EcAp Coordination Group?***

EcAp Coordination Group consists of MAP focal points, the Coordinating Unit, the MAP components and MAP partners to oversee the implementation of the ecosystem approach, identifying progress gaps in the implementation of the road map and find feasible solutions for the advancement of the EcAp agenda.

- ***Who is represented in the Correspondence Groups?***

Experts (on Good Environmental Status and Targets; Monitoring; Economic and Social Analysis), representatives of the Contracting Parties to the Barcelona Convention, as well as the MAP Components and other stakeholders (scientific institutions), participate in the Correspondence Groups meetings.

Figure1 : Governance of EcAp



Coordination support by UN Environment/MAP Secretariat and its components.

Box 2:Mediterranean IMAP Programme and EcAp Ecological Objectives (2016)

BIODIVERSITY AND NIS

EO1 Biodiversity
EO2 Non-indigenous species
EO3 Fisheries
EO4 Food webs (to be further developed)

POLLUTION

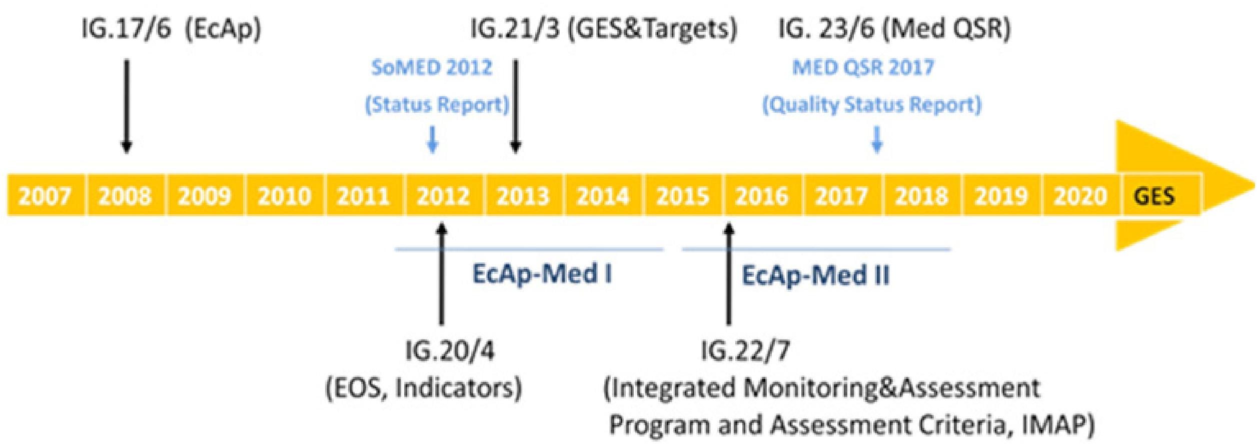
EO5 Eutrophication
EO9 Contaminants
EO10 Marine Litter
EO11 Marine Noise (to be further developed)

COASTAL ECOSYSTEMS AND HYDROGRAPHY

EO6 Sea-floor integrity (to be further developed)
EO7 Hydrography
EO8 Coastal ecosystems and landscapes

Box 3: The Ecosystem Approach Roadmap (2008-2018)

- Decision IG.17/6 (COP 15 in 2008): Implementation of the Ecosystem Approach;
- Decision IG.20/4 (COP 17 in 2012): Mediterranean ecological and operational objectives, indicators and timetable;
- Decision IG.21/3 (COP 18 in 2013): Adopting definitions of Good Environmental Status and targets;
- Decision IG.22/7 (COP 19 in 2016): Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and related assessment criteria (IMAP);
- Decision IG.23/6 COP 20 in 2017): 2017 Mediterranean Quality Status Report



The main added-value of EcAp in the context of the Barcelona Convention is a renewed emphasis on the integration of cross-cutting issues and challenges. Such an approach will help strengthen our ability to understand and address cumulative risks and effects as well as to better focus our actions on priority targets into a single integrated framework. The proposed adaptive management strategy allows for periodic monitoring, evaluation and revision through rigorous six-year management cycles. The second EcAp cycle runs from 2016 to 2021.

Projects and donors to support EcAp implementation in the Mediterranean

Various donors have supported the implementation of EcAp roadmap in the Mediterranean, including the European Union.

The **Ecosystem Approach-MED I project** (2012-2015)[3] was instrumental to support the implementation of the Ecosystem Approach (EcAp) in the Mediterranean Sea, in synergy and coherence with the implementation of the European Union Marine Strategy Framework Directive (MSFD 2008/56/CE). The project addressed central issues on EcAp Roadmap such as: the establishment of targets and GES; the definition of integrated monitoring system; environmental quality and socio-economic assessments; the EcAp governance.

The **Ecosystem Approach-MED II project** (2015-2018)[4] has the specific aim to support the Southern Mediterranean Contracting Parties to the Barcelona Convention to implement the EcAp Roadmap, in synergy and coherence with the implementation of the MSFD, through the establishment of a coherent monitoring programme for the entire Mediterranean basin in line with IMAP recommendations.

The EcAp-MED II project analysed countries' capacity to ensure future resource mobilization needs. A Funding Strategy was developed to provide an overview of possible funding opportunities for the implementation of EcAp with a focus on the implementation of IMAP in the Southern Mediterranean Sea.

In addition, EcAp-MED II project contributed to the 2017 Mediterranean Quality Status Report (MED QSR 2017), which assesses the status of the Mediterranean marine and coastal environment, through IMAP common indicators.

The **GEF Adriatic project (2017-2019)**[5] "Implementation of Ecosystem Approach in the Adriatic Sea through Marine Spatial Planning" is a sub-regional project, implemented in Albania and Montenegro, to restore the ecological balance of the Adriatic Sea providing integration of two key governance frameworks: Ecosystem Approach (EcAp) and Marine Spatial Planning (MSP).

This project assists Albania and Montenegro in establishing new monitoring programs in line with EcAp, strengthening science-policy interface, addressing sub-regional implementation needs, and responding to data and information challenges.

Building a Science-Policy Interface (SPI) for IMAP

To enable the implementation of the EcAp process and in particular of IMAP, it appears crucial to bridge existing gaps between the scientific and policy making spheres. Therefore, one of the key activities of the second phase of EcAp, the EcAp MED II project 2015-2018 supported by the European Union, focuses on the strengthening of the interface between science and policy. Plan Bleu, UN Environment / MAP Regional Activity Center was mandated to coordinate this activity.

An inception workshop on SPI was organized on 15-16 December 2015 (in Sophia Antipolis, France), bringing together key stakeholders (scientists and decision makers/managers) to frame SPI activities and to discuss the implementation of SPI activities for IMAP. Decision makers are the ones in charge of the development of environmental/marine policies and practitioners/managers are the ones following the implementation of environmental/marine policies.

Some scientists participating in the workshop were involved in research projects dealing with the marine environment and others represented international institutions. Decision makers/managers were designated by Contracting Parties to the Barcelona Convention.

During this workshop, a first set of around 15 key cross-cutting and topic-specific knowledge gaps for the implementation of IMAP was identified along with proposed actions to address these gaps.

In 2016 and 2017, successive SPI workshops (2 thematic and 2 transversal workshops; Graph 1) were organized subsequently back to back with Correspondence Group On monitoring (CORMON) since those offered the opportunity to bring together environmental policy-makers and marine scientists and allowed to collaborate in identifying scientific gaps in programs that contribute to achieving the GES and seek solutions to fill them.

The four workshops also supported scientists and policy-makers to define or structure monitoring programs, in line with EcAp Roadmap step 6[6] at national level. Those workshops were the opportunity to exchange best practices. Finally, one of the main objectives of SPI workshops was to assess the extent to which SPI could help to develop, structure and organize existing national monitoring programs and networks and to develop new ones, e.g. on risk-based approach (RBA) to monitoring and assessment.

Under the umbrella of reinforcing SPI in the implementation of IMAP and EcAp to facilitate and enhance monitoring and assessment of the status of the Mediterranean Sea, two underlying transversal issues have been thoroughly addressed: on Risk-based Approach (RBA) (Box 4) and on temporal and geographic scales (Box 5).

3 http://web.unep.org/unepmap/who-we-are/ecosystem-approach
4 http://web.unep.org/unepmap/who-we-are/ecosystem-approach
5 https://www.thegef.org/project/implementation-ecosystem-approach-adriatic-sea-through-marine-spatial-planning

6 Revision of existing monitoring programs for ongoing assessment and regular updating of targets.

Graph1: topic, date, location and scope of the SPI workshops for EcAp

SPI strengthening for the implementation of IMAP on Pollution	SPI SPI strengthening on Marine biodiversity in the Mediterranean	SPI strengthening for the implementation of IMAP with a focus on the Risk Based Approach (RBA) for monitoring	Joint workshop on SPI strengthening and EcAp Coordination Group Meeting on IMAP scales of monitoring and assessment, including the Quality Status Report 2017
20-21 October 2016 Marseille, France	28 November 2016 Tangiers, Morocco	2 March 2017, Madrid, Spain	27-28 April 2017, Nice, France
Thematic workshop focused on IMAP pollution issues, held as a specific session of a CORMON meeting on Pollution	Thematic workshop focused on biodiversity and Marine Protected Areas (MPAs), held as a joint session of the 2016 Forum of MPAs in the Mediterranean	Transversal workshop focused on the use of the RBA as a method aiming at both developing monitoring strategies to implement IMAP and dealing with the risks of not achieving GES in national waters	Transversal workshop focused on temporal and spatial scales for the implementation of IMAP: monitoring, reporting and assessment

Box 4: The Risk Based approach for coastal and marine monitoring

The RBA presents a pragmatic approach allowing for the prioritisation of monitoring strategies and assessment, thereby managing large scales and keeping monitoring requirements practicable. It is an overarching principle of IMAP representing a method for joined-up thinking across scientists, managers and decision-makers. The RBA allows for considering variations in scales of monitoring, reporting and assessment, as well as areas of high pressures and vulnerability. In designing monitoring programmes, it is necessary to identify components and locations likely to be at most risk of impact from human activities. For each component, the risk of impact needs to be assessed in terms of intensity, frequency and geographical extent of pressures. RBA is particularly relevant to EOs that are spatially patchy and where pressures are applied at specific locations, such as EO7.

Box 5 - The definition of geographical and temporal scales for monitoring and assessment

The definition of scales depends on the variability and predictability of the phenomena to be monitored; the greater the variability and unpredictability, the finer the scales must be to provide reliable results. The selection of scales has a direct consequence on the cost of monitoring; in general, the finer the scales, the higher cost, but also the higher the quality of the results. The objective is to find the right compromise between reasonable costs and acceptable level of robustness and reliability of assessments based on monitoring that provide relevant information for establishing appropriate programs of measures. It should be noted that monitoring scales and assessment scales are interlinked, yet distinct. Assessment scales define the scale at which GES is evaluated as (not) achieved for each specified element. This is the result of a process that draws from and aggregates monitoring data that is often collected at finer spatial and temporal scales. The concept of "scales" reflects the necessity to clearly define the different scales of the integrated monitoring, and assessment actions, using a "nested approach".

The challenge of strengthening SPIs in the framework of IMAP

A prerequisite for the successful implementation of IMAP and the design of national monitoring programmes following the ecosystem approach is bridging the existing gaps between the scientific and policy-making spheres. SPI is considered as one of the key activities of the EcAp-MED II project (2015-2018) under the coordination of Plan Bleu. The strengthening of SPI operates bi-directionally by ensuring that:

(i.) outcomes of ongoing scientific projects resulting in data collection are reflected in the design and implementation of country-specific and regional EcAp monitoring programmes and plans;

(ii.) the policy process supports the articulation of policy challenges in relation to monitoring where scientific input is necessary.

Through this process, policy-making and scientific communities are made aware of mutual needs and challenges to develop efficient sub-regional and regional monitoring policies. The need for channelling new scientific guidance into the policy process and ensuring the efficient use of scientific outcomes and existing knowledge in a rapid manner presents a specific challenge for the region due to non-equal capacities among Mediterranean countries.

The following sections introduce the methodology used in practice by Plan Bleu to prepare, organize and capitalize the workshops as well as the first results and identified needs to strengthen SPI for IMAP implementation.

SPI Workshop, Marseille (France), October 2016

Plan Bleu methodological support for the SPI activities undertaken

The method

The method used to identify scientific research needs that could support the full implementation of IMAP has been adapted from the methodology used by the EU FP7 STAGES project[7], in particular for a workshop on the identification of specific research needs as part of the implementation of monitoring programs to implement the EU MSFD.

To prepare for the SPI workshops, Plan Bleu identified cross-cutting issues and preliminary information gaps based on the following documents: the Decision IG.22/7 "Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria" and the Draft Integrated Monitoring and Assessment Guidance (2015). A preliminary analysis of ongoing research projects over the period (2015-2017) was also conducted.

Thematic SPI workshops, gathering scientists and technical representatives of the relevant ministries by thematic clusters[8], further analysed the main gaps and scientific research needs for the compliance of the national monitoring systems with the requirements of the IMAP Decision. Scientists and decision makers/managers also agreed on some shared recommendations to fill the identified gaps.

Three thematic brochures (pp. 11-40) summarize the conclusions of the science-policy workshops:

- Key SPI recommandations for Ecosystem-based Ecological Objectives on Eutrophication (EO5), Contaminants (EO9) and Marine Litter (EO10); p. 11
- Key SPI recommandations for Ecosystem-based Ecological Objectives on Marine biodiversity (EO1) and Fisheries (EO3); p. 19
- Key SPI recommandations for Ecosystem-based Ecological Objectives on Hydrography (EO7) and Coast (EO8); p. 27

7 The STAGES (Science and Technology Advancing Governance on Good Environmental Status) project aimed to bring science and policy closer together to help achieve the Good Environmental Status in European marine waters by helping to bridge the gap between 'science' and 'politics' of the Marine Strategy Framework Directive (MSFD) and improving the availability of scientific knowledge to Member States (Le Moigne et al., 2014).

