



Mediterranean Action Plan Barcelona Convention



UNEP/MAP WG.549/Inf.2

27 February 2023 Original: English

Meeting of the Ecosystem Approach Correspondence Group on Monitoring (CORMON) Coast and Hydrography

Marseille, 28-29 march 2023

Agenda item 4

Practical solutions to strengthen and sustain Science-Policy Interface mechanisms to support IMAP implementation in Morocco. SPI frameworks and processes regarding monitoring of IMAP Common Indicators 1 & 15 in Morocco

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Acknowledgments

This work has been supported by the project[s] "Support to Efficient Implementation of the Ecosystem Approach-based Integrated Monitoring and Assessment of the Mediterranean Sea and Coasts and to delivery of data-based 2023 Quality Status Report in synergy with the EU MSFD" (EcAp MED III) funded by the European Union (EU).

The Authors wish to thank all individuals and organisations that have generously contributed by their expertise, time and energy to this report. We would also like to acknowledge the collaborative efforts of the Department of Sustainable Development/Ministry of Energy Transition and Sustainable Development (Farah Bouqartacha, Mustapha Tarzazh, and Amal Moufarreh) and the interviewees of the institutions involved in monitoring Cl15 and Cl 1.

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List of Abbreviations and Acronyms

In view of respecting the full meaning of the acronym, both French and English are used in the table below.

Acronym	Extended name
ANDA	Agence Nationale du Développement de l'Aquaculture
AGIR	Association de Gestion Intégrée de Ressources
ANP	Agence Nationale des Ports
ASPIM	Aire Spécialement Protégée d'Intérêt pour la Méditerranée
CICATEL	Interministerial Commission for Coastal Tourist Development
СИСНОС	Comité National de coordination dans les domaines de l'Hydrographie, de l'Océanographie et de la Cartographie Marine
CRTS	Centre Royal de Télédétection Spatiale
DHMPE	Directorate of Environmental Hygiene and Environmental Protection
DHOC	Division Hydrographie, Océanographie et Cartographie
DPDPM	Direction des Ports et du Domaine Publique Maritime
ЕНТР	École Hassania des Travaux Publics
FPN	FacultéPluridisciplinaire de Nador.
GES	Good Environmental State
GEOSS	Global Earth Observation System of Systems
GBIF	Global Biodiversity Information Facility
GOOS	Global Ocean Observing System
IAV Hassan II	Institut Agronomique et Vétérinaire Hassan-II
ICZM	Integrated Coastal Zone Management
ΙΜΑΡ	Integrated Monitoring and Assessment Programme
INAU	Institut National d'Aménagement et d'Urbanisme
INRH	Institut National de Recherche Halieutique
LNESP	Laboratoire National pour les Études de Surveillance de la Pollution
LPEE	Laboratoire Public d'Essais et d'Etudes
MAPAMED	Marine Protected Areas in the Mediterranean

Acronym	Extended name				
МРА	Marine protected areas				
NOAA National Oceanic and Atmospheric Administration					
OGP	Open Government Partnership				
ΟΝΗΥΜ	Office National des Hydrocarbures et des Mines				
OREDD	Observatoires Régionaux pour l'environnement et le développement durable				
PAS BIO	Plan d'Action Stratégique pour la conservation de la BIOdiversité marine et côtière en Méditerranée				
SPI	Science-Policy Interface				

1 Preface

The Ecosystem Approach (EcAp) is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.

The Contracting Parties to the Barcelona Convention have been committed, at their 18th Ordinary Meeting (Decision<u>IG.21/3</u>), to the implementation of the ecosystem approach to the management of human activities in the Mediterranean, with the ultimate objective to achieve a Good Environmental Status (GES) of the Mediterranean Sea. They outlined a dedicated Roadmap for its implementation and a specific decision (<u>IG</u> <u>22/7</u>) to support countries with the development of an integrated monitoring and assessment programme with a proposal of common indicators to monitor EcAp's ecological objectives implementation.

Moreover, the implementation of the EU Marine Strategy framework Directive (MSFD, 2008) by the EU Member States in the region presents crucial opportunities and needs for the application of the EcAp throughout the Mediterranean region ensuring that the MSFD and EcAp mutually strengthen and build on each other with the common ultimate aim to achieve GES of the Mediterranean Sea.

The Ecosystem Approach process has been supported by a series of projects since 2012 and entered in its third phase.

Plan Bleu led a specific activity dealing with strengthening the science-policy interface to support IMAP implementation during the recent past years. A regional policy-oriented report has been drafted and presented to the members of the EcAp Coordination Group meeting in Athens in September 2019. The Group recognized the relevant theoretical recommendations provided by the report and called for their implementation in a more concrete manner in one pilot country. This is now possible thanks to the EU-funded EcAp MED III project and a specific activity entitled *"Strengthen SPI networks of scientists and policy makers for the IMAP and its implementation with a focus on one national pilot"* (project output 2.2.2).

This activity will also contribute to the preparation of the Mediterranean Quality Status Report (QSR) 2023, the second regional assessment product based on the MAP Ecological Objectives, IMAP indicators and related existing monitoring data.

The activity is also connected with the United Nations Decade of Ocean Science for Sustainable Development (2021-2030), which is the first ever regional programme to support efforts to reverse the cycle of decline in ocean health and gather ocean stakeholders worldwide behind a common framework that will ensure ocean science and technology can fully support countries in creating improved conditions for sustainable development of the Ocean.

During the project EcAp Task force meeting on 24th November 2021, members Proposed Morocco as a good candidate and has been selected for the implementation of this pilot activity.

All participants also agreed on the added value to focus on one country with the three clusters (pollution & marine litter, biodiversity, and coast & hydrography) and the need for good coordination between the IMAP-MPA project and EcAp MED III.

2 Introduction

Science-Policy Interfaces (SPIs) provide ways in which scientists, policy makers and other relevant actors can cooperate to co-create the actionable knowledge, which is needed to design and implement policies. In the specific context of the United Nations Environment Programme (UN Environment), SPI is defined as a structure or a process (Figure 1) that aims to improve the identification, formulation and evaluation of policies to improve the effectiveness of governance (UN-Environment 2009).



Figure 1. Designing optimal Science-policy Interfaces. Source: Plan Bleu, 2018.

Science represents a crucial component to the wider knowledge base used to enrich decision making that also includes technological, social, economic behavioural and political considerations. Marine knowledge providers (e.g. research organisations, NGOs, industry, fisheries, aquaculture etc.) play an important role in producing and making available knowledge that can be used to inform the policy process. However, several barriers still affect the efficient transfer of scientific knowledge into the policy making process, for example in terms of differences in objectives, expectations, timing and languages, etc. Therefore, there is an increasing necessity for a clearer identification of policy-related knowledge needs, at the regional, national and local scales.

In the Barcelona Convention framework, the IMAP decision (Integrated Monitoring and Assessment Programme) provides a mechanism to evaluate status and progress towards the achievement of <u>Good</u> Environmental Status (GES) by means of a set of agreed common and candidate indicators (UNEP/MAP 2016). The 2017 Mediterranean Quality Status Report (MedQSR 2017) issued in 2018 (UNEP/MAP 2018) collates and synthesises data from different sources. The implementation of both regional and national IMAPs is focused on integrated quantitative assessment and monitoring of the Mediterranean marine and coastal environment, to inform decision making processes.