8 Three clusters have been identified gathering coherent Ecological Objectives (EO). So, EOs 5 (Eutrophication), 9 (Contaminants) and 10 (Marine litter); EOs 1 (Marine Biodiversity) and 3 (Fisheries); EOs 7 (Hydrography) and 8 (Coastal ecosystems and landscapes) are gathered.

In practice

Sections in the reference documents mentioning needs for further developments for the future implementation of IMAP were identified. Each selected section was then analysed to identify the relevant EcAp Ecological Objective (EO), or cross cutting scientific issues addressing several EO (e.g. scale issues) and formulate a need for scientific action.

These needs were synthetized and sorted according to main thematic challenges (Cross cutting issues, EcAp EOs) in a table displaying the following information:

- Need formulation,
- Proposed action to address this need,
- Scope or typology of the action,
- Level or scale of the action (local, national, regional),
- Estimated duration of the action: Short (less than 2 years) Medium (2-4 years), Long (more than 4 years),
- Opportunities: outputs of research projects, partnership with UNEP/MAP, availability of resources.

Preliminary analysis and results of the Inception SPI workshop

The preliminary analysis of the IMAP science needs prepared by Plan Bleu and summary table presented as a working document to the SPI inception workshop held in December 2015 in Sophia Antipolis[9] and reviewed by the scientific experts who participated.

The table below shows the specific objectives and expected results of the thematic SPI workshops.

The first results / general comments obtained in 2015

The inception workshop reached the following conclusions:

- **A recognized lack of knowledge**. The workshop acknowledges that scientists are not in all areas currently able to provide necessary knowledge to policymakers to support the goal of achieving GES. Participants also recognize that additional efforts for identification, hierarchizing and synthesis of knowledge gaps are currently required.
- **Heterogeneous spatial distribution of knowledge availability.** Knowledge availability differs along Contracting Parties. Generally, a gap between Northern and Southern Mediterranean countries can impact the robustness of regional Mediterranean models and knowledge.
- **Monitoring versus obtaining new knowledge**. Workshop participants point out the difference between routine activity with the purpose of monitoring and scientific activities for obtaining new original knowledge. Furthermore, if new knowledge is considered GES relevant, a sustainable monitoring process should be developed.
- **Scientific results to inform different processes**. Scientific research results produced need to be suitable to cater different purposes integrated in IMAP: (i) monitoring, (ii) integrated environmental assessment and (iii) IMAP further revisions.
- **"Ecosystem functioning" approach**. Workshop participants consider that currently available knowledge on the functioning of Mediterranean marine and coastal ecosystems is still lacking, although they also acknowledge that the mobilization around EcAp and the MSFD has so far succeeded in developing new knowledge.

Specific objectives of the thematic SPI workshops	Expected results of the thematic SPI workshops
1. Ascertain scientific gaps listed in the working document and identify new ones, if appropriate	1. Contribute to the implementation of IMAP and contamination related work in identifying scientific needs and practical solutions to address them
2. Identify the needs of the Contracting Parties representatives in matter of research and knowledge development to implement IMAP	2. Improve access to relevant scientific projects the results of which could be useful to IMAP implementation
3. Share relevant results of existing scientific projects in the domain / EcAP cluster	3. Identify existing cooperation mechanisms between scientists, managers and policy makers in the Mediterranean, developing recommendations for strengthening collaboration between managers and scientists
4. Exchange on concrete steps and identify scientific actions (expertise, research, pilot projects ...) in response	4. Propose future scientific projects and practical scientific actions that can improve, for e.g, pollution/litter reduction in the Mediterranean (cluster related to EO 5, 9, 10)
5. Develop recommendations and identify solutions to reinforce Science Policy interfaces and network of scientists to implement IMAP at regional and national levels	

9 http://planbleu.org/sites/default/files/publications/rapport_atelier_ecap-spi_en.pdf

Transversal issues identified in 2015

- **Mapping results**. Outputs of the integrated assessments should be mapped under a GIS for a better understanding of environmental processes.
- **Cost-benefit analysis**. Workshop participants bring forward the interest of conducting cost-benefit analyses of monitoring.
- **Scales**. Relevant scales and timelines for the integrated assessment need to be clearly defined.
- **Aggregation rules**. Aggregation rules for the results of monitoring if the GES has been achieved or not need to be clarified.
- **Guidelines for risk-based approach.** IMAP document recommends applying a risk-based approach for the definition of monitoring procedures. The workshop approves this recommendation but calls for the development of guidelines to apply such an approach.
- **Empowerment of national task forces**. It is recommended to develop a mechanism for expertise and capacity building aiming at establishing operational national task forces to support IMAP.
- **Filling knowledge gaps with remote sensing**. Results of remote sensing should be used to for monitor physical elements, especially to establish baseline data for coast and hydrography issues, where no field data is available. However, in some cases, more detailed data will require field work.

From SPI thematic and transversal workshops to SPI key recommendations

For most of EcAp's ecological objectives, the categorization of research needs[10] for the implementation of IMAP and the corresponding scientific actions to fill identified gaps were discussed during thematic workshops organized around three thematic clusters in 2016 and 2017.

Building on the proposals formulated during these workshops, by scientists and the technical representatives of the ministries concerned (referred to here as "decision makers"), it has been possible to identify and structure recommendations to ensure that the knowledge produced by scientists contributes to the operational implementation of IMAP.

The workshops opened up perspectives to develop SPI for IMAP, namely by pointing out the need to formalize SPI along with dedicated structures and processes and to identify resources to support SPI. Scientists and decision makers convened to workshops have made it clear that the limits or absence of current SPI is a real issue for a full implementation of IMAP.

The three following brochures (one per IMAP cluster) provide Mediterranean stakeholders with key recommendations and conclusions that emerge from workshops to support EcAp roadmap and IMAP decision implementation by strengthening SPI.

10 The scientific needs have been categorized as far as possible in a more detailed way along the following categories:
1. Needs in methodologies (to define scales, selection of sites, aggregation)
2. Needs in guidelines for monitoring (do we have the protocols/guidelines for all indicators?)
3. Needs in data regarding the ecosystem status (and how research projects can contribute?)
4. Needs in data on sources of pollution or pressures
5. Needs in additional models and tools to complement and support IMAP implementation

SPI Workshop, Nice, 27 April 2017

Part 1: Key SPI Recommandations for Ecosystem-Based Ecological Objectives on Eutrophication (EO5), Contaminants (EO9) and Marine Litter (EO10)

Author: Carlos Guitart, Plan Bleu's consultant
Reviewers and contributors: Jelena Knezevic, MedPOL; Gyorgyi Gurban, UN Environment/MAP; François Galgani, Ifremer; Bruno Andral, Ifremer; Antoine Lafitte, Plan Bleu

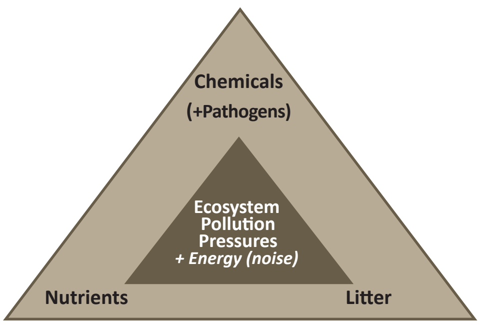
The achievement of the Good Environmental Status (GES) through the adoption of measures and target solutions in relation to pollution pressures in the Mediterranean coastal and marine environments relies on the IMAP monitoring programme, national data submission and the harmonization of the pollution impacts and state assessments of corresponding ecological objectives (5, 9 and 10) from national up to regional scales.

SPI workshops conclusions on eutrophication, chemical contaminants and marine litter

The 11 Ecological Objectives (EOs), as they stand in the EcAp initiative, were selected in the framework of the Barcelona Convention, as descriptors of the marine ecosystem, to inform on pressures, state and impacts. These EOs are divided into three main areas: Biodiversity and Non-indigenous species, Pollution and Coastal ecosystems and Hydrography.

The cluster on pollution includes EO5 (eutrophication), EO9 (contaminants) and EO10 (marine litter). These 3 EOs reflect the scientific-based knowledge on pollution pressures to the marine ecosystem monitored to date (see Figure below). Together with EO2 (Non-indigenous species) and EO11 (Energy) conforms the pollution pressures to the biodiversity in the marine environment (biological, chemical and physical). In this sense, the online Mediterranean QSR 2017 includes the 3 current EOs (EO5; 9 and 10) within their Land and Sea-based Pollution core theme.

Figure 1: the Ecosystem Approach "Pollution Cluster"



Within EcAp Med II project (2015-2018), a series of SPI workshops were undertaken to deepen key questions such as, the scales of assessment and the use of the risk-based approach (RBA) to develop fit-for-purpose monitoring strategies. Concrete sessions along the MEDPOL CORrespondence Expert Group on MONitoring (CORMON) meetings held in October 2016[1] and March 2017[2] on Ecological Objectives EO5, EO9 and EO10 discussed the SPI. The knowledge needs and fields for action for each of the Ecological Objectives (EO5, EO9 and EO10), highlighted the following facts:

Eutrophication (EO5) monitoring and assessment requires a deeper local and sub-regional approach with long time series of field measurements and observations not solely for Chlorophyll-a (common indicator 14), but also for nutrients (common indicator 13), in order to characterize with more than one Candidate Indicator this complex phenomena and its natural variability; and therefore, assessing eutrophication with both Common Indicators 13 and 14 of the IMAP. This will refine the scales of assessment in different ecological areas with improved thresholds values. In turn, those field observations are useful to validate ongoing satellite-based monitoring programmes (i.e EU Copernicus) to assess marine eutrophication.

Contaminants (EO9) observation needs continuous developments in terms of chemical monitoring and assessments due to the increasing number of chemicals of concern, threats and emerging priorities. Scientific research on the relationship between chemical concentrations and effects needs to be strengthened to improve the knowledge on this matter. The cross-enhancement of the contaminants reference lists (e.g. emerging contaminants) with the MEDPOL list suggests additional compounds should be monitored.

1 Workshop on Science Policy Interface (SPI) strengthening for the implementation of the UNEP/MAP Integrated Monitoring and Assessment Programme, for Pollution.

2 Workshop on Science Policy Interface (SPI) strengthening for the implementation of the UNEP/MAP IMAP in relation to Marine Litter, Biodiversity & fisheries, Hydrography, with a focus on the Risk Based Approach (RBA) for monitoring.

With respect to bathing waters quality, in terms of microbiology (pathogens), shellfish data has been suggested to be included in routine monitoring within IMAP. Monitoring strategies beyond coastal areas, coherent data management and the application of the risk-based approach (RBA) promises targeted monitoring strategies coherent with policy and societal needs.

Marine Litter (EO10) monitoring and assessment requires further developments. A common and harmonised approach for the definition of baselines, beyond the Mediterranean basin, is needed. Modelling, as well as GIS platforms, combined with spatial data on marine litter (accumulation areas, hotspots, sources) will depict their distribution and fate in order to implement remediation policy measures. On the other hand, effects on seafloor and fisheries are needed to be monitored.

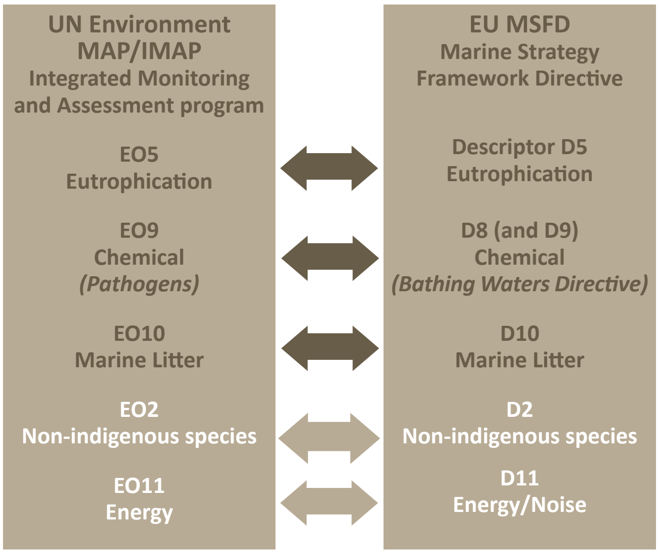
The SPI transversal workshops on **risk-based approach (RBA)** tools and scales of assessment to implement the IMAP in the Mediterranean Sea concluded that RBA should be an overarching principle of IMAP and represents a method for joined-up thinking across scientists, managers and decision makers. Therefore, RBA is a convenient way to design and optimize marine and coastal environmental monitoring and assessment strategies, as well as to minimize their economical cost. The **scales of assessment** were initially defined at the COP17 for the Ecosystem Approach Roadmap implementation at the 4 sub-regional geographical scales (Western Mediterranean Sea, Adriatic Sea, Central and Ionian Seas and Aegean-Levantine Seas) and are aligned with relevant policy such as the EU MSFD. The Contracting Parties monitoring and assessment programmes should consider their sub-regional basin to perform assessments based on the established geographical IMAP threshold values and pollution criteria, whilst observing their national and local environmental particularities and protection requirements.

Contracting Parties implementation of Ecological Objectives EO5, EO9 and EO10 and their Common Indicators

The UN Environment/MAP/IMAP and the EU MSFD established synergistic roadmaps for their implementation, and therefore, there is a special importance of the UN Environment/MAP decisions for those Contracting Parties that are EU members states, and similarly, to the activities developed in the framework of structures stemming from international agreements, such as other Regional Sea Conventions (RSCs) (i.e OSPAR Convention).