The main objectives of the study are twofold. This report aims to provide an insight into a general national context for CI 1 and 15 implementation, taking into account national IMAP developments and status and

Morocco's priorities: identify at national level relevant existing mechanisms and processes as well as SPI frameworks (if they exist) in place, involving scientific centres/laboratories and institutions that follow the implementation of environmental (especially coastal and marine) policies. Data coming from SEIS projects¹ should be capitalised.

Based on this achievement, the second objective of the study is to identify country priorities and needs with a focus on coast and hydrography clusters, in order to analyse the baseline and definition of requirements and approach for the monitoring of the Common Indicator 15. The consultant is expected to elaborate where scientific gaps and policy needs exist and where are the difficulties to comply with the requirements of the Guidance Factsheet for Common Indicator (CI) 15.

Interest in CIs 1 and 15. CIs 1 and 15 have been chosen for this because they are linked one to each other (building and changing land cover on the coastline affects hydrographic conditions and habitat functions) and they are among the most difficult indicators to be assessed (particularly CI 15). CI 15 has been also selected because of the availability of a recent study (PAP/RAC, 2022) regarding CI 15 that can be capitalised in order to improve transfer from science to policy of data and knowledge related to this indicator.

Main achievements included in the present report are: better understanding and existing framework, ongoing mechanisms and process in Morocco to be strengthened and formalised as an efficient Science Policy interface relevant for CI 15 implementation; mapping of national institutions working on CI 15.

¹<u>https://eni-seis.eionet.europa.eu/south/countries/morocco/key-docs/key-documents/rapport-national-sur-les-progres-de-mise-en-oeuvre-du-seis-ii-sud-2013-maroc</u>

3 IMAP Common Indicators 1 and 15

'Indicator' is an established term which is used in different ways. In general, an indicator consists of one or several parameters chosen to represent ('indicate') a certain situation or aspect and to simplify a complex reality. For the purpose of assessing environmental status, the GES Decision² adopted the term 'indicator'. Among the Ecological Objectives (EO) contributing to GES, **EO7 Hydrography aims to ensure that "Alteration of hydrographic conditions does not adversely affect coastal and marine ecosystems"**. EO7 is linked to Common Indicator 15: Location and extent of the habitats impacted directly by hydrographic alterations to also feed the assessment of EO1 on habitat extent.

The Common Indicator 15 (CI 15) is defined as the "Location and extent of the habitats potentially impacted by hydrographic alterations". This indicator assesses marine habitats which may be affected or disturbed by changes in hydrographic conditions due to new developments. The main target of this indicator is to ensure that all possible mitigation measures are taken into account when planning the construction of new infrastructures, in order to minimise the impact on coastal and marine ecosystems and its services, integrity, and cultural/historic assets. The GES regarding EO7 Hydrography is achieved when negative impacts due to new structures are minimal with no influence on the larger scale coastal and marine systems.

The indicator focuses on the assessment of physical loss including the footprint of the structures and permanent changes determining areas of potentially impacted habitats. Other parameters to be monitored (such as salinity and temperature) are structure-specific. (UNEP/MAP 2019).

Large-scale coastal and off-shore developments have the potential to alter the hydrographical regime of currents, waves and sediments in marine environments (UNEP/MAP/PAP 2015). To address this, UN Environment/MAP has included the Ecological Objective 7 ("Alteration of hydrographical conditions") as part of the Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast (UNEP/MAP, 2016a). EO7's Common Indicator 15 - 'Location and extent of habitats impacted directly by hydrographic alterations'. There are clear links between EO7 and other ecological objectives, especially EO1 (Biodiversity), and these need to be determined on a case-by-case basis.

Methodology used for this indicator's measurement encompasses elaboration on:

- Mapping of area where human activities may cause permanent alterations of hydrographical conditions
- Mapping of habitats of interest in this area of hydrographical changes;
- Combination of maps showing areas of hydrographical changes with habitat maps to determine the areas of individual habitat types that are impacted by hydrographical changes (Figure 2).

To correctly assess changes in time on habitats induced by constructions, different monitoring timescales are proposed:

- Before construction, initial state assessment (baseline conditions): monitoring should provide the initial hydrodynamics conditions surrounding the future construction.
- During construction: monitoring should ensure that impacts due to works are limited in space and time.
- After construction, short term changes (0 to 5 years after): at least yearly up to 5 years.
- After construction (5 to 10 years after): at least biennium to 10 years.

Ecological Objective 7 and more specifically Common Indicator 15 present a real challenge in the implementation of national regional monitoring programmes (UNEP/MAP Athens, Greece (2016)). This

²https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1495097018132&uri=CELEX:32017D0848

indicator is complex, requiring specific technical competencies, modelling tools and data for a number of parameters, making it costly, time-consuming and not straightforward. Though the equipment to study seabed interface (Autonomous underwater Vehicle, scan sonar, very high resolution seismic, hydrodynamics) is expensive and rapidly evolving in the market, their maintenance requires specialised technicians and use of very expensive software. Significant gaps and difficulties have been identified related to the use of numerical models and limited data coverage to assess hydrographic alterations, which rely on specific technical expertise and knowledge on the processes and theories involved.

EO 1 Biodiversity aims to ensure that 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.

EO1 is linked to five CIs:

- Common Indicator 1: Habitat distributional range (EO1) to also consider habitat extent as a relevant attribute
- Common Indicator 2: Condition of the habitat's typical species and communities (EO1)
- Common Indicator 3: Species distributional range (EO1 related to marine mammals, seabirds, marine reptiles)
- Common Indicator 4: Population abundance of selected species (EO1, related to marine mammals, seabirds, marine reptiles)
- Common indicator 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)



Figure 2. Parameters needed for monitoring CI15 and CI1.

EO7 Hydrography

Alteration of hydrographic conditions does	Common Indicator 15: Location and extent of the habitats impacted
not adversely affect coastal and marine	directly by hydrographic alterations (EO7) to also feed the assessment
ecosystems.	of EO1 on habitat extent

4 Methodology

For the preparation of the present report, desk analysis of available literature (e.g. technical reports, peer reviewed scientific articles, national policies, national databases) was combined with active interaction with relevant stakeholders in Morocco belonging to the areas of CI 1 and CI 15 for data gathering and management.

Relevant institutions and departments were identified (see Annex 1 for a list) and reference persons were contacted and invited to contribute to the project by participating in interviews.

In order to complement results from desk analysis and get more specific knowledge about the state of knowledge on the matter, the institutions involved in monitoring, the process of data exchange and the issues at stake, interviews were arranged.

The interviewees were selected with the full support of the Department for Sustainable development - Moroccan Ministry of Energy transition and Sustainable development in order to represent the diversity of institutions dealing with marine and coastal fields. Out of the 24 persons contacted, it was possible to establish direct contacts and to obtain answers from 19 interviewees. In-depth, semi-structured interviews were carried out with 16 high level administrators and 3 researchers, most of whom had been working in marine and coastal areas for a decade or more. Sixteen interviews (5 women and 11 men) were conducted by the lead author, mostly at ministries headquarters and 3 over phone. The interviews were held between May 2022 and June 2022 and lasted 30-60 min. The interviews provided additional textual information which we could qualitatively analyse and complete with questionnaire results.

An overview of interviewed persons is given in Table 1. All these interviewees represented their own institutions. The key principles of the selection process were:

1) to contact the institutions (ministries, foundation, laboratories, NG...) active in terms of monitoring in hydrography, habitats and ecosystem services; and

2) Contact researchers involved in the monitoring of CI 15 and CI 1

Information obtained with interviews are presented in chapter 5.

Questions were defined in order to gain insights on specific aspects of SPI regarding this indicator and specifically to collect elements to identify gaps in the process and highlight aspects to be considered to improve the assessment of this indicator. In addition, the need to keep the questions limited in number, simple to be approached and eventually feasible to be answered in a written format (like a questionnaire) was also considered.

Interview topics were anticipated via mail and a list of questions was provided in advance (see template in Annex 2 - English and French versions). The content of the interviews was announced under the auspices of the "Ministère de la Transition Énergétique et du Développement Durable" and invitations were sent out through personalised emails to relevant Head of departments of other institutions.

Based on the interviews, we identified "barriers" to and "opportunities" for establishing the SPI. "Barriers" refer to factors that constrain SPI, while "opportunities" refer to factors that improve SPI. Basically, both barriers and opportunities are crucial factors influencing SPI. Obviously, barriers can turn into opportunities, and vice versa.

Table 1. Overview of th	ne interviewees
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Interviewees	Number
Overall number	19 (13 men and 6 women)
Of which Directors, Head of department	16 (11 men and 5 women)
Of which University researchers	3 (2 men and 1 woman)

5 IMAP in Morocco

As for Protocols of the Barcelona Convention relevant for the EO7, the <u>Protocol</u> concerning Specially Protected Areas and Biological Diversity in the Mediterranean calls to Contracting Parties of the Barcelona Convection for continuous monitoring of ecological processes, population dynamics, landscapes, as well as the impacts of human activities (Article 7 b). In addition, it calls on Parties to evaluate and take into consideration the possible direct or indirect, immediate or long-term impacts, including the cumulative impact of the projects and activities, on protected areas, species and their habitats (Article 17).

The <u>Protocol</u> on the Integrated Coastal Zone Management in the Mediterranean, in its Article 9, calls for Parties to minimise negative impacts on coastal ecosystems, landscapes and geomorphology, coming from infrastructure, energy facilities, ports and maritime works and structures; or where appropriate to compensate these impacts by non-financial measures. In addition, Article 9 demands maritime activities to be conducted in such a manner as to ensure the preservation of coastal ecosystems in conformity with the rules, standards and procedures of the relevant international conventions.

Figure 3 illustrates the status of ratification of the Barcelona Convention and its protocols by the Mediterranean countries (MSSD indicator 6). Morocco has ratified the Barcelona Convention and all its protocols.

Legal instruments	Albania	Algeria	Bosnia and Herzegovina	Croatia	Cyprus	European Union	Egypt	France	Greece	Israel	Italy	Lebanon	Libya	Malta	Monaco	Montenegro	Morocco	Slovenia	Spain	Syrian Arab Republic	Tunisia	Turkey
Barcelona Convention and Amendments																						
Dumping Protocol and Amendments																						
Emergency Protocol Prevention and Emergency Protocol																						
LBS Protocol and Amendments																						
SPA Protocol SPA and Biodiversity Protocol																						
Offshore Protocol																						
Hazardous Wastes Protocol																						
ICZM Protocol																						
	No instrument of ratification, adhesion, approval or accession deposited. Instrument of ratification, adhesion, approval or accession deposited but Protocol has not yet entered into force.								ce.													
	Instrument of ratification, adhesion approval or accession deposited and Convention or Protocol entered into force.																					

Figure 3. Ratification of Barcelona Convention and Protocols by the individual Contracting Parties, December 2019

Within the framework of the project "Towards the achievement of good ecological status of the Mediterranean Sea and its coastline through a network of ecologically representative and effectively managed and monitored marine protected areas" (hereinafter referred to as "IMAP-MPA project"), SPA/RAC, under UNEP/MAP, granted funding to support Morocco in the implementation of IMAP.

The IMAP-MPA project is based on:

- Decision IG.23/06 on the report on the state of quality in the Mediterranean 2017 (Tirana, Albania, 17-20 December 2017);
- UNEP/MAP Medium Term Strategy (MTS) 2016-2021 (Decision IG.22/1 COP 19);
- The Integrated Monitoring and Assessment Program for the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP) (Decision IG. 22/7 COP 19);
- Decision IG.24/7 on the roadmap and needs assessment for the Mediterranean Quality Status Report 2023 (Naples, Italy, 2-5 December 2019); and
- Decision IG.24/17 on the UNEP/MAP Program of Work and Budget 2020-2021 (Naples, Italy, 2-5 December 2019);
- The UNEP/MAP Program of Work and Budget (PoW) 2020-2021 (Decision IG.24/14 COP 21);

Objective of the IMAP-MPA project is to contribute to the implementation of the National Integrated Monitoring and Assessment Program (IMAP) through the execution of activities, which concern the ecological objectives (EO): **EO1 Biodiversity**, EO2 Non-indigenous species, EO5 Eutrophication, **EO7**

Hydrography, EO8 Ecosystems and Coastal Landscapes, EO9 Pollution and EO10 Marine Litter for the collection of data that will be used for the preparation of the Mediterranean Quality Status Report 2023 (MED QSR).

Project activities include:

- Designate a national team and/or a contact person who will ensure the coordination between UNEP/MAP and the national team(s) involved in the implementation of the IMAP national programs
- Prepare a work plan and design an EO monitoring plan, in agreement with the SPA/RAC.
- Design and approve a concrete follow-up plan for the relevant EOs;
- Prepare, implement field data collection campaigns and successfully upload all relevant quality checked datasets into the IMAP information system.
- Organise capacity building workshops, training sessions and round tables.

Two committees have been set up in Morocco to ensure the implementation of the various activities:

- "Laboratoire National des Etudes et de Surveillance de la Pollution" and formed by Département du Développement Durable, Laboratoire National des Etudes et de Surveillance de la Pollution, Direction des Programmes et Réalisations, Direction du Partenariat, de la Communication et de la Coopération, Division du Budget et des Affaires Générales
- Technical Implementation Monitoring Committee, led by "Laboratoire National des Etudes et de Surveillance de la Pollution" and formed by Département du Développement Durable, Laboratoire National des Etudes et de Surveillance de la Pollution, Institut National de la Recherche Halieutique, Direction régional de l'Environnement, Direction des Programmes et réalisation, Observatoire National de l'Environnement et du développement Durable, Haut-Commissariat des Eaux et Forêt et Lutte Contre la Désertification.

Regarding the **IMAP cluster on Biodiversity and Fisheries**, the monitoring program concerns: Biodiversity components (Ecological Objective EO1), non-indigenous species (Ecological Objective EO2), fisheries (Ecological Objective EO3).

At the national level, Morocco fully adheres to the ecosystem approach concept. This translates clearly in the recommendations of the national PAS/BIO report (Plan d'Action Stratégique pour la conservation de la BIOdiversité marine et côtière en Méditerranée) and of the third³ and fourth⁴ national biodiversity reports (Third national biodiversity report, 2006; Fourth national biodiversity report, 2009.