The online Correspondence Expert Groups set within the Ecosystem Approach Roadmap for EO5, EO9 and EO10 (i.e. online CORMON meetings) are in close collaboration with relevant EU MSFD working groups (e.g. MSFD working groups under the Common Implementation Strategy, such as MSFD Technical Group on Marine Litter (TGML), MSFD Contaminant Expert Group), groups linked to relevant EU policies (e.g. EU Water Framework Directive (WFD) Chemicals Working Group), as well as working as working groups within the different Regional Seas Conventions (RSCs) and others(e.g. ICES Marine Chemistry Working Group, OSPAR Commission's Hazardous Substances and Eutrophication Committee-HASEC). In this way, both scientific and policy developments and synergies are shared and implemented.

Figure 2: Comparability of biological, chemical and physical pollution descriptors and ecological objectives towards GES between EU MSFD and IMAP, respectively.



The 'Ecological Objectives' within the IMAP have their corresponding analogues as 'Descriptors' of the ecosystem characteristics within the EU MSFD. The pollution cluster integrates Eutrophication, Contaminants and Marine Litter in both policies and share similar criteria and targets. In addition to the existing 3 EOs in the IMAP pollution cluster, the Non-invasive species (EO2) and the introduction of Energy/Noise (EO11) would be a part of a set of a coherent set of objectives on human-induced pollution pressures, although integrated assessments have not been conducted yet. It should be observed that with EO9, IMAP includes a Common Indicator of coastal/bathing water quality which does not exist in the EU MSFD. Alternatively, the EU Bathing Water Quality Directive guarantees the requirements for the healthy use of recreational waters.

As mentioned above, each of the Ecological Objectives within the Pollution cluster in use, contains a number of specific common indicators to be monitored and assessed and ultimately integrated to respond to the requirements of IMAP towards the achievements of GES. These are presented in the following sections.

- **Common indicators 13 and 14 (EO5 Eutrophication)**

The eutrophication processes in coastal waters are considered a disturbance in the ecosystem affecting major ecosystem services such as fisheries, aquaculture and recreational waters. The majority of Contracting Parties monitor Common Indicator 13 (nutrient concentrations), whilst Common Indicator 14 (Chlorophyll-a) needs further developments. In the table below are presented the selected operational objectives to achieve GES.

EO5 EUTROPHICATION (LAND AND SEA-BASED POLLUTION)		
Ecological Objective (EO)	Operational Objectives (OOS)	Common Indicators (CIs)
EO5 Eutrophication	Human introduction of nutrients in the marine environment is not conducive to eutrophication	CI 13: Concentration of key nutrients in water column
	Direct and indirect effects of nutrients over-enrichment are prevented	CI 14: Chlorophyll concentration in water column

The wider Mediterranean basin presents from West to East numerous and unique characteristics in terms of primary production cycles and nutrients input distribution and processes (the north-western Mediterranean and Adriatic receive the discharges of main rivers such as Ebro river, Rhone river and Po river); and therefore, threshold values to assess the EO5 should observe the scales of assessment. There is a further need to refine and develop threshold values for common indicators contributing to the eutrophication processes in the Mediterranean.

Threshold values were derived by means of joint EU-Contracting Parties exercises and workshops on thresholds and assessment for the different areas and sub regions in the Mediterranean Sea and have been established for Chlorophyll-a. These are the values of reference agreed by Contracting Parties to the Barcelona Convention to assess the status and impacts of coastal eutrophication to adjust and further develop the national programmes of measures towards the achievement of the GES. The technical information on assessment criteria established to assess EO5 (Eutrophication; see box 1) has been developed under IMAP brochures (2016 and 2017)[3].

Box 1 - IMAP Assessment Criteria on Eutrophication

The table below present the detailed sub-regional assessment criteria to evaluate Ecological Objective 5 on Euthropication in the Mediterranean Sea.

Coastal Water Typology	Reference conditions Chl-a (ug L^{-1})		Boundaries of Chl-a (ug $^{L-1}$) for Good/Moderate status	
	G_mean	90th percentile	G_mean	90th percentile
Type I	1,4	3,33[1] - 3,93[2]	6,3	10 - 17,7
Type II (FR-SP)		1,9		3,58
Type II-A Adriatic	0,32	0,8	1,5	4,0
Type II-B Tyrrhenian	0,33	0,77	1,2	2,9
Type III-W Adriatic			0,64	1,7
Type III-W Tyrrhenian			0,48	1,17
Type III-W (FR-SP)		0,9		1,80
Type III-E		0,1		0,4
Type Island-W		0,6		1,2 - 1,22

[1] Applicable to Gulf of Lion Type I, [2] Applicable to Adriatic Type I. Source: IMAP Brochure, 2016.

3 https://wedocs.unep.org/rest/bitstreams/45233/retrieve

- **Common indicators 17, 18, 19, 20 and 21 (EO9 Contaminants)**

This Ecological Objective considers the occurrence, distribution and fate of natural and/or man-made contaminants which might lead to contamination or pollution effects. The implementation of this ecological objective builds on earlier work under the UN Environment/MAP MEDPOL Programme (Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea) running for almost 3 decades. Complementary and integrative Common Indicators, such as CI19 (on acute pollution events), CI20 (contaminant levels on seafood) and CI21 (microbiological seawater quality) have been put together to assess the ecological status and impacts of human-induced pollution in the marine ecosystems.

Table 1 : EO9 Chemical/bathing water quality (land and sea-based pollution)

Ecological Objective (EO)	Operational Objectives (OOs)	Common Indicators (CIs)
EO9 Chemicals	Concentration of priority contaminants is kept within acceptable limits and does not increase	CI 17: Concentration of key harmful contaminants measured in the relevant matrix (biota, sediment, seawater)
	Effects of released contaminants are minimized	CI 18: Level of pollution effects of key contaminants where a cause and effect relationship has been established
	Acute pollution events are prevented and their impacts are minimized	CI 19: Occurence, origin (where possible), extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution
	Levels of knows harmful contaminants in major types of seafood do not exceed established standards	CI 20: Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood
	Water quality in bathing waters and other recreational areas does not undermine human health	CI 21: Percentage of intestinal enterococci concentration measurements within established standards

With respect to this Ecological Objective it is worth to mention that monitored chemicals could be divided in two categories: 'legacy pollutants' and 'emerging contaminants' (see box 2). The first class refers to well-known and yearly time-series monitoring under MEDPOL were measures and policy actions have been already taken over the last 3 decades, whilst the 'emerging contaminants' are new potential chemical threats to the marine ecosystem were substantial knowledge is still required to address measures.

- **Common indicators 22, 23 and 24 (as a candidate indicator) (EO10 Marine Litter)**

Within IMAP Programme, Marine litter (macro/micro litter) occurrence, composition, and compartment distributions (beached, floating, seawater column and seafloor litter) have been the major focus for Common Indicator 22 (Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source) and Common Indicator 23 (Trends in the amount of litter in the water column including microplastics and on the seafloor). Currently, candidate Common Indicator 24 (Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds and marine turtles) is under development and taking a major role due to the seriousness of marine litter interactions with marine organisms.

Due to the increased public concern with marine litter impacts in the sea, a specific **Regional Plan on Marine Litter Management in the Mediterranean (2013)**[4], was adopted by the Contracting Parties to the Barcelona Convention and its Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities (LBS) in December 2013. Similarly, RSCs have evaluated the marine litter issue (see box 3), which has culminated with adopted Action Plans on Marine Litter by most of the EU member states, with clear links with the EU MSFD (Descriptor 10) and IMAP EO10, respectively.

Conclusion

The current global, regional and national frameworks both for science and policy programmes, as well as the elevated number of initiatives and projects underway in the Mediterranean Sea, forecasts an increasing scientific-based knowledge of pollution in the marine environment for policy-making. These will be exacerbated by the inclusion, within the national IMAP, of monitoring strategies related to pollution data management, research and policy in the Mediterranean region. The key recommendations presented should support national, sub-regional and regional policy developments for IMAP "Land and Sea-based pollution cluster" monitoring and assessment.

4 Decision IG.21/07 - Regional Plan on Marine Litter Management in the Mediterranean in the Framework of Article 15 of the Land Based Sources Protocol. COP18, Istanbul, Turkey, December, 2013

Table 2: EO10 Marine Litter (land and sea-based pollution)

Ecological Objective (EO)	Operational Objectives (OOs)	Common Indicators (CIs)
EO9 Chemicals	The impact related to propeties and quantities of marine litter in the marine environment and coastal environment are minimized	CI 22: Trends in the amount of litter washed ashore and/or deposited on coastlines (including analysis of its composition, spatial distribution and, where possible, source)
		CI 23 [A, B]: Trends in the amount of litter in the water columb including micro-plastics and on the seafloor [A] Seafloor Marine Litter [B] Floating Marine Litter
	Impacts of litter on marine life are controlled to the maximum extent practicable	Candidate CI 24: Trends in the amount of litter ingested by or entangling marine organisms, especially mammals, marine birds and turtles

Box 3 Marine Litter EO10: Awareness and other RSCs Regional Action Plans

UN Environment/MAP Regional Plan on Marine Litter Management in the Mediterranean (2013),

OSPAR Marine Litter Regional Action Plan (2014),

HELCOM Marine Litter Action Plan (2015),

Black Sea Integrated Monitoring and Assessment Programme (2017-2022)

Box 2. Emerging Chemicals in the Mediterranean Sea

Preliminar studies have been undertaken by the MAP Secretariat to elucidate potential chemical gaps and priorities with respect new emerging chemical threats in the Mediterranean Sea. The Barcelona Convention Candidate List 2017 was presented at the MEDPOL Focal Points Meeting in Rome (May 2017) and was based on scientific knowledge gaps in the Mediterranean. Below a comparasion of major chemical substances groups, showing the groups were at least two Regional Seas Conventions (RSCs) coincides, including emerging chemicals.

Categories and/or chemical compounds	LBS protocol (1996)	SAP-MED (2000)	HELCOM (2010)	OSPAR (2013)
Metallic compounds				
Cadmium	x	x	x	x
Lean and organic lead compounds	x	x		x
Mercury and organic mercury compounds	x	x	x	x
Organometallic compounds				
Organic tin compounds	x	x	x	x
Organohalogenated compounds				
Perfluorooctanyl sulphonic acid (PFOS)			x	x
Brominated flame retardants (PBDEs)		x	x	x
Polychlorinated biphenyls (PCBs)	x	x	x	x
Polychlorinated dibenzodioxins (PCDDs)	x	x	x	x
Polychlorinated dibenzofurans (PCDFs)	x	x	x	x
Short chain chlorinated paraffins (SCCP)		x	x	x
Endosulfan			x	x
Hexachlorocyclohexane isomers (HCH)	x	x		x
Pentachlorophenol (PCP)		x		x
Nonylphenol/ethoxylates (NP/NPEs)			x	x
Octylphenol /ethoxylates (OP/OPEs)			x	x
Polychlorinated naphthalenes (PCNs)		x		x
Polycyclic aromatic compounds				
Polyaromatic Hydrocarbons (PAHs)	x	x		x

Programmes and platforms related to the EcAp Cluster on Pollution for data management, research and policy in the Mediterranean region to support IMAP and Ecosystem Approach implementation.

Project/Initiative	Funding	Period	Partnership	Related IMAP EOs and CLs	Description and objectives	Links to IMAP pollution thematic
Research, data science and innovation projects supporting policy developments More information about funded projects EU Interreg, EU LIFE, JPI Oceans can be consulted through the MARINE KNOWLEDGE GATE 2.0 http://www.kg2.eurocean.org/						
Oceans of Tomorrow (report available): https://publications.europa.eu	EU FP7	2010-2013	Over 150 European partners	EO5, EO9 and EO10 (CIs: 13, 14, 17, 18, 19, 20 and 22)	Over 31 funded projects to implement the marine and maritime research agenda and to advance in marine sciences, such as new monitoring technologies.	Eutrophication, Contaminants and Marine Litter monitoring technologies
Ocean Data Interoperability Platform http://www.odip.eu/	H2020 IOC/ IODE	2012-2018	International partnership	EO5, EO9 and EO10	The Ocean Data Interoperability Platform (ODIP) contributes to the effective sharing of data across scientific domains and international boundaries (EU, US, and Australia).	Shared information systems, policy and decision making, harmonization of marine data management and standards
SeaDataCloud http://eurogoos.eu/seadatacloud/	EU	2016-2020	Pan-European infrastructure including 34 countries bordering the European seas	EO5 (CIs: 13 and 14)	The SeaDataCloud project works to advance SeaDataNet services and increase their usage adopting cloud and high-performance computing technology.	Wide range of in situ observations and remote sensing data access through improved services and tools
Big Data Ocean http://www.bigdataocean.eu/site/	H2020	2017-2020	10 European partners, including SMEs	EO9 (CI 19)	BigDataOcean will deliver the greatest repository for maritime data to enable big data scenarios	Marine protection applications through bid data tools and improvement cross-cutting management
Spatial Analysis, Operational Platforms and EU Agencies for marine matters and cooperation						
EDMONET http://www.emodnet.eu/portals	EU	2011-Current (3rd phase)	Over 100 partners in European member states 2011	EO5, EO9 and EO10 (CIs: 13, 14, 17, 19, 20, 22 and 23)	The European Marine Observation and Data Network (EMODnet) is a network of organisations supported by the EU's integrated maritime policy.	Provides data flows and mapping products for thematic regional and sub-regional assessments
EU Copernicus http://marine.copernicus.eu/	EU	2015-ongoing	EU research centres and industry	EO5 (CI 13)	The Copernicus space program has been designed to respond to issues emerging in the environmental, business and scientific sectors.	The EU space strategy for marine environment monitoring services