Morocco has a relatively developed and coherent legal framework in terms of biological diversity and Environmental Protection. This legislative context and regulation are based on Morocco's commitments both internationally and nationally Current institutional and legal arrangements are in favour of the implementation of a national IMAP program in the Moroccan Mediterranean. From a scientific point of view, only the common indicators linked to objective EO3 (fisheries) are widely followed by INRH, which monitors and evaluates these indicators from its creation. For EO1 and EO2, the obvious lack of knowledge of marine and coastal ecosystems in Morocco would constitute a major handicap for the comprehensive monitoring and evaluation of their respective common indicators. However, many initiatives and future opportunities have been identified and can be valued to meet IMAP expectations.

According to IMAP recommendations, each country of the Mediterranean shore is called upon to choose at least two locations; one disturbed and the other under low anthropogenic pressure. In the Moroccan

³<u>https://ma.chm-cbd.net/implementation/rap_nat/3_rap_nat_biodiv_ma.pdf</u> ⁴<u>https://www.cbd.int/doc/world/ma/ma-nr-04-fr.pdf</u>

Mediterranean, the sites for IMAP surveillance criteria were selected using a multi-criteria approach⁵. The choice of monitoring sites focused on two MPAs and two future MPAs:

- Cap des Trois Fourches: characterised by low anthropogenic pressure, good environmental condition, a good knowledge of marine habitats (mapping carried out as part of the MedMPAnet project in 2013);
- Al Hoceima National Park: this is the only MPA in the Moroccan Mediterranean. The knowledge of the part are satisfactory and there are many opportunities to improve them considerably (for example the mapping project of marine habitats planned for 2018 as part of the MedKeyHabitat 2 project piloted by RAC/SPA);
- Zone for fishing purposes 'Alboran': the only one of this gender in the Moroccan Mediterranean which is managed by the Department of Maritime Fisheries. The knowledge of the marine part is satisfactory and monitoring programs are regularly planned by the INRH. It is a proposed MPA, with on-going process.
- Jbel Moussa: is located between 2 large cities (Tangier and Ceuta) in the Strait of Gibraltar near the Port Tangier Med. Knowledge of marine biocenosis is recent and programs for monitoring seagrass beds and coralligenous have been undertaken there since 2015. In addition, temperature chips (sensors) have been installed there since 2017 at depths of 20 m in coralligenous monitoring sites. It is a proposed MPA, with on-going process for the declaration.

The choice of these sites was validated in a workshop consultation held in Rabat on July 4 2017, in which many local actors and national (administrations, research institutions, non-governmental organisations) participated. It focused on two components of IMAP, namely Eutrophication (Ecological Objective 5) and Marine Litter (Ecological Objective 10).

⁵(1) vision for 2020 of the Master Plan for Protected Areas of Morocco, (2) priority list of marine sites deserving of being set up as MPAs, (3) availability of relevant scientific information that allows the country to meet the requirements of IMAP, (4) future potential in terms of research project and 5- good representativeness of the Moroccan Mediterranean.

6 SPI for Common indicators 1 and 15 in Morocco

The coastal zone has always been a privileged place for the development of human society. This area fulfils functions in terms of job creation, economic growth, quality of life, mobility and trade, conservation of cultural heritage, and defence against the destructive forces of the sea.

As in all Mediterranean countries, the Moroccan coast tends to become an area that is over-occupied and over-used due to urbanisation, industries, ports, fishing, and leisure activities. This occupation leads to the degradation of the physical environment and in mortgaging any possibility of better management of coastal and marine space in the future (Laouina 2006).

Moroccan Mediterranean coastal areas are particularly threatened by coastal development that modifies the coastline through the construction of buildings and infrastructure needed to sustain residential, commercial, transport and tourist activities. The land, intertidal zone and near-shore estuarine and marine waters are increasingly altered by the loss and fragmentation of natural habitats and by the proliferation of a variety of built structures, such as ports, marinas, breakwaters, seawalls, jetties and pilings (REEM4,2020). These coastal human-made infrastructures cause irreversible damage to landscapes, losses in habitat and biodiversity, and strong influence on the configuration of the shoreline. Indeed, physical disturbance due to the development of artificial structures in the coastal fringe can disrupt the sediment transport, reduce the ability of the shoreline to respond to natural forcing factors, and fragment the coastal space. The modification of the emerging beach and elimination of the dune system contribute to coastal erosion phenomena by lessening the beach resilience to sea storms.

Monitoring data will be used to complement the more targeted and site-specific monitoring of marine installations and activities, and to provide information on whether the impact of marine activities affects the wider marine and coastal environment. It will also contribute towards the development of the Mediterranean Offshore Reporting and Monitoring System, i.e. regional data bank on offshore activities through the Barcelona Convention Reporting System (BCRS).

Common Indicator 1: Habitat distributional range (EO1) to also consider habitat extent as a relevant attribute.

Marine habitats are generally defined by physical features and characteristic species. Nonetheless, habitat types are not clearly distinct regions with clear boundaries in nature. Benthic habitats are considered as important drivers of diversity and therefore the modification or loss of habitats are considered a serious threat to marine ecosystems. Due to heterogeneity of habitats and limited available data, the monitoring of habitat status is a great challenge for ecological assessment programs.

Monitoring, developing indicators, reporting on the state of the environment, trends, pressures and impacts biodiversity and related issues are required under several policies and legislations.

This assessment presents a brief overview of the habitat distributional range and condition of the habitat's typical species and communities (fig. 4) based on published data issued from recent or ongoing research projects/studies. It will enable the identification of the progress elaborated towards the achievement of targets adopted regarding relatively known habitat types. Habitat types and parameters to be monitored are subject to revision as further knowledge and baseline data becomes available, on the basis of a risk-based approach.



Figure 4. Moroccan Mediterranean Sea ecological potential (Atlas du potentielscôtiers et marins, 2017).

https://fr.scribd.com/document/360582047/Atlas-Des-Potentiels-Marins-Et-Cotiers

Assessments of the status and the extension of marine habitats require the adoption of rigorous approaches (in terms of sampling design, selection of appropriate spatial and temporal scales, habitat classification, identification of vulnerable taxa) that can give a good image of the distributional range and the condition of marine systems and of their alteration by pressures from human activities. Following changes in space and time in the occurrence of target species/habitats (e.g. habitat formers) able to indicate the status of the systems, and including the consideration of appropriate control areas should be the way to go.

Ground-truth sampling from benthic and pelagic monitoring and assessment, and environmental data are required to assess condition of the habitat's typical species and communities occurring at a site scale (100's of metres to 10's of kilometres). Various methods exist to collect pelagic or benthic data (e.g. grabs, cores, visual imagery techniques, or trawl surveys (Van Hoey et al., 2010)). Each method has its advantages and disadvantages which should be taken into consideration (Underwood & Chapman, 2013). If sufficient data are available, broad scale, Special and biogenic habitat can then be predicted and mapped using this benthos data with the support of environmental data.

6.1 Moroccan legal base for monitoring of coastal zone

The Moroccan legal arsenal has a large number of laws and decrees relating to the management of the environment in general. Several legislative texts, sometimes very old, govern, for example, the maritime public domain, town planning, the conservation of the natural and cultural heritage, fishing, hunting, the exploitation of forests, the creation of national parks, installations classified for environmental protection, etc.