EOOS http://www.eoos-ocean.eu/	EU	2018-2022	Coordinating framework with high-level EU organisations participation	EO5, EO9 and EO10	EOOS is a coordinating framework designed to align and integrate Europe's ocean observing capacity and to promote a systematic and collaborative approach to collecting information	Long-term oceans observing systems on the variability and state of the sea
SeaDataCloud http://eurogoos.eu/seadatacloud/	EU	2016-2020	International partnerships	EO5 (CI 13)	IODE provides a "one-stop shop" approach to oceanographic data held by the IODE global network of 80 National Oceanographic Data Centres (NODCs), as well as to resources from other participating systems.	Standards and data harmonisation toolss
JPI-Oceans http://www.jpi-oceans.eu/	EU	2011-ongoing	EU member states partnership	EO10 (CIs: 22, 23 and 24)	The Joint Programming Initiative Oceans (JPI Oceans) is an intergovernmental platform. Currently, includes a programmatic theme on Ecological Aspects of Microplastics (BASEMAN, EPHEMARE, PLASTOX and WEATHER-MIC projects).	Scientific data collection and innovative research
Global Analysis and International Initiatives on Marine Litter						
GESAMP http://www.gesamp.org	Interna-tional	1969-ongoing	Thematic expert groups	EO9 and EO10 (CIs: 17, 20, 22 23 and 24)	. The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) is an advisory body to the United Nations (UN) system on the scientific aspects of marine environmental protection	Global review on marine pollution topics
US Marine debris programme https://marinedebris.noaa.gov/	US	2006-2020	A number of US coordinating organisations	EO10 (CIs: 22, 23 and 24)	The mission of the NOAA Marine Debris Program is to investigate and prevent the adverse impacts of marine debris (2016-2020 Strategic Plan).	References for IMAP development and standards
LITTERBASE http://litterbase.awi.de/	Germany	Current	Leaded by the Alfred Wegener Institute (AWI)	EO10 (CIs: 22, 23 and 24)	Interactive marine litter world ocean's maps compiled from scientific publications at the Alfred Wegener Institute (Germany).	Datasets on Marine litter interactions with biodiversity to fill the data gaps
Pelletwatch http://www.pelletwatch.org/	Japan	2005-ongoing	Over 80 groups in 50 countries	EO9 and EO10.	IPW is a volunteer-based global monitoring program designed to monitor the pollution status of the oceans.	The project deliveries aim to study and update the microplastic thematic.

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Part 2: Key SPI Recommandations for Ecosystem-Based Ecological Objectives on Marine Biodiversity (EO1) and Fisheries (EO3)

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The Contracting Parties to the Barcelona Convention agreed to apply the Ecosystem Approach to manage human activities in the Mediterranean, with the ultimate objective to achieve a Good Environmental Status (GES). The Ecosystem Approach-MED I and II projects (2012-2018) and the GEF Adriatic project (2017-2019) support the implementation of EcAp, in synergy and coherence with the European Union Marine Strategy Framework Directive (MSFD 2008/56/CE) and Marine Spatial Planning (MSP). The SPI activity aims to ensure that the outcomes and ongoing work of scientists can be effectively channelled into the policy discussions taking place under the Barcelona Convention. This brochure will focus on the key recommendations to strengthen SPI for Ecological Objectives 1 and 3 achievements.

Tables 1 and 2 present Ecological Objectives 1 and 3, corresponding operational objectives and indicators[1].

SPI workshop findings on marine biodiversity and fisheries

In relation to Biodiversity and Fisheries, the SPI workshops' participants (policy makers of the Barcelona Convention Contracting Parties and scientists) concluded on some key recommendations identifying gaps to be filled for an optimal implementation of the IMAP process[2]. Those recommendations represent a summary of the discussions held during the SPI workshops. It has notably been recommended to promote specific workshops to improve the scientific knowledge on specific topics, and to answer specific policy needs regarding marine biodiversity to strengthen the science-policy interface.

Table 1: EO1 on Marine Biodiversity

Ecological Objectives (EO)	Common indicator	Related operational objective
EO1 Biological diversity is maintained or enhanced. The quality and occurrence of coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.	1 Habitat distributional range - Habitat extent	Key coastal and marine habitats are not being lost.
	2 Condition of the habitat's typical species and communities	Key coastal and marine habitats remain in natural condition, in terms of structure and functions.
	3 Species distributional range (related to marine mammals, seabirds, marine reptiles)	Species distribution is maintained.
	4 Population abundance of selected species (related to marine mammals, seabirds, marine reptiles)	Population size of selected species is maintained, or, if depleted, it recovers to natural levels.
	5 Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles)	Population condition of selected species is maintained

1 Meeting of the Correspondence Group on Monitoring (CORMON), Biodiversity and Fisheries Madrid, Spain, 28th February - 1st March 2017. UNEP(DEPI)/MED WG.430/3 2017.

2 SPI Interface Workshop on Scales of Monitoring and Assessment and on the draft Quality Status Report. Agenda item 3: Best practices on assessment and reporting scales (practices of regional seas and of Contracting Parties). Temporal and geographical scales of monitoring, reporting and assessment to further develop the implementation of IMAP. Nice, France, 27-28 April 2017.

Table 2: EO3 on Commercially exploited Fish and Shellfish

Ecological Objectives (EO)	Common indicator	Related operational objective
EO3 Populations of selected commercially exploited fish and shellfish are within biologically safe limits, exhibiting a population age and size distribution that is indicative of a healthy stock	7 Spawning Stock Biomass	The Spawning Stock Biomass is at a level at which reproduction capacity is not impaired
	8 Total landing	Total catch of commercial species does not exceed the Maximum Sustainable Yield (MSY) and the by-catch is reduced.
	9 Fishing mortality	Fishing mortality in the stock does not exceed the level that allows MSY (F≤ FMSY).
	10 Fishing effort	Fishing effort should be reduced by means of a multi-annual management plan until there is an evidence for stock recovery.
	11 Catch per unit effort (CPUE)	Population condition of selected species is maintained Stable or positive trend in CPUE Declines in CPUE may mean that the fish population cannot support the level of harvesting. Increases in CPUE may mean that a fish stock is recovering and more fishing effort can be applied.
EO1-EO3	12 Bycatch of vulnerable and non-target species	Incidental catch of vulnerable species (i.e. sharks, marine mammals, seabirds and turtles) are minimized

To date, the key issues identified are:

- heterogeneous spatial distribution of knowledge availability among the Contracting Parties, decreasing from North to South;
- capacity building and funding for equipment would be required to implement IMAP in non-European countries;
- science should cater for the different purposes of the IMAP such as monitoring and integrated environmental assessment;
- IMAP further revisions, and specific insights on marine ecosystem functioning should be promoted, such as composition and relative proportions of the components of the ecosystem; productivity of main species or trophic groups; proportion of selected species at the top of trophic webs; abundance / distribution of functional or trophic groups and main species;
- to improve IMAP process, there is the need to develop scientific and management exchange of knowledge on specific topics, particularly with MPA scientists and managers, to enhance the capability of understanding, assessing and managing the challenges of the IMAP process implementation;
- particular attention should be paid to the methodologies employed by the Contracting Parties to develop coherent monitoring programmes and databases;
- the Mediterranean region is still lacking a complete list of species and habitat communities per ecosystem which is a fundamental requirement to produce reliable data to upgrade the habitat and species inventory.

Species and habitat inventories are cornerstones to understand trends and changes of selected biodiversity components, but also to guide pursuit of new knowledge and, more generally to manage the ecosystem, supported by adequate monitoring activities. In particular to better define the baseline/reference condition for the definition of GES could be appropriate to give a description of the interactions between species, which can be complex.

This will lead to the possibility to select **common indicator species,** to be monitored at regional scale in order to address IMAP Common indicators 1 to 5[3], and to assess major environment disturbances, including climate change.

Furthermore, the SPI Inception Workshop (held in December 2015) allowed to identify the main fields of action for a better implementation of the IMAP:

- the marine stations network (including pelagic and benthic habitats into monitoring and assessment) should be strengthened and further developed;
- knowledge on taxonomy, building up gene banks for species identification, the production of monographs for each taxonomic group and fostering capacity building for linking phenotypes and genotypes should be boosted up.

3 CI 1 - Habitat distributional range (EO1) to also consider habitat extent as a relevant attribute; CI 2 - Condition of the habitat's typical species and communities (EO1); CI 3 - Species distributional range (EO1 related to marine mammals, seabirds, marine reptiles); CI 4 - Population abundance of selected species (EO1, related to marine mammals, seabirds, marine reptiles); CI 5 - Population demographic characteristics (EO1, e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles).

Harmonising monitoring activities by coordination and cooperation leads to a system were data is produced once and used many times. This goal could be reached by increasing joint initiatives such as sampling surveys and shared stations exploiting the existing network of marine stations, universities, research institutes and MPAs, taking advantage of scientific capacities, as observational platforms of Mediterranean biodiversity, harmonising existing GIS databases (or new platforms while avoiding duplications) to store and make available results of habitat mapping, including data mining of past projects.

Particular knowledge needs have been highlighted on diversity, density and distribution of important marine mammal habitats. These could be met by:

- developing coherent and standardised national monitoring programmes using sea or aerial observations;
- based on existing large-scale observations allowing identifying recurrent patterns;
- observation data could be coupled with data on physiology and epidemiology;
- the identification of few species (e.g. coastal dolphins) of different functional groups should be included, a minima, in national monitoring programmes. Those data should improve and sustain existing databases and GIS platforms for marine mammal distribution in the Mediterranean region.

Table 3: Priorities identified for Biodiversity and Fisheries coming from thematic SPI workshop

Species (invertebrates)	• Enhance taxonomy competences (training) • Produce monographs for each taxonomic group • Develop Genetic taxonomy • Build up gene banks • Select common indicator species
Benthic Habitats	• Homogeneous habitat mapping and typology standards from Northern to Southern Mediterranean • Develop (or harmonize existing) GIS databases • Encompass geological and biological features in habitat mapping
Pelagic Habitats	• Extend the concept of habitat to the pelagic realm
Species (Mammals)	• Include in national monitoring programmes few species (e.g. coastal dolphins) of different functional groups • Gather data on physiology and epidemiology • Couple large scale observation with data on physiology and epidemiology
Habitat (Mammals)	• Develop coherent, standardised national monitoring programmes using sea or aerial observations, based on existing large-scale observations • Sustain existing databases and GIS platforms or develop new ones while avoiding duplications
Cross-cutting issues	• Develop (or harmonize existing) marine stations network • Define the baseline/reference conditions • Build capacity and increase funding for equipment in non-European countries

Main findings regarding two cross-cutting issues: the risk-based approach for monitoring and scales of assessment and monitoring

Within the frame of the SPI activity, transversal workshops have been dedicated to the Risk-based Approach (RbA) to monitoring and assessment; and to temporal and geographical scales of monitoring, reporting and assessment.

The Risk-based Approach to monitoring and assessment is an overarching theme for the IMAP process. The key concepts of the RbA are:

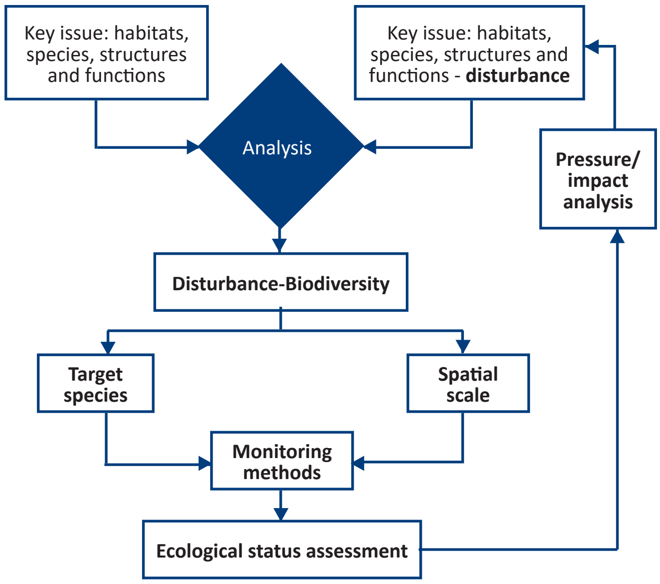
- identify the areas (sub-areas) that are under higher pressures and the biota that are known to be more sensitive;
- extend GES evaluation of the sub-areas to large areas following a nested approach;
- if the environmental status in the sub-areas is not "good", then monitoring and assessment would be conducted stepwise at additional sites along the decreasing gradients of pressure or sensitivity;
- to focus on some representative sites and species, which can showcase the relationship between environmental pressures and their main impacts on the marine environment.

In this framework, the countries' representatives have recommended to perform a pressure/impact analysis (Figure 1) to select sites were pressures and risks on biodiversity are most strongly associated. Those "representative sites" should be of high biodiversity importance and conservation interest according to national, regional or international regulations and standards. Furthermore, priority should be given to areas characterized by intense anthropic activities and where impacts may be particularly severe or long term. Areas representing the physiographic and hydrological conditions of the pressured areas considered un-impacted should be also monitored to establish reference/baselines. The degree to which pressures occur in isolation or in combination should also be evaluated, giving rise to cumulative effects of pressures/impacts on habitat and species.

Marine and coastal protected areas, or Specially Protected Areas (SPAs), under the Protocol on Specially Protected Areas and Biological Diversity (SPA/BD Protocol) should be monitored during the IMAP initial phase (2016-2018) in order to determine reference conditions for the definition and thresholds of GES. Monitoring of marine and coastal protected areas of different protection status could also inform on the effectiveness of protection measures. Regional risk-based approach should seek to prioritise those habitats that need active and regular monitoring programmes in a cost-effective manner.

In relation to the indicative list of habitats and species to be monitored, it is recommended to select those habitats that are essential for important species functions such as spawning and feeding grounds, and species that best represent the impacts of the pressure on each broader group.