The concept of sustainable development is a widely recognized benchmark today, and Moroccan laws and public policies tend to conform to its principles. The coastal zones are physically and ecologically very

sensitive to the various projects, carries socio-economic stakes, difficult to harmonise, and their development is inspired by a particular concept known as Integrated Coastal Zone Management (ICZM). As a result, Morocco adopted on October 15, 2015, Law No. 81-12 on the littoral, which will help to structure the integrated management of these areas in Morocco

The protection of the littoral in Morocco has remained governed by a plurality of fragmentary texts, which is often very old, non-dissuasive, and applied in a non-coordinated manner by the institutions in charge (Menioui 2007).

To ensure the sustainable development of the littoral, the law on the littoral adopts the basic principles and rules of an integrated management of the coastal zones resulting from international recommendations. Examples include United Nations Conferences on Environment and Development of Rio 1992 and Rio + 20, the 2002 Johannesburg World Summit on Sustainable Development, and regional protocol relating to the Integrated Coastal Zones Management (ICZM) in the Mediterranean, ratified by Morocco on September 21, 2012. Thus, this entered into force effective October 21, 2012 (MEME 2015).

This law sets the fundamental principles of integrated coastal management as a transversal management process involving the simultaneous consideration of different interests in the coast including in particular the systematic consideration of the environment for all decisions affecting this fragile territory (<u>https://www.environnement.gov.ma/fr/lois-et-reglementations/textes-juridiques</u>).

Thus, this law aims to achieve the following objectives (Motib 2020):

- 1. Preserving biological and ecological balances, natural and cultural heritage, historic and archaeological sites, natural landscapes and combating coastal erosion;
- 2. Preventing the struggle, reducing pollution and degradation of the coastline, and rehabilitation of polluted or deteriorated areas and sites;
- 3. Planning, in particular, through a national coastal plan and regional coastal plans that are compatible and in perfect harmony with land use planning documents;
- 4. The involvement of associations, the private sector and the local authorities, concerned in making decisions relating to coastal management;
- 5. The promotion of a research and innovation policy in order to enhance the coast and its resources

In addition, and in order to achieve the objectives of protection, enhancement and conservation of the coastline to guarantee the balance and sustainability of its multiple functions, the law establishes a national commission and regional commissions⁶ with a unifying nature and mobilizer. Thus, this brings together all the national and regional components.

In regard to protection and conservation measures, the law establishes the principle of prohibition to harm the natural state of the seashore. In addition, the law establishes a non-constructible zone, adjacent to the coastline of a width of 100m, calculated from the land limit of this coastline as well as a zone for withdrawal from transport infrastructure with a width of 2000m.

In terms of pollution struggle, the law on the littoral prohibits any discharge causing pollution of the coast and subject to authorization the spill.

⁶ http://www.environnement.gov.ma/fr/134-actualites/1013-adoption-de-la-loi-n-81-12-relative-au-littoral-par-le-parlement

Legal framework	Content
Prime Minister's circular1964	On tourism development. Which led to the creation of the Interministerial Commission for Coastal Tourist Development (CICATEL), which until 2002 was responsible for defining the general policy for tourist and seaside facilities. In particular, investment projects to be carried out within a 5 km strip were subject to the approval of this commission.
Decree of December 6, 1924	Regulation of the extraction of sand
Law no. 99-12, of March 20, 2014	This law relates to the national charter for the environment and sustainable development. This law has stipulated in its article 7 the promotion and protection of marine and coastal ecosystems and the preservation and enhancement of their SIBE.
Law no. 11-03 of May 12, 2003	This law relates to the protection of the environment: AThis law devotes its "section V" to marine areas and resources, including the coastline, providing for the protection of marine areas and resources and the cessation of activities that may alter the quality of waters and resources or harm human health or the fauna, flora, related interests and the marine and coastal environment in general. Article 35 of the same law refers to the integrated management of coastal areas and Article 36 provides for the implementation of legislative and regulatory provisions relating to the development and use of the coastline, the classification of part of the coastline as specially protected areas and the conditions for the use, exploitation and development of coastal resources. Article 57 Law no. 11-03 of May 12, 2003 establishes that the administration set up a national environmental observatory and regional networks of observation, control and continuous monitoring of the quality of the environment.
Law no. 22-07 of July 16, 2010	This law relates to protected areas: the management plan of the protected area should describe the monitoring and control mechanisms, as well as the environmental impact indicators and the estimate of financial needs on a five-year basis

Table 2. Legislation relevant for environmental protection and monitoring.

Legal framework	Content
Law no. 81-12 of July 15, 2015	This law relates to the coast: Article 35 establishes that "bathing water is subject to periodic and regular monitoring with a view to controlling its quality. The Administration classifies the beaches according to the quality of their bathing water on the basis of standards and criteria set by regulation."
Decree no. 2-95-717 of November 22, 1996 Standard 03-7-199 (2014)	This Decree relates to the preparation and the combat against accidental marine pollution: this plan involves the collection of information, directives and instructions necessary for the public authorities to prevent and combat, under the best conditions, any massive marine pollution by oil and other harmful products. This Regulation relates to the management of bathing water
Dahir no. 1-73-255 of 27 chaoual 1393 (November 23, 1973)	This Dahir regulates maritime fishing, with general rules on the exercise of sea fishing, classification of nets, prohibited baits and fishing methods, water pollution, Regulation of the size of the fish caught
Law no. 15-12 of May 12, 2014	This law relates to the prevention and the combat against illegal, unreported and unregulated fishing
Law no. 12-03 of May 9, 2003.	This law relates to environmental impact studies: the administration must take "all necessary measures to ensure that the information and conclusions relating to the environmental impact studies are accessible to the public during the period of the public inquiry, with the exception of information and data which are considered confidential" (Art. 10).
biological rest 1989	allows stocks to recover during the restocking period
law no. 49-17, 3 November, 2020	This law relates to environmental assessment: it establishes the obligation to carry out environmental assessment studies by approved consulting firms and will strengthen the principle of prevention stemming from international environmental law. This law fills the gaps in Law 12-03 of 2003 by providing for Strategic Environmental Assessment,

Legal framework	Content
	Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS) and Environmental Audit. It defines environmental assessment as a study that consists of integrating the environmental and social aspects of a project, plan or programme or public policy, which can be used to evaluate foreseeable impacts and to consider and argue for acceptable solutions.

[i] DRAFT Article 8 MSFD Assessment Guidance, V1.2

6.2 Strategies and Programs involving monitoring in Morocco

To face the threats posed to the sustainability of coastal areas and marine fisheries and to the resulting economic, social and environmental problems, Morocco has put in place development strategies and plans for the sectoral, spatial, and sustainable development of the marine fisheries sector and of the coastline. These are mainly:

- The National Strategy for Integrated Coastal Management which is now in phase 3 relating to the design of this strategy and the development of a cartographic atlas: It sets itself the goal of defining a concerted and shared policy and prospective vision of the Moroccan coastline. The strategy will provide actors with skills on the coastline with the necessary insights for an integrated and territorialized management of the coastline by defining the challenges, goals, appropriate modes of governance and the priorities for the development and integrated planning of this area, by seeking a fair balance between the imperatives of protection and the need to manage it reasonably (National Report 2020⁷ on the implementation of the Sustainable Development Goals by the Kingdom of Morocco)

- **The National Coastal Plan:** it is part of the implementation of the provisions of the law relating to the coastline, concerning the preservation and enhancement of coastal areas. It is broken down into 6 axes and 20 strategic objectives:
 - Strategic axis 1: establish governance of the coastline
 - Strategic axis 2: Develop territorial planning instruments that are compatible with national spatial planning policies and with the objectives and guidelines of the NIP.
 - Strategic axis 3: Protect and preserve the coastal ecosystem against degradation.
 - Strategic axis 4: Ensure better development of the coastline
 - Strategic axis 5: Improve knowledge to guide decision-making towards sustainable coastal development.
 - Strategic axis 6: mobilise and strengthen the capacities of stakeholders to successfully protect and enhance the coastline.
- Integrated Coastal Zone Management (ICZM) in the Oriental region;
- The Coastal Development Program of the central Rif;
- The Oualidia Project;
- Monitoring the quality of bathing water on Moroccan beaches;
- Monitoring of sand (including marine litter) on Moroccan beaches;

⁷<u>https://odd.hcp.ma/Rapport-National-2020-sur-la-mise-en-oeuvre-par-le-Royaume-du-Maroc-des-Objectifs-de-</u> <u>Developpement-Durable_a3109.html</u>

- Monitoring of land-based pollution conveyed to the Atlantic Ocean and the Mediterranean Sea;
- The fight against pollution of the Marchica lagoon;
- The Coastal Protection Program;
- The Master Plan for the Promotion of the Public Maritime Domain; -

- The **Halieutis strategy (2009–2020)**: It is based on three principles, namely sustainability, performance, and competitiveness. To do this, a set of levers have been designed and relate to traceability, skills building, the legal system, governance, and the organization of the sector. This strategy encompasses a multitude of programs and actions, including:

- The national coastal development program;
- The fisheries development plans;
- The "IBHAR" program;
- The satellite positioning and monitoring system for fishing vessels;

- **The National Port Strategy 2030:** It aims to support the development of the national economy by anticipating demand for port infrastructure and by further integrating Morocco into global competitiveness. One of its goals is the strengthening of the adaptive capacity of the port system in order to seize the geostrategic opportunities that the Halieutis strategy offers, in this case the development of sites dedicated to aquaculture

- **Plan Azur 2020** (for coastal development), Legacy & Heritage, Eco & Sustainable Development, Animation, Leisure & Sports, and Domestic Tourism and other niche applications with high added value.

- **Coastal and marine environment monitoring programmes** (National Bathing Water Quality Monitoring Programme, Mediterranean Pollution Monitoring and Assessment Programme (MED POL) National Marine Pollution Emergency Plan (PUN).

- **The Regional Coastal Plan** (*SchémaRégional du Littoral*- **SRL**) for the Rabat-Salé-Kenitra region has been developed with the Technical Assistance of the World Bank in the framework of the Italy-World Bank World Bank Cooperation Programme for the promotion of green and climate change resilient development (AGREED)

- **The regional spatial planning scheme** (schémarégionald'amenagement du Territoire- **SRAT**) aims to reach an agreement between the State and the region on measures for planning and upgrading measures, according to a strategic and prospective vision, so as to enable the definition of regional development and choices for regional development.

Example of Project and Actors:

- The Association for Integrated Resource Management (AGIR), the EU-funded ODYSSEA project's principal Moroccan partner has signed an agreement to establish and run ODYSSEA's Moroccan marine observatory, at the Al Hoceima National Park, an important part of ODYSSEA's pan-Mediterranean platform.
- The agreement was signed between AGIR and Morocco's Waters and Forests Department (Directorate for the North-East Region), the AbdelmalekEssaadi University's Faculty of Sciences and Technology at Al Hoceima, and the Institute for Maritime Fishery Technology at Al Hoceima. It is focused on the establishment, management and functioning of the ODYSSEA marine observatory at the Al Hoceima National Park and its adjacent slice of sea. The observatory and platform will generate and make available real-time physical, chemical and biological data related to the coastal and marine zones of the park (Rapport National 2020 sur la mise en oeuvre par le Royaume du Maroc des Objectifs de Développement Durable)

 the MAVA funded project (MedKeyHabitatProject) where benthic habitats were monitored and mapped⁸

6.3 State of monitoring of CI 15 and CI 1

Monitoring effort for marine and coastal biodiversity in Morocco has increased in recent years. The action plan relating to the National Strategy for the Conservation and Sustainable use of Biodiversity has encouraged the establishment of field studies. This observation activity has developed in particular around marine protected area systems, such as the Al Hoceima National Park (SPAMI since 2009), the Cap des Trois Fourches (Ramsar Site 2005), the mouth of Moulouya (Ramsar Site 2005), SebkhaBouAreg (Ramsar Site 2005), and the Intercontinental Biosphere Reserve of the Mediterranean (recognised in 2006), as well as around the sites being studied in order to be designated as MPAs (LITTOCEAN 2021) like Jbel Moussa (Site d'intérêtBiologique et Écologique).

The National Environment and Sustainable Development Observatory is the main institution responsible for Collecting, processing, analysing and sharing the country's environmental data, and has enabled the development of functional information systems. However, the absence up until July 2020 of a coherent legislative framework on environmental monitoring hindered the development of the monitoring activity (UNECE 2014).

On the Moroccan Mediterranean coast, some vulnerable sites require surveillance and monitoring. These sites are recognized by the national authorities as being of biological and ecological interest, for example: the **Moulouya estuary**, the **coast of Jebha**, **Jbel Moussa**, **Trois Fourches Cap** (Figure 5) and many others. These are sites that risk being affected by new structures, knowing that Cl 15 only concerns new structures that may have an impact on sensitive areas.



Figure 5. Moroccan Mediterranean coast typology and some vulnerable sites (from left to right: Jbel Moussa, Jebha coast, Trois Fourches Cap, Moulouya Estuary).

⁸ http://rac-spa.org/sites/default/files/doc_mkh/morocco/jbel_moussa_cartographie_des_habitats_marins_cles.pdf

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6.4 Data on hydrography and benthic habitats

The Cap des Trois Fourches Site (Figure 6) includes both land and sea areas. Its marine area includes coastal areas of high biological productivity where the diversity of marine habitats (seagrass meadows, detrital or coralligenous among others) benefits local fisheries as nursery or feeding areas. It is also a passage area for marine mammals, in particular the bottlenose dolphin (*Tursiops truncatus*).



Figure 6. Habitat map of the "Cap des trois fourches" (UICN et al. 2014).

The **National Park of Al Hoceima** is located on the Mediterranean Moroccan coast, 150 km east from the Gibraltar Strait, in proximity to the city of Al Hoceima and has a 47 km long coastline.

The area is affected by the surface Atlantic water jet-like flow through the Strait, moving eastward with strong currents and complex dynamics. Alboran basin topography induces anticyclonic gyres. Al-Hoceima is affected by the western Alboran Gyre (WAG) the combination of strong tidal currents at the entrance of the Strait, noticeable winds, mostly strong regional westerlies and easterlies regimes, and the existence of recirculations at both margins of the jet.