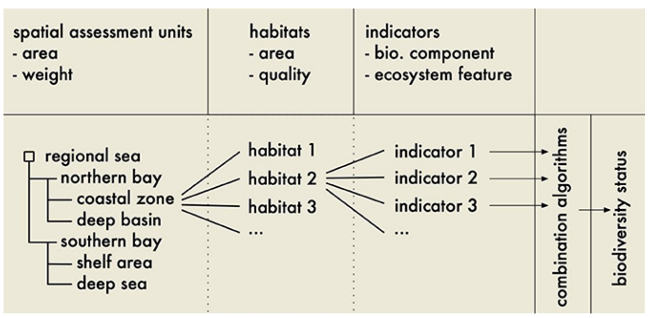
Figure 1: Pressure impact analysis diagram according to the risk-based approach



Considering the dynamic nature of ecosystems and the naturally varying environmental conditions, GES can only be directly quantified for certain temporal and spatial scales for species and habitats.

The concept of "scales" reflects the necessity to clearly define the different scales of the integrated monitoring and assessment actions, using a "nested approach". This means that the assessment should provide data of nested (rather than overlapping) areas, which facilitate aggregation, where appropriate, up to sub-region or region scales. The process can be schematically descripted by the conceptual model of the design of the Nested Environmental Assessment Tool (NEAT) illustrated below.

Table 4: Conceptual model of the design of the Nested Environmental Assessment Tool (NEAT). From Borja et al., 2016



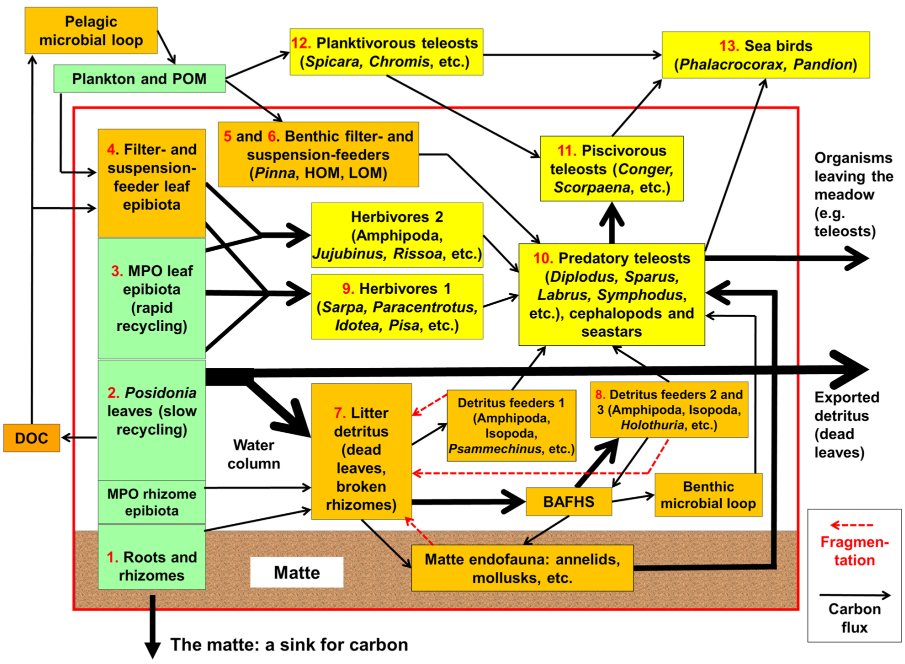
The SPI Workshop on Scales of Monitoring and Assessment clarified that monitoring scales and assessment scales are linked but distinct, the latter defining the scale at which for each specified element GES has been achieved or not, a process that needs to draw from and aggregate the monitoring data that will often be collected at finer spatial and temporal scales. In addition, it gave the following key conclusions and recommendations on scales of monitoring and assessment in the context of IMAP:

- national scales of monitoring and regional level assessment are linked, as data on monitoring serve to feed the assessment, but are addressed through different methodological approaches. Hence to define the best temporal and spatial scales for monitoring and assessment, scientists have to investigate on practical issues to answer to managers and stakeholders;
- there is a need for networking among scientists even on interdisciplinary tasks, building mixed research teams (mixing disciplines) on specific issues at regional and sub-regional levels working together on agreed standardized protocols[4].

Summary of key recommendations and outcomes expressed during the SPI workshop on Marine biodiversity and fisheries:

- The first key step for the implementation of the IMAP at national level is the optimization of marine station networks or the development of new ones, in line with the country specific national IMAPs. These networks should be moderated by scientists from different disciplines, in particular by marine taxonomists. This to lead to a more holistic approach of the marine and coastal environment monitoring and assessment. Pelagic and benthic realms, not only large-top food chain predators should be study objectives as well as along threats and pressures to the marine ecosystem. More networking should be done among scientists to develop standardized methods and protocols; links between physicochemical oceanology, ecosystems functioning knowledge, and threats and pressures, considering connectivity effects and processes, should be developed, overcoming each countries specificity in terms of habitat and socioeconomy.

Figure 2: From Personnic et al., 2014: Conceptual model of the functioning of Posidonia oceanica seagrass ecosystem. Primary producers are in green; filter-feeders, suspension-feeders, litter, detritus feeders, Dissolved Organic Carbon (DOC) and microbial loops are in orange; predators (including herbivores) are in yellow. The width of the arrows roughly represents the importance of the carbon flow. The proper P. oceanica ecosystem is included within the red rectangle. MPO: Multicellular Photosynthetic Organisms. POM: Particulate Organic Matter.



4 Marine Protected Areas: A multidisciplinary Approach Ecology, Biodiversity Conservation. J. Claudet. Cambridge University Press, 2011 pp 373 ISBN 1139502360

- Shifting from an "habitat logic" to an "**ecosystem logic**" there is the need of better understanding of the **functional role** of marine species and of marine ecosystems for conservation purposes. In particular, the improvement of knowledge on trophic networks as part of the ecosystem functioning, applying for example the Ecosystem-Based Quality Index (EBQI) to few significant Mediterranean ecosystems (Posidonia meadows, coralligenous, caves and other dark habitats). For this purpose, research projects must be promoted on less known bentho-pelagic couplings - e.g. short food webs including microbial loops, role of suspension feeders (sponges, gorgons) in the ecosystem functioning and on other networks of interactions (e.g. chemical ecology) explaining some behaviour leading to habitat selection, recruitment, etc. The research and development on the above-mentioned topics could lead to rationale and quantitative monitoring programmes.
- Accordingly, the development of a monitoring programme should be based on a holistic, integrated understanding of the marine ecosystem of the region or sub-region to be assessed. This could be done by compiling relevant information in a Geographic Information System (GIS) to enable a spatial (and temporal) understanding of the relationship between human activities (which may be causing adverse pressures on the environment) and the characteristics of the environment, including its biodiversity. Overlapping maps (cross analyses of spatial layers) in a GIS will help give a holistic visualization of the assessment area, the anthropogenic pressures acting upon it, and locations of current monitoring programmes. This will enable to inform decision making on how to prioritise the areas to be considered for monitoring.
- To ensure networking, "SPI platforms" should be build up structuring it at different levels, starting from simple interfaces adapted to the context: local (e.g. raising awareness on local habitat peculiarities), national (e.g. promoting initiatives between adjacent countries), or regional (at Mediterranean level).
- There is a need to create links between the scientific community (nature and social sciences) and policy makers / public institutions in order to create a network of experts and projects regarding specific issues (e.g. pollution monitoring). SPI should include evaluation processes to assess performance and allow improvement.

SPI Workshop on Marine Biodiversity, Tangiers (Morocco), November 2016

Programmes and platforms related to the EcAp Cluster on Marine Biodiversity, Non-Indigenous Species and Fisheries for data management, research and policy in the Mediterranean region to support IMAP and Ecosystem Approach implementation

Name	Funding	Year	Relevance to IMAP implementation	Project Leader	EO/CI
EMODnet Seabed Habitats Biology During the current Phase III (2017-2020), Seabed Habitats will extend the work carried out during the preparatory Phases to move from a prototype to an operational service delivering full coverage of a broad-scale map for all European sea-basins, along with the dissemination of maps from surveys.	EU Integrated Maritime Policy	On going ending in 2019	- Broad scale habitat mapping. - Free access to data on temporal and spatial distribution of marine species and species traits from all European regional seas.	JNCC (UK government's nature conservation advisor)	EO1/ CI1
CONFISH This project aims to design a Mediterranean-based network that relies on robust social framework and cutting edge evolutionary science for future implementation of bottom up approach into fishery management. The overarching goal is to promote knowledge transfer between evolutionary scientists and local fishery stakeholders towards sustainable fisheries management.	EU - Interreg MED	2018	Mediterranean-based network that relies on robust social framework to implement bottom up approach into fishery management.	University of Zagreb (PMF), Croatia	EO3
MEDCIS Support Mediterranean member states towards coherent and coordinated implementation of the second phase of the MSFD	DG ENV	On going ending in 2018	- Methodological standards towards coordinated approaches between EU Member States, across the Mediterranean by reviewing, comparing, selecting and adapting appropriate existing methodologies. - Standardization of suitable approaches to achieve GES, taking in consideration the specificities of the basin and of the countries. - Network with RSCs (particular UNEP/ MAP), MSFD competent authorities, policy makers and other stakeholders, as well relevant projects to ensure coordination across regions/sub-regions, and boost dissemination of results and the direct use of the project's outcomes in accessible manner to stakeholders.	HCMR IFREMER AZTI tecnalia	EO1/ CI1, 2,3,4,5 EO 3
PANACeA Regional initiative to channel common efforts towards an effective protection of natural resources in the Mediterranean	EU - Interreg MED	On going	- Networking of Mediterranean Protected Areas as a mechanism to enhance nature conservation and protection in the region. - Synergies between relevant Mediterranean stakeholders, including managers, policymakers, socio-economic actors, civil society and the scientific community.	ETC-UMA, University of Malaga Spain	EO1/CI 3,4,5

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Meeting of the Correspondence Group on Monitoring (CORMON), Biodiversity and Fisheries Madrid, Spain, 28th February – 1st March 2017 Agenda item 4: Common indicator factsheets for biodiversity (EO1), NIS (EO2) and Fisheries (EO3)

Meeting of the Correspondence Group on Monitoring (CORMON), Biodiversity and Fisheries Madrid, Spain, 28th February – 1st March 2017 Agenda item 7: Progress in the preparation of the 2017 Mediterranean Quality Status Report related tobiodiversity and NIS (EO1-EO2)

Personnic S, Boudouresque CF, Astruch P, Ballesteros E, Blouet S, et al. (2014) An Ecosystem-Based Approach to Assess the Status of a Mediterranean Ecosystem, the Posidonia oceanica Seagrass Meadow. PLoS ONE 9(6): e98994. doi:10.1371/journal.pone.0098994

Plan Bleu - Strengthening the Science-Policy interface in the field of Marine Protected Areas (MPAs) and marine biodiversity in the Mediterranean Sea Workshop organized in the framework of the 2016 Forum of Marine Protected Areas in the Mediterranean, Tangier, Morocco, 28 November 2016

Plan Bleu - Report of the "Workshop on Science Policy Interface (SPI) strengthening in the field of Marine Protected Areas and Marine biodiversity in the Mediterranean". Tangier, Morocco, 28 November 2016

Report of the Meeting on "Joint Workshop on Science Policy Interface (SPI) strengthening and Ecosystem Approach Coordination Group Meeting on IMAP scales of monitoring and assessment, including the next QSR, Nice, France, 27-28 April 2017" UNEP(DEPI)/MED WG.438/8.

Workshop on Science Policy Interface (SPI) strengthening for the implementation of the UNEP/MAP IMAP in relation to Marine Litter, Biodiversity & fisheries, Hydrography, with a focus on the Risk Based Approach (RBA) for monitoring. Madrid, Spain, 2nd March 2017. UNEP(DEPI)/MED WG.432/3

Workshop on Science Policy Interface (SPI) strengthening for the implementation of the IMAP in relation to Marine Litter, Biodiversity & fisheries, Hydrography, with a focus on the Risk-based Approach for monitoring. Madrid, Spain, 2nd March 2017. Report of the Meeting "Workshop on Science Policy Interface (SPI) strengthening for the implementation of the IMAP in relation to Marine Litter, Biodiversity & fisheries, Hydrography, with a focus on the Risk based Approach for monitoring, Madrid, Spain, 2 March 2017" UNEP(DEPI)/MED WG. 432/6

Workshop on Scales of Monitoring and Assessment and on the draft Quality Status Report (SPI). Agenda item 3: Best practices on assessment and reporting scales (practices of regional seas and of Contracting Parties). Temporal and geographical scales of monitoring, reporting and assessment to further develop the implementation of the map integrated monitoring and assessment programme (IMAP). Nice, France, 27-28 April 2017

Part 3: Key SPI Recommandations for Ecosystem-Based Ecological Objectives on Hydrography (EO7) and Coast (EO8)

Author: Dr. Claudette Spiteri, Plan Bleu's consultant
Reviewers and contributors: Olivier Brivois, UN-Environment/MAP's consultant; Giordano Giorgi, ISPRA; Antoine Lafitte, Plan Bleu.

Science Policy Interface (SPI) plays an important role in the effective development and implementation of environmental policy, one that is based on sound scientific principles and evidence. It offers the opportunity for scientists, policy makers to communicate, exchange ideas, and jointly develop knowledge for making research, policy and decision-making processes more robust. As part of the activities under the EcAp cluster Hydrography and Coast, emphasis was put on two underlying transversal issues (i) Risk-based Approach (RBA) and (ii) temporal and geographic scales, as a way to reinforce SPI in the development of monitoring and implementation plans. Although the indicators associated to the EcAp cluster Hydrography and Coast are still in the process of being developed, efforts on reinforcing SPI highlighted the need to support countries through capacity building on numerical modelling, GIS and map digitization. Efficient use of existing relevant open scientific data should be made to circumvent the identified lack of available data. This requires strong coordination at the national level between administrative services and scientific institutions and presents opportunities for new partnerships with business and public bodies managing relevant environmental data.