The PNAH is an unusual biotope consisting of caves, islets and rocks which host one of the most original biodiversity in the Mediterranean, like rare or threatened species from small invertebrates (giant limpet) to large marine mammals, monk seals and dolphins (fig.7). Also a very rich avifauna Osprey, Bonelli's Eagle, Audouins, the main missions of Al-Hoceima marine observatory included expanding knowledge about the Mediterranean coast of the country, its marine habitats and biodiversity, as well as its physicochemical and marine sediment characteristics, microplastic pollution, marine mammals, acoustics, marine heritage and other assets, bringing all of this together into accessible digital cartography tools.

Much research over the last few decades have focused on defining, locating and understanding the parameters for cetacean critical habitat. Some of these are conventional geographical aspects and others are the more fluid oceanographic parameters such as temperature, salinity and current.



Legend: Critical Cetacean Habitats (orange areas) Pelagos Sanctuary (green area)

Figure 7. Marine protected areas for whales and dolphins in the Mediterranean, 2021 (MAPAMED through MapX)

A selection of studies about hydrographical parameters are compiled in table 2. There are several made by countries on the territorial waters of Morocco (by oceanographic vessels (MARUM-Brenem, Germany (fig.8), from IFREMER Brest, France, from CSIC from Spain...). It would be interesting to get copies of these data to serve as a baseline.



Figure 8. MARUM expeditions' working areas in the last 10 years. https://www.marum.de/en/Research/Expeditions.html

Table 3. Compiled studies about hydrographical parameters in Moroccan Mediterranean Sea

Studies	Monitoring parameters	Data
d'Acremont, E., Lafuerza, S., Rabaute, A., Lafosse, M., Castelot, M. J., Gorini, C., & Ammar, A. (2022). Distribution and origin of submarine landslides in the active margin of the southern Alboran Sea (Western Mediterranean Sea). <i>Marine Geology</i> , 106739.	Bathymetric and seismic epicentral map. Swath bathymetric and seismic reflection coverage of the study area, from CONTOURIBER (2010), Marlboro-1 (2011), Marlboro-2 (2012), SARAS (2012), MONTERA (2012), and INCRISIS (2016) projects and the Fishing General Secretary (Spanish Government) (HR: high resolution; VHR: very high resolution).	<figure><figure></figure></figure>
Clementucci, R., Lafosse, M., Casalbore, D., Ridente, D., d'Acremont, E., Rabaute, A., &Gorini, C. (2022). Common origin of coexisting sediment undulations and gullies? Insights from two modern Mediterranean prodeltas (southern Italy and northern Morocco). <i>Geomorphology</i> , 402, 108133.	Multibeam bathymetric data and high-resolution seismic profiles in the Al-Hoceima Bay were collected during two oceanographic surveys in 2012: the Marlboro-2 and the SARAS surveys (d'Acremont et al., 2014). Multibeam data were acquired using a shallow-water Reson 8101 system during the MARLBORO-2 survey and a Kongsberg EM710 system during the SARAS survey (Fig. 3b). QUINCY and CARAIBES (IFREMER) software were used to process data and generate DEMs; both have a cell size of 5 m and vertical resolution of 0.5 m for water depths below 100 m (MARLBORO-2 survey). The 2D seismic profiles were acquired using a 250–500 J SPARKER source and a six-channel streamer. High-resolution parametric profiles (TOPAS PS18, 15–21 kHz, 32 kW) were also acquired during the SARAS survey. The seismic data were stacked, filtered and migrated using SEISMIC UNIX software and imported into IHS Kingdom software for seismic interpretation.	in the second

Studies	Monitoring parameters	Data
lacono, C. L., Gràcia, E., Ranero, C. R., Emelianov, M., Huvenne, V. A., Bartolomé, R., & Torrent, J. (2014). The West Melilla cold water coral mounds, Eastern Alboran Sea: Morphological characterization and environmental context. <i>Deep Sea</i> <i>Research Part II: Topical Studies in</i> <i>Oceanography</i> , <i>99</i> , 316-326.	Shaded relief bathymetric map of the West Melilla mound area based on data acquired during the MELCOR Cruise-2012. The white dots indicate the location of the CTD casts. The blue dots indicate the location of the seafloor samples collected with a Van Veen grab. The yellow dot indicates the top of the mound where fossil fragments of Madreporaoculata were collected. The red line indicates the track of the ROV dive.	https://doi.org/10.1016/j.dsr2.2013.07.006
Saddik, M., &Zourarah, B. (2013). Assessment of environmental and ecological quality status in the NE of Moroccan Mediterranean coast. <i>Am.</i> <i>Int. J. Res. Form. Appl. Nat. Sci</i> , 13-245.	water physicochemical parameters, sediments analyze, benthic communities and their biological parameters.	Image: constrained of the second of the se
El Mrini, A., Anthony, E. J., Maanan, M., Taaouati, M., &Nachite, D. (2012). Beach-dune degradation in a Mediterranean context of strong development pressures, and the missing integrated management perspective. Ocean & coastal management, 69, 299-306.	Short-term sediment budget determinations were carried out from three topographic surveys conducted on the two selected beach sites of Cabo Negro and KsarRimal (respectively CN and KR in Fig. 1) on 28 February, 06 March and 12 March, 2008 using a TopCon (GTS 225) Total Station, with an accuracy of1 cm. Benchmarks located on the backshore of the survey sites were referenced to the national Moroccan geodesic network. The surveys covered the dune (or remnants thereof on KasarRimal beach) and were extended seaward to a depth of approximately 1 m below mean sea level	<figure><section-header><section-header></section-header></section-header></figure>

Regarding CI 1, there's a major gap in habitat mapping along the Mediterranean coast of Morocco. The

available existing mappings were performed in the framework of projects executed by the SPA/RAC. These are as follows:

1. 2013. Map of benthic habitats between 0 and 40m depth in Cap des Trois Fourches.

2. 2015. Map of benthic habitats between 0 and 40m in JbelMoussa (Strait of Gibraltar, Morocco)

3. 2019. Map of benthic communities in the National Parc of Al Hoceima between 10m and 50m depth.

These studies serve as reference conditions for the Cl 1 (surface area of the key habitats in each site, namely the coralligenous and seagrass meadows).

On the other hand, monitoring surveys of fixed points were installed in the marine part of:

- Jbel Moussa for coralligenous (three points) and Zostera marina meadows (2 points) since 2015.

- National Park of Al Hoceima for coralligenous (three points) and Cymodocea Nodosa Meadows (2 points)

In addition, in the fixed point for coralligenous surveys, data loggers were installed for water temperature measures both in Jbel Moussa and in the National Park of Al Hoceima.

6.4.1 Upcoming infrastructure planned on the Moroccan Mediterranean coast

Mapping of habitats which is made for other indicators (biodiversity clusters) should be coordinated with the issues linked to this objective for economies of scale and consistency. Mapping of existing man-made structures will provide a baseline for the assessment of future measures and their impacts

Morocco has 27 commercial ports that handle 92.3 million tons annually in merchandise traffic. The government's 2030 port strategy intends to dedicate nearly \$7.5 billion to upgrade and expand the 27 ports along the country's Atlantic and Mediterranean coasts in building (fig9-A)⁹, expansion and upgrade work.