Port du Prado and Plage du Grand Roucas in Marseille, France.
Source: http://www.medam.org

1. EcAp and IMAP's specificities for the Hydrography and Coast cluster

All three indicators in the EcAp cluster Coast and Hydrography are relatively new in the framework of UN Environment MAP, and in a process of being developed. Unlike EO7, EO8 does not have a precedent in other regional ecosystem approach initiatives, such as HELCOM or OSPAR, or in the MSFD.

Box 1: EcAp cluster Coast and Hydrography

Correspondence Groups on Monitoring (CORMONs) were set up with the aim to further specify the common indicators*, discuss monitoring methodologies and parameters related to them and as such form the core of IMAP. These groups tackle the issues covered by the Ecological Objectives, grouped in three clusters namely: Pollution and Litter; Biodiversity and Fisheries; and Coastal Ecosystems and Landscapes and Hydrographical conditions, better known as Coast and Hydrography.

At the core of EcAp cluster Coast and Hydrography are following Ecological Objectives:

- Ecological Objective 7 (EO7) Alteration of hydrographic conditions does not adversely affect coastal and marine ecosystems (EO7: Hydrography in short). EO7 addresses permanent alterations in the hydrographical regime of currents, waves and sediments due to new large-scale developments.

- Ecological Objective 8 (EO8) The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved (EO8: Coastal ecosystems and landscapes, or Coast in short). The EO8 reflects the aim of the Barcelona Convention to include coastal areas in the EcAp assessment, which became a legal obligation upon the entry into force of its Protocol on Integrated Coastal Zone Management in the Mediterranean (ICZM Protocol).

Table 1: Monitored EOs 7 & 8

Hydrography	***EO7 is monitored using:***			
	Indicator	**Indicator name**	**Target**	**GES**
	Common Indicator 15	Location and extent of the habitats impacted directly by hydrographic alterations (linked with the assessment of EO1: Biodiversity on habitat extent)	To ensure that all possible mitigation measures are considered when planning the construction of new structures, in order to minimize the impact on coastal and marine ecosystem and its services, integrity, and cultural/historic assets.	Is achieved when negative impacts due to new structures are minimal with no influence on the larger scale coastal and marine systems.
Coast	***EO8 is monitored using:***			
	Indicator	**Indicator name**	**Target**	**GES**
	Common Indicator 16	Length of coastline subject to physical disturbance due to the influence of man-made structures	Left to the countries to establish due to strong socio-economic, historic and cultural dimensions, in addition to specific geomorphological and geographical conditions.	Is achieved by minimizing physical disturbance to coastal areas induced by human activities.
	Candidate Indicator* 25	Land use change	General targets for this indicator may include: no further construction within the setback zone; change of coastal land use structure - dominance of urban land use reversed; and keeping, and increasing, where needed, landscape diversity.	Is achieved when linear coastal development is minimised, with perpendicular development being in balance with integrity and diversity of coastal ecosystems and landscapes. In addition, mixed land-use structure should be achieved in predominantly man-made coastal landscapes.

*Unlike common indicators, candidate indicators still have issues regarding their monitoring and assessment and therefore are recommended to be monitored in the initial phase of IMAP on a pilot and voluntary basis (UNEP(DEPI)/MED IG.22/28). However, on several occasions (e.g. CORMON meeting on Coast and Hydrography in March 2017, PAP/RAC Focal Points meeting in May 2017) it was indicated that the "Land-use change" indicator is already mature enough to become a common indicator, and to be included in the following revision of the IMAP as well as in the following edition of the Quality Status Report 2023.

2. SPI aspects of monitoring Coast and Hydrography

Under the umbrella of reinforcing SPI in the implementation of IMAP and EcAp to facilitate and enhance monitoring and assessment of the status of the Mediterranean Sea, two underlying transversal issues have been thoroughly addressed: (i.) Risk-based Approach (RBA) and (ii.) temporal and geographic scales (see Graph1, in the introduction).

Aspects of RBA and Scales pertinent to *Coast and Hydrography* resulting from the SPI process are presented in more detail below.

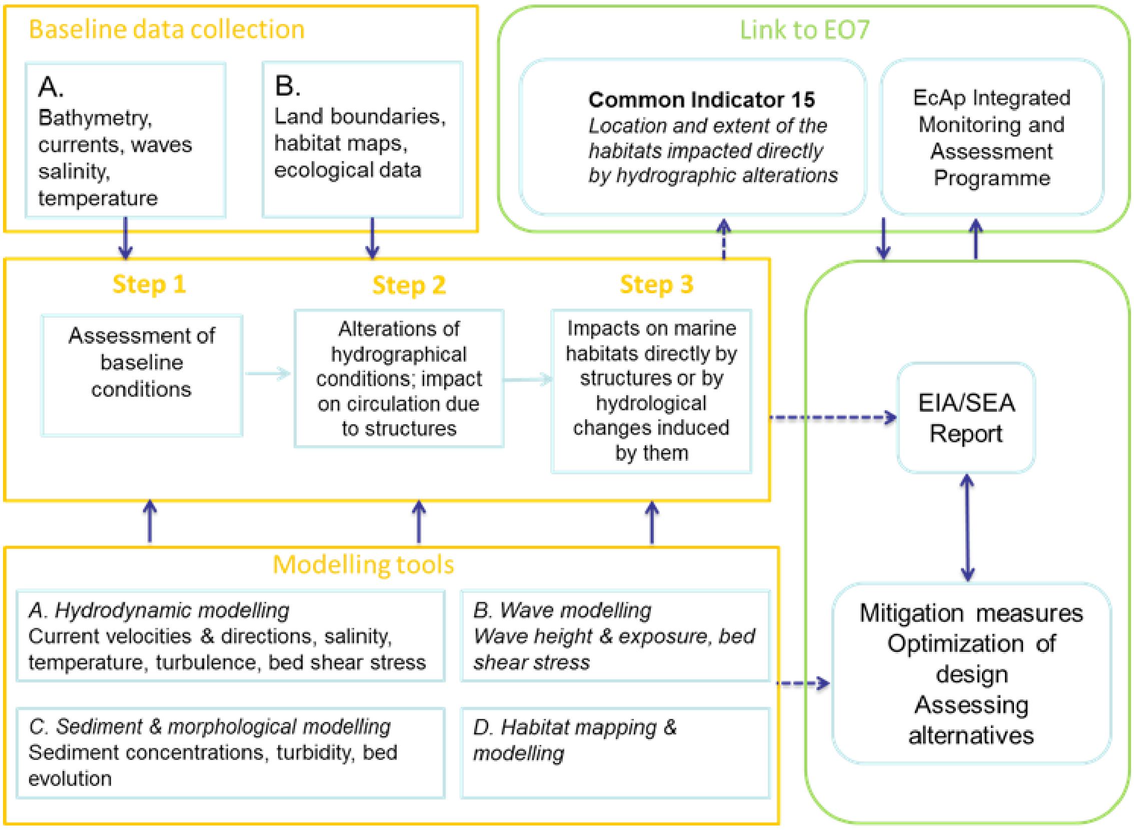
2.1. Considerations for Hydrography (EO7)

As part of the development of Common Indicator 15 - Location and extent of the *habitats impacted directly by hydrographic alterations*, a methodological approach within the broader scope of EO7 was presented in Spiteri (2015).

The identified steps therein provide a coherent and logical approach to assess the impacts of a construction/development in coastal and marine areas, both on the hydrographical conditions as well as marine habitats. The applicability and feasibility of this methodology could be greatly enhanced if in each step the SPI considerations and pragmatic application of RBA and scales are also considered, as presented in the following sections.

A methodological approach (Graph below) was developed for the development EO7 Common Indicator 15 – Location and extent of the habitats impacted directly by hydrographic alterations.

Strengthened SPI would greatly benefit the collection of baseline data, application and validation of models in support of Steps 1-3 (orange boxes) as input to the policy process (green boxes), indicated by dashed arrows. Modified from Spiteri (2015).


Baseline data collection
A.
Bathymetry, currents, waves salinity, temperature
B.
Land boundaries, habitat maps, ecological data
Link to EO7
Common Indicator 15
Location and extent of the habitats impacted directly by hydrographic alterations
EcAp Integrated Monitoring and Assessment Programme
Step 1
Assessment of baseline conditions
Step 2
Alterations of hydrographical conditions; impact on circulation due to structures
Step 3
Impacts on marine habitats directly by structures or by hydrological changes induced by them
EIA/SEA Report
Modelling tools
A. Hydrodynamic modelling
Current velocities & directions, salinity, temperature, turbulence, bed shear stress
B. Wave modelling
Wave height & exposure, bed shear stress
C. Sediment & morphological modelling
Sediment concentrations, turbidity, bed evolution
D. Habitat mapping & modelling
Mitigation measures
Optimization of design
Assessing alternatives

Step 1: Characterization of baseline hydrographical conditions - Assessment of actual conditions without structure (monitoring and modelling)

As a first step, the existing data and information on the site selected for development are collected. This is essential to get an understanding of the phenomena/drivers dominating the local dynamics. A desk-based evaluation of all relevant information (e.g. local hydrography, the distribution of seabed sediments and the associated benthic fauna and other man-made activities) should provide a good characterisation of baseline conditions.

This step should also include the identification and distribution of potential sensitive areas, such as marine protected areas, spawning, breeding and feeding areas and migration routes of fish, seabirds and marine mammals, which will determine the choice of and need for certain specifications in subsequent steps (e.g. modelling in Steps 2 and 3). In the case where existing data sources do not provide sufficient information and resolution on the domain of interest, monitoring may be required as a way of supplementing existing data and providing sufficient baseline information at different spatial and temporal scales. Additional monitoring may also be required for setting up hydrographical and habitat models to be used in the assessment of impacts (Step 3).

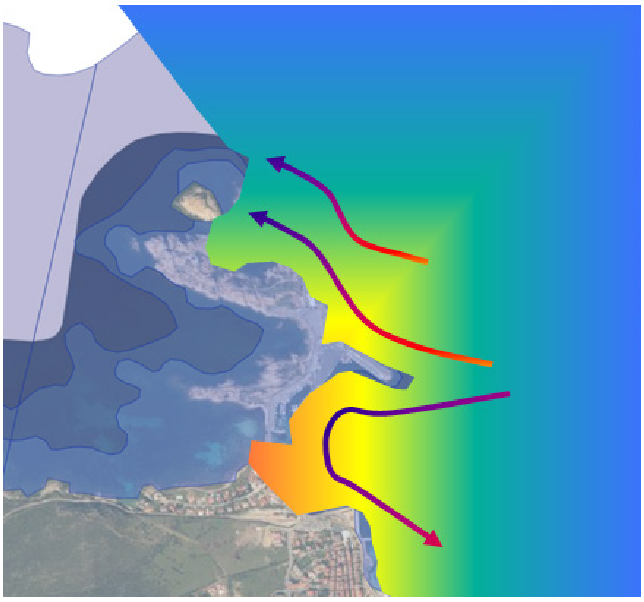


Illustration for baseline hydrodynamic conditions.

Source: Presentation by Olivier Brivois, First training workshop on Coast and Hydrography Indicators, October 2016, Rabat, Morocco.

Focus on SPI, RBA and scale in Step 1:

Opportunities for SPI:

- **In the collection of data and information, collaboration with appropriate scientific institutions, projects and use of scientific products should be investigated**
- **In case additional monitoring is required for site characterization and subsequent setting up of models, this could be combined with research monitoring campaigns**

Important to:

- **Consider natural hydrographical conditions of the site and their variability**
- **Distinguish natural variability from alterations caused by structure (Step 2)**
- **Assess seasonal differences, shifting baseline due to climate change, etc.**

In relation to scales:

- **The resolution of the hydrographical data (e.g. bathymetry) will depend on location, local topography, etc.**
- **Finer resolution is required closer to the structure**
- **If topography is uniform, low resolution data is sufficient; if topography is complex, high resolution e.g. bathymetric data is required**
- **Differences in scales between coastal and offshore locations**

Step 2: Assessment of hydrographical alterations induced by new structure - Comparing baseline conditions and with structure conditions (modelling)

In order to assess the baseline conditions and potential impacts of a proposed development, a full understanding of the natural physical environment of the site and the surroundings must be first established. This system understanding/expert judgement is often coupled to the use of numerical models. Mathematical models are powerful tools to integrate data from various sources, to produce combined new data layers, to complement insufficient field data, to fill in the spatial and temporal gaps and to increase the understanding of a particular site. Numerical models are especially useful for a quantitative evaluation of impacts but as a first step, the baseline conditions should be simulated with sufficient accuracy.

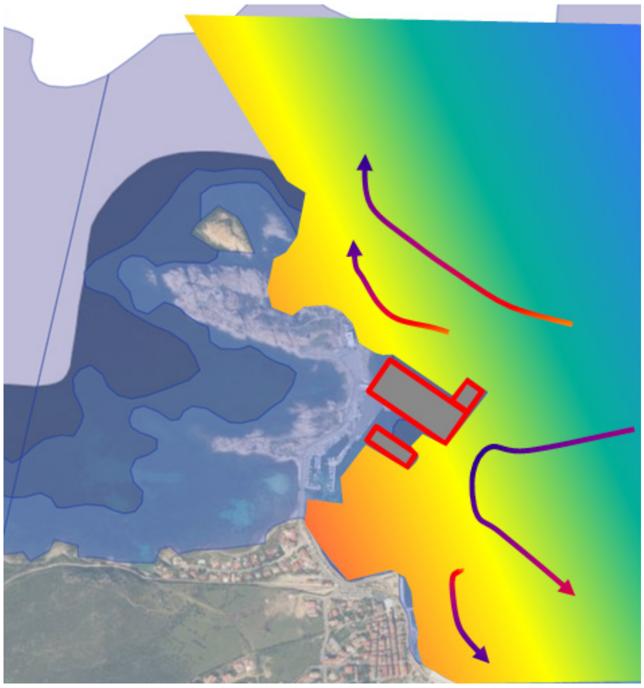


Illustration for hydrodynamic conditions with structure.

Source: Presentation by Olivier Brivois, First training workshop on Coast and Hydrography Indicators, October 2016, Rabat, Morocco.

Focus on SPI, RBA and scale in Step 2:

Opportunities for SPI:

- **The use of numerical models for assessing hydrological alterations should build on partnerships with scientific institutions and research communities with expertise on the development and application of numerical models**
- **The further development of scientific models should integrate policy requirements, in terms of parameters, temporal and geographical scale, etc.**

Important to consider:

- **The longevity of structures (>10 years), and not the size**
- **Significant alterations of hydrographical conditions, i.e. pressures (physical pressures) that act on biologic habitat (Step 3)**
- **Use of existing products and services for the Mediterranean Sea, such as Copernicus Marine Environment Monitoring Service**
- **Appropriate spatial and temporal scales that allow for the assessment of the (main) hydrographical alterations induced by the future structure. These scales are strongly site-dependent**
- **Case-by-case approach e.g. depending on the nature of the coast, vicinity to sensitive areas, etc.**
- **Prioritization of structures with respect to their potential impacts**

Step 3: Assessment of habitats impacted directly by hydrographic alterations - Overlaying hydrographical alterations and habitat maps

With knowledge on the site and its surroundings, supplemented by the baseline data collection and assessment (Steps 1 and 2), the magnitude and significance of the impact of the development are qualitatively and quantitatively assessed in Step 3. The impact of the development is assessed in terms of alterations in hydrographic conditions and impacts on pelagic and benthic habitats. The latter includes direct impacts on habitats caused by the construction/development, as well as indirect impacts due to changes in hydrographical conditions. Changes in the sediment transport regime and in bathymetry due to new developments may in turn cause alterations in the hydrographic regime, in particular in coastal areas. Although changes in currents, waves or sediment processes are not in themselves significant environmental impacts, they should be nevertheless evaluated due to the effects physical changes may have on sensitive receptors.

The use of a combination of modelling tools (hydrodynamic, wave, sediment and habitat modelling with GIS mapping) and in situ data presents a robust tool, in particular for the quantitative evaluation of impacts. The "final product" of the Common Indicator 15 is the intersection of the spatial map of the areas of hydrographical changes with spatial maps of habitats (UNEP(DEPI)/MED WG.432/5). This provides information on the extent of changes, whereas habitat condition is assessed integrally together with other EOs, namely EO1 Biodiversity.

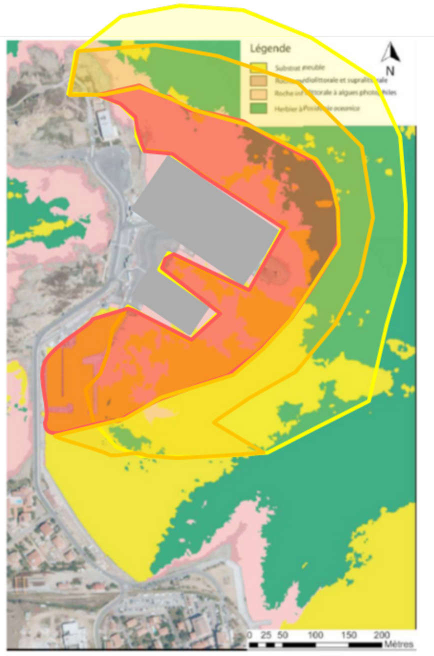


Illustration for habitat assessment.

Source: Presentation by Olivier Brivois, first training workshop on Coast and Hydrography Indicators, October 2016, Rabat, Morocco (habitat map taken from STARESO, 2011)

Focus on SPI, RBA and scale in step 3:

Opportunities for SPI:

- **Collaboration with research institutes for in-depth scientific knowledge on impacts on habitats and sensitive species**
- **Scientifically-sound expert judgement may be required to assess the extent of impacted habitats, especially in cases of limited data availability**

Important to consider:

- **The scale of the impacts, not the scale of the structure**
- **The overlap of hydrographical alterations and habitat maps**
- **The location of sensitive receptors, such as local habitats, fauna and/or flora and habitat/ecosystem functions, and their natural extent**
- **The sensitivity/vulnerability of habitats to hydrographical alterations. Special attention to vulnerable types of habitats, e.g. marine protected areas, spawning, breeding and feeding areas, migration routes**
- **Spatial and temporal scales for monitoring that cover all the habitats of interest that could be potentially impacted.**
- **The scales used for the EO1 Biodiversity habitat assessments**
- **A model spatial scale that includes sensitive receptors into the computational domain with adequate resolution**

Focus on monitoring and modellings

The monitoring of hydrographical conditions could be treated in two ways (UNEP(DEPI)/MED WG.411/3):

- Monitoring to provide baseline information at different spatial and temporal scale on variations of hydrographical conditions which might not be connected (at least not directly) to the human activities;
- Specific monitoring to assess the extent of area affected by alterations and impacts with a focus on the list of areas where alterations could be expected due to new developments.

In the definition of monitoring programmes, a set of components and locations ranging from expected high impact to low or no impact (reference areas) are to be compiled, and prioritised according to the risk of not achieving the established targets. For the prioritisation, the spatial and temporal occurrence as well as the intensity of pressures are to be considered. GIS tools are recommended to overlap and link different data in order to identify critical areas.

The spatial and temporal scales for monitoring and modelling are strongly site-dependent. The monitoring frequencies to be used depend on the intensity of changes in hydrographical and morphological conditions occurring on the site, and should therefore be determined on a case by case basis. The monitoring frequency should be high enough to assess these changes. As for modelling, the determination of the extent of the domain will depend on the distance from the specific human activity to areas subject to impact and areas of specific interest, for example adjacent coasts or bays, or sensitive habitats. A clear identification of the sensitive receptors, such as local habitats, fauna and/or flora and habitat/ecosystem functions, and their natural extent is a key input for the determination of the spatial scale, as the model boundaries might need extending or adjusting to fully include these into the computational domain. The scale determination should therefore consider the scales used for the EO1 habitat assessments.

General guidelines for the determination of appropriate spatial and temporal scales		
Spatial scales (monitoring)	10 to 50 times the characteristic length of the structure	Depending on the first results obtained, the area should be enlarged or zoomed in around the structure.
Spatial scales (modelling)	Near-field, i.e. the area within the immediate vicinity of the development (5 times the obstacle length)	Far-field, e.g. coastline, non-immediate areas of scientific and conservation interest
Temporal scales	During construction (0-5 yrs) High frequency Yearly up to 5 years	After construction (5-10 yrs) Medium frequency Biennial to 10 years

2.2. Challenges and opportunities in developing "Hydrography" and Common Indicator 15

Ecological Objective 7: Hydrography and more specifically Common Indicator 15 (Location and extent of the habitats impacted directly by hydrographic alterations) present a real challenge in the implementation of national regional monitoring programmes. This indicator is rather novel and complex, requiring specific technical competencies, modelling tools and data for a number of parameters, making it costly, time-consuming and not straight forward. Significant gaps and difficulties have been identified related to the use of numerical models and limited data coverage to assess hydrographic alterations, which rely of specific technical expertise and knowledge on the processes and theories involved (UNEP(DEPI)/MED WG.432/5). The definition of a unique and well-defined assessment methodology remains a challenge as this strongly depends on (Brivois, 2017):

- the site of interest and its natural hydrographical conditions;
- the dimension, the location and the functions of the future structure;
- the data, tools and means available.

To date, the assessment of hydrographic alternations due to structures and their intersection with marine habitats is not common in the Mediterranean, except for some local studies of Environmental Impact Assessment (EIA) / Strategic Environmental Assessment (SEA).

The use of state-of-art numerical models (hydrological, sediment, wave, habitat) together with field data to set up and validate models as the main tool for the quantitative assessment of impacts within the scope of EO7 present an opportunity for strengthening SPI. Scientific models are to be developed in line with policy requirements, calling for the establishment of partnerships between administrative bodies and the scientific communities. Another opportunity to strengthen SPI could be the legal requirement of EIAs to provide an assessment of the location and extent of impacted habitats by the new structure considered, as well as monitoring of impacts on habitats during construction. Monitoring and assessment of EO7 should capitalize on existing products e.g. Copernicus Marine Environment Monitoring Service (CMEMS)[1], (sub)regional models, etc. which would require bringing the scientific and monitoring networks closer together.

1 http://copernicus.eu/main/marine-monitoring

The evaluation of the feasibility of this indicator highlights its complexity, the need for long temporal scales, costly modelling tools and specialized technical skills as major shortcomings. To this end, the Contracting Parties to the Barcelona Convention have requested a proposal for a more feasible option for the IMAP Common Indicator Guidance factsheet[2] and Assessment Fact Sheets[3] .

2.3. Considerations for Coast (EO8)

The monitoring of Common Indicator 16 - Length of coastline subject to physical disturbance due to the influence of man-made structures - entails an inventory of (UNEP(DEPI)/MED WG.438/3):

i. the length and location of man-made coastline infrastructures (hard coastal defence structures, ports, marinas; soft techniques e.g. beach nourishment are not included); and

ii. land claim, i.e. the surface area reclaimed from the 1980's onward (ha).

The key objective of this indicator is to identify those areas which have denser (less patchy) urbanized or industrialized areas, in particular in the vicinity of sensitive coastal habitats. In line with the RBA approach to the monitoring of "Coast", the aim is not only to classify artificialization by its intensity/ level of impact but rather to evaluate the extent and trends in physical disturbance due to the influence of man-made structures (UNEP(DEPI)/MED WG.432/5). The ultimate objective is to preserve coastal habitats, biodiversity and prevent coastal erosion phenomena. Despite the lack of systematic monitoring of Common Indicator 16, estimations based on data from night-time light radiation surveys suggest that about 40% of the total Mediterranean coastal zone is under some form of artificial land cover (Plan Bleu, 2005). The inclusion of Common Indicator 16 in IMAP supports the establishment of systematic quantitatively-based monitoring and homogenous characterization of coastal ecosystems on a regional Mediterranean basis.

Under the realm of SPI and considerations of appropriate scales, the optimum spatial scale for a proper identification of man-made structures should be 5 m or 1: 2000 by satellite imagery or aerial photographs. Some of the elements required to monitor are structures of a few metres in length and/or amplitude (e.g. groynes, seawalls, etc.). If the spatial resolution is too low, man-made structures could be poorly identified or completely missed with implications on the calculation of length of artificial coastline. Spatial resolution depends both on the resolution of data sources as satellite imagery or aerial photographs and on the accuracy assured by the digitalization process.

Once an appropriate spatial scale has been established, monitoring should focus in particular on the location, the spatial extent, the types of coastal structures and their digitalization as polygons or polyline in order to estimate the coastal length that can be classified as artificial or natural (UNEP(DEPI)/MED WG.438/3).

Source: Presentation by Giordano Giorgi, First training workshop on Coast and Hydrography Indicators, October 2016, Rabat, Morocco

2 Guidance factsheets have been developed for each Common Indicator to ensure coherent monitoring, with specific targets defined and agreed in order to deliver the achievement of Good Environmental Status (GES) and as such, provide concrete guidance and references to Contracting Parties to support implementation of their revised national monitoring programmes towards the overall goal of implementing the Ecosystem Approach (EcAp) in the Mediterranean Sea and achieveing GES.

3 The Assessment Fact Sheets serve as templates in which the countries will provide the monitoring results for the EcAp indicators. These fact sheets allow the assessment of the indicators to be linked via metadata to the underlying datasets, methods, authors, increasing transparency, and repeatability. The Assessment Fact Sheets will be linked and published on the UN Environment/MAP Integrated Data and Information System. The fact sheets also served as an input to the web-based Mediterranean Quality Status Report (QSR 2017).

Source: Presentation by Giordano Giorgi, First training workshop on Coast and Hydrography Indicators, October 2016, Rabat, Morocco

The coastline to be considered for the calculation of the indicator for each monitoring and assessment cycle is a fixed reference official coastline as defined by the responsible Contracting Party. If needed, the scanned data (i.e. metres of coastline affected, or hectares reclaimed or occupied by impervious surfaces) can be added to higher levels following a bottom-up approach i.e. the length of man-made structures and the area occupied by land claim at different spatial levels: water body, town, department, region and country. Such an approach was illustrated in the MEDAM Project inventory[4].

It is recommended to update the monitoring of man-made structures at least every six years. This would lead to a coherent level of knowledge, which will make data comparison and transfer/exchange of project and management experiences more effective (UNEP(DEPI)/MED IG.22/Inf.7).

4 http://www.medam.info/index.php/en/

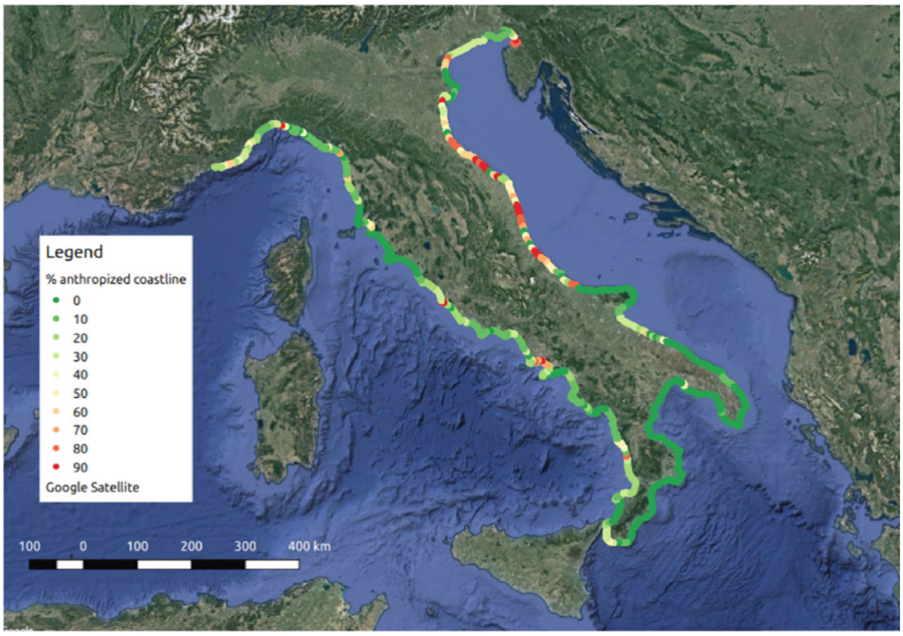
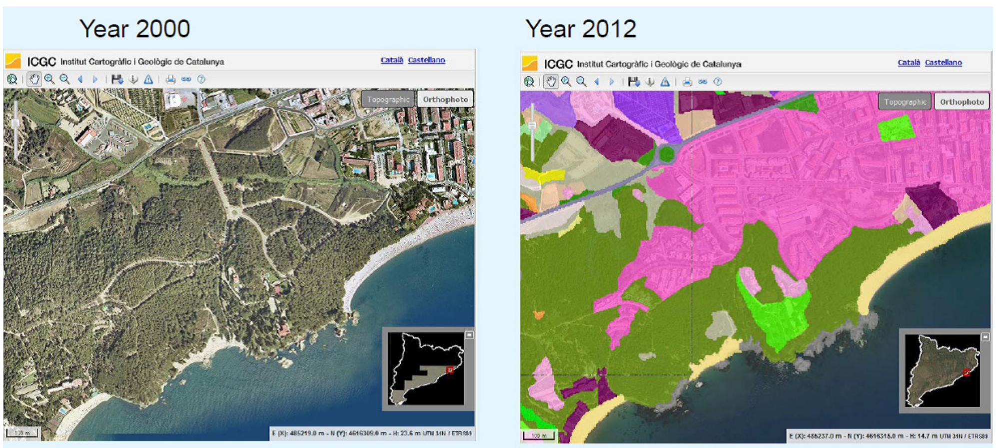


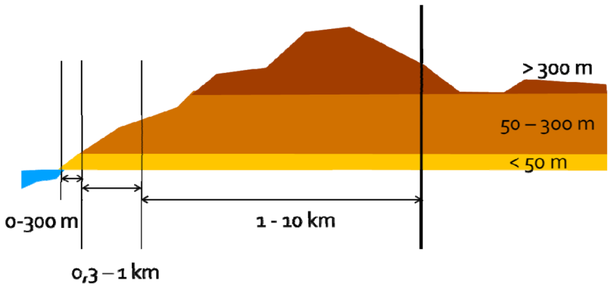
Illustration of Common Indicator 16 applied to the coastline of Italy.
Source: Presentation EO7/EO8 indicators for Italy (by Giordano Giorgi)

Next to Common Indicator 16, the cluster "Hydrography and Coasts" also comprises Candidate Indicator 25 - Land use change. This indicator is commonly used in land use planning or for similar purposes. However, it is widely recognised that there is a significant link between land use changes and impacts on coastal and marine habitats and ecosystems. The approach consists of assessing the changes among five cover classes (artificial surfaces, agricultural, forests and semi-natural, wetlands, and water bodies) over time, based primarily on aerial photos and remote sensing, e.g: European Space Agency (ESA) and SENTINEL satellite imagery; Copernicus. The spatial scale considers the competent coastal units (municipality, wilaya, countries…) as defined in the ICZM Protocol (Article 3 states that the landward limit of coastal zone is the "limit of the competent coastal units as defined by the Parties"). This implies that the landward limit will be country-specific.



Example of land use change.
Source: Presentation on EO8 Land Use Change by Jaume Fons-Esteve Meeting of the Ecosystem Approach Correspondence Group (CORMON) Coast and Hydrography Monitoring 3rd March 2017, Madrid, Spain.

The resolution of the source data represents a compromise between the precision and efforts needed in processing the satellite images. In line with RBA, the areas where most valuable habitats were lost due to land use change (changes from natural areas to urbanized areas for example) as well as areas subject to significantly higher change should be prioritized. The definition of the analytical units of the coastal zone may be revised if more detailed data on habitat distribution becomes available or if subjected to input from national experts. However, the implications of the different delineations should always be considered when interpreting the results. It is recommended to repeat monitoring every 5 years, in order to be effective in counteracting negative effects and taking early actions in problematic areas (UNEP(DEPI)/MED WG.433/Inf.2)



Schematic representation of the different analytical units considered within the coastal zone. *Source: Marin et al., 2015*.

As part of EcAp MED I project, a pilot study on Candidate Indicator 25 in the Adriatic region (Albania, Bosnia and Herzegovina, Croatia, Italy, Montenegro, and Slovenia) was carried out (Marin et al., 2015). This pilot showed that the use of common remote sensing data and a common method for processing and presenting the results could be regarded as a feasible and a positive step forward in monitoring the processes, the state and evolution of the coastal zones (UNEP(DEPI)/MED WG.420/Inf.18). More recently, the evolution of built-up area in coastal zones of Mediterranean countries between 1975 to 2015 was analyzed, based on a set of data processed from the Landsat collection (UNEP, 2017). This study provides a good insight for assessing and testing this indicator at the regional level.

2.4. Challenges and opportunities in developing "Coast" indicators

The selection of the appropriate spatial resolution and temporal coherence presents a challenge in the development of Coast indicators.

The implementation of Common Indicator 16 indicator requires a reference coastline on which the length subject to physical disturbance is calculated.

To assure comparability of results between successive reporting exercises, each country should choose a fixed reference coastline, preferably the official coastline as defined by responsible government office.

As for Candidate Indicator 25 "Land Use Change", the different delineation of analytical units of the coastal zone (defined mathematically) and low spatial resolution limiting the detection of significant land use changes are amongst the identified challenges. Note however that Sentinel images provide adequate resolution for the purpose of Candidate Indicator 25.

To this end, it is recommended to employ well-trained personnel with sufficient scientific expertise in GIS digitalization and agreed procedures. Currently there is no common land use map of the Mediterranean region. The further implementation of Candidate Indicator 25 presents the opportunity for the development of a land use map for the Mediterranean coastal area (Fons-Esteve, 2017).

Other issues relate to insufficient data coverage, complexity of processes and heterogeneity of methods. Merging products related to Coast indicators carried out by different teams, although based on the same data sources, may result in an inhomogeneous final output (Giorgi, 2017). This illustrates a case in point for SPI, in which decision-makers need to be aware of the scientific gaps and limitations, while adopting the precautionary principle to management.

3. Key recommendations and conclusions from SPI transversal workshops (Risk Based Approach & Scales of monitoring)

The two transversal workshops organized in 2017 brought together decision-makers and scientific experts, creating the opportunity to exchange ideas and discuss the strengthening of science policy interface in the successful implementation of IMAP. More specifically, these two workshops addressed the usefulness of RBA in monitoring and selection of the appropriate geographical and temporal scales in monitoring and assessment. The discussions held in these two events led to the following recommendations and conclusions for the EcAp cluster Hydrography and Coast (see UNEP(DEPI)/MED WG. 432/6 and UNEP(DEPI)/MED WG. 438/8 for full meeting reports; UNEP(DEPI)/MED WG.432/3 for summary outcome of SPI workshops).

- *Capacity building*

The indicators associated to the EcAp cluster Hydrography and Coast are still in the process of being developed. They may be considered complex, requiring specific scientific expertise and tools. There is a need to support countries on the implementation of EO7 and EO8 indicators, in particular capacity building on numerical modelling, GIS and map digitization. Specific trainings should build on existing partnerships, collaborations and projects.

- *Data availability and accessibility*

Data availability linked to biodiversity and habitats (EO1) for the implementation of Common Indicator 15 presents a challenge. Scientists involved in the biodiversity monitoring should provide an input to this common indicator, thus enabling strong interaction between EOs, promoting joint thematic monitoring, and ensuring coherence and cost efficiency. The need to make use of existing relevant open scientific data is also highlighted as a way to address the lack of available data. Another issue is the accessibility of free public data and the need of financial support to purchase data. The use of open source such as ESA's C-TEP software, Copernicus products and services, should be considered as a way to complement limited field data. Apart from capitalizing on existing data, software and information, best practices from other countries and regions should also be considered.

- *National coordination*

Strong coordination at the national level between administrative services and scientific experts is required for the implementation of EcAp cluster Hydrography and Coast. For instance, the spatial scale for implementing Coast indicators should be based on the national official coastline and coastal zone delimitation. In case of ambiguities, scientists should assist policy-makers in coastline definition.

- *Need for exploring new synergies and opportunities*

The implementation of EcAp cluster Hydrography and Coast presents an opportunity for stronger interactions with scientific institutions and projects, new partnerships with business and public bodies managing relevant environmental data.

Research programmes, e.g. Horizon 2020 of the European Union open to riparian countries across the region, offer possibilities for developing scientific expertise and knowledge as well as knowledge transfer. National and international institutions are called to build more on science for regulatory purpose, fostering more effective science-based policy-making.

Conclusion

The activity on strengthening SPI in support of IMAP monitoring and implementation plans highlighted the benefits of SPI on the further development of the cluster Hydrography and Coasts. SPI could help narrow the identified gaps in relation to the lack of access to data and tools, and the further development of knowledge and methodologies for indicator development and assessment. The development of scientific products, such as state-of-art modelling tools and GIS products should consider the policy requirements. A point in case is the development of hydrodynamic models by research institutes tailored to address the needs of EO Hydrography, e.g. the appropriate temporal and spatial scales. Increased interaction and exchange between research and policy-making communities can be promoted through e.g. joint programmes, national (online) platforms composed of both researchers and policy-makers, and embedding researchers within government agencies or vice versa. More specifically to the cluster Hydrography and Coasts, a pilot study on the implementation of EO7 and EO8 could be set up, with the project team composed of policy-makers and scientists. In some cases, intermediary organisations that serve as knowledge brokers at the science–policy interface and as capacity builders for both researchers and policy-makers could help bring organizations closer together for their mutual benefit.

Programmes and platforms related to the EcAp Cluster on Coast and Hydrography for data management, research and policy in the Mediterranean region to support IMAP and Ecosystem Approach implementation.

Project acronym	Full project name	URL	Project dates	Project coordinator	Relevance to cluster Coast and Hydrography	Relevance to Common Indicators
EMODnet Bathymetry		http://www.emodnet-bathymetry.eu/	Multiple contracts since June 2009	Shom, France	Bathymetry	EO7/CI 15
EMODnet Physics		http://www.emodnet-physics.eu/		ETT Solutions Ltd., Italy	Waves, temperature, salinity, currents, optical properties, sea-level, winds	EO7/CI 15
EMODnet Seabed Habitats		https://www.emodnet-seabedhabitats.eu/	Phase 3 (2017-2020)	Joint Nature Conservation Committee (JNCC), UK	Seabed habitat maps	EO7/CI 15
JERICO-Next		http://www.jerico-ri.eu/	September 2015 – August 2019	French Research Institute for Exploitation of the Sea (IFREMER) France	Winds, waves, currents, salinity, temperature-coastal part of a European Ocean Observing System	EO7/CI 15
PERSEUS	Policy-Oriented Marine Environmental Research in the Southern European Seas	http://www.perseus-net.eu/	January 2012-December 2015	Hellanic Centre for Marine Research (HCMR), Greece	-Gaps analysis for MSFD Descriptor 7 (similar to EO7) in the Mediterranean region; -Database containing physical, geochemical and biological data of the Mediterranean Sea ecosystems	EO7
PEGASO	ICZM Mediterranean and Black Sea	http://www.vliz.be/projects/pegaso/index.html	February 2010 – January 2014	Universitat Autònoma de Barcelona (UAB), Spain	- Core set of ICZM indicators; - Core indicator: Area of built-up space http://www.coastalwiki.org/w/images/4/46/PEGASO_Area_of_built-up_space.pdf	EO8/CI 16
MEDAM	Mediterranean French Coast (Inventory and impact of land reclamation)	http://www.medam.org/index.php/en/	September 2015 – April 2017	ECOMERS/ University Nice Sophia Antipolis	nventory of initial state of coastline, including: -Initial state of the coastline -Inventory of reclamations -Surface area of reclamations by type of reclamation -Reclaimed area : surface area built over and area of bodies of water -Length of artificialized coastline -Rate of artificial coastline	EO8/CI 16
MEDINA	Marine Ecosystem Dynamics and Indicators for North Africa	http://www.medinageoportal.eu/	October 2011 - December 2014	Universita Ca' Foscari Venezia	Among others: -North Africa Share of Built up in the 0-10 km Among others:	EO8/CI 16

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UNEP(DEPI)/MED WG.432/5 *Background document on Risk-Based Approach (RBA) and its usefulness for EcAp and IMAP -* Strengthening for the implementation of the UNEP/MAP IMAP for Marine Litter, Biodiversity & fisheries, Hydrography & Coast. Agenda item 4: Background working document on the RBA for monitoring. Workshop on Science Policy Interface (SPI) strengthening for the implementation of the UNEP/MAP IMAP in relation to Marine Litter, Biodiversity & fisheries, Hydrography, with a focus on the Risk Based Approach (RBA) for monitoring. Madrid, Spain, 2nd March 2017.

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