⁹https://fr.scribd.com/document/360582047/Atlas-Des-Potentiels-Marins-Et-Cotiers



Figure 9. A: Moroccan Mediterranean harbours, B : Future aquaculture parks, C : Tourism potential map.<u>https://fr.scribd.com/document/360582047/Atlas-Des-Potentiels-Marins-Et-Cotiers</u>

Nador West Med

The port complex of Nador west Med, in the Bay of Bentoya(fig. 10). The 1,520-metre quay is designed to accommodate the largest container ships. This infrastructure, with a cost of 3,200 million dollars, is designed for the transport of energy along the western Mediterranean. When completed in 2024, the port will have tanker facilities capable of storing up to 170,000 tons of oil and chemicals and will be connected to Morocco's new rail transport networks.



Figure 10. Situation of Nador West Med.

New aquaculture sites. Aquaculture is recognized as an important food production sector that contributes to the global economy, food safety and more specifically to rural development in the coastal areas where employment opportunities are often limited (fig.11).

The environmental impacts of aquaculture can include: habitat loss bycatch during collection of wild seed and broodstock, introductions and transfers of species, spread of parasites and diseases, misuse of chemicals, and release of wastes. Local changes in productivity, biodiversity, and behavioural changes of wild fauna are affected by nearby farm habitats.

Silvert (1992) assessed the environmental impacts of marine fish aquaculture and recognized that there are small scale local impacts at a specific farm affecting its immediate environment within 1 km radius (i.e., nearby habitats), and also certain regional impacts, affecting spatial scale of many kilometres on wild populations of marine biota as ecosystem components. Small scale impacts might be related to changes of the seabed biocenosis beneath aquaculture installations, local changes in productivity and biodiversity, behavioural changes of local wild fauna, etc. At the broad spatial scale, aquaculture impacts on marine biota might include genetic changes in wild fish populations due to cultured fish escapement, exploitation of wild populations in capture-based aquaculture, effects on threatened species, and changes in the behaviour of the fisher communities as an integral part of marine ecosystems, etc.



Figure 11. Aquaculture sites. <u>https://anda.gov.ma/</u>

New tourist sites. The Ministry of Tourism's Vision 2020 program aims to double the size of Morocco's tourism industry in terms of number of visitors, foreign exchange earnings, and accommodation capacity, with plans for an additional 200,000 beds (fig. 9-C). American hotels like Hilton, Marriott, and others underway have opened in key tourist cities throughout Morocco. Vision 2020 comprises six specific programs: Plan Azur 2020 (for coastal development), Legacy & Heritage, Eco & Sustainable Development, Animation, Leisure & Sports, and Domestic Tourism and other niche applications with high added value.

Tourism has been gradually recognized as a key economic sector within the UNEP/MAP - Barcelona Convention system with the 1980 Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities identifying tourism as an economic activity to consider when setting priorities for action plans, and the 2015 Sustainable Consumption and Production (SCP) action plan setting a goal-oriented framework to promote sustainable tourism in marine and coastal protected areas in Moroccan Mediterranean sea.

6.5 Centers, institutions and partners for Cl 1 and Cl 15

In relation to the monitoring and assessment needs related with CI 15 Morocco can count on a series of actors, projects and initiatives (table 4).

In Morocco, oceanology research is not yet coordinated and coming under a multitude of departments whose activities often overlap due to the absence of exchange of data and information. However, despite these constraints, many works on coastal environments are carried out in particular in the following research

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institutions: the INRH, the SHOMAR, the IAV Hassan II, the CRTS, the Scientific Institute/UM5, the Institute of Hygiene, LNE, EHTP, LPEE (CEH and CEREP), INAU and all Moroccan universities.

6.5.1 Institutions at national level

The following tables identify the relevant institutions at national level (fig. 12) involved in environmental monitoring, and particularly in monitoring and data management relevant for CI 1 and CI 15.

In addition to the Institutions presented in the Diagram and in the Tables, also the IMAP National Committee is involved in the process (namely Department of Sustainable Development/Ministry of Energy Transition and Sustainable Development).



Figure 12 Institutions at national level involved in environmental monitoring, and particularly in monitoring and data management relevant for CI 1 and CI 15

Governmental Institutions providing data	Role	Monitoring Parameters
Department of Sustainable Development/Ministry of Energy Transition and Sustainable Development	Responsible for the monitoring, development and execution of government policy in the field of the environment and sustainable development	Biodiversity Seabed habitats
Department of Maritime Fisheries/Ministry of Agriculture and Maritime Fisheries	In charge of ensuring the protection and preservation of the marine environment. Within this Department, a research institution, the National	Fisheries Sampling networks which ensure the in-situ collection along the entire Moroccan coast of
	Institute for Halieutic Research (INRH) (see description below) is also responsible for ensuring the continuous monitoring of the state of the marine environment.	robust, quantitative and homogeneous data. Five networks are already functional: - The fishery resources sampling network; - The quality and health of the marine environment network; - The zoo-sanitary network;
	-Marine Protected Areas under the auspices of this department are for the sustainable use of natural marine ecosystems	- The grounding network.
National Ports Agency (ANP)/Ministry of Equipment and Transport.	The body of authority and regulation of the new Moroccan port system set up by Law 15. In charge of Police, safety and environmental protection in the harbour environment	Geophysical study but located only at ports -bathymetry - currents - swell - tides
Ministry of Territorial Planning, Urban Planning	The various urban agencies are responsible, among other things, for carrying out the studies required to draw up the master plans for urban development and for monitoring the implementation of the guidelines defined therein. Several coastal regions have already been the subject of urban development master plans	 coastal master plan Hazards (aptitude maps for urbanisation in the littoral), (seismicity, submersion, tsunami, marine landslides)

Table 4. Administrative bodies involved in monitoring and environmental management in CI1 and CI15 in Morocco.

Governmental Institutions providing data	Role	Monitoring Parameters	
Hydrography Oceanography and Marine Cartography Division/ Royal Navy in Morocco	Mapping, bathymetryThis department has two research vessels and the latest generation equipment for mapping shallow waters	Bathymetry (side scan sonar, Lidar,)	
Ministry of Tourism	In charge of seaside tourism, proposes and implements the national policy for the development of coastal tourist resorts. It also ensures the development of tourism projects integrating the environmental aspect.	Employment and revenue / turnover	
The Mohammed VI Foundation for Environmental Protection	The fundamental mission of the Mohammed VI Foundation for the Protection of the Environment is awareness and education for sustainable development.	Each year, a report is produced on the results of analyses carried out on the various beaches. The statistical processing of the results leads to a classification of the quality of the water according to a grid of the Moroccan standard.	

Environmental advisory bodies

Administrations/departments have multi-sectoral councils that serve as a horizontal platform for reflection and consultation to assist and guide decision-making and the implementation of government actions (Table 5). Those that could be considered here as working in the field of the littoral and coastal environment are:

Environmental advisory bodies	Role
The National Council for the Environment (CNE)	Under the auspices of the Department of Sustainable Development , the CNE includes representatives of all governmental and non-governmental departments that are directly or indirectly concerned with the issue of the environment and sustainable development.
	The CNE's task is to ensure the integration of environmental concerns into economic and social development processes. it is empowered to:
	 guide, animate and coordinate any activity relating to the protection, improvement, management of the environment and the promotion of sustainable development;
	 study and propose to the government all means likely to contribute to the protection and improvement of the environment;
	 ensure that the population is informed and aware and promote their participation;
	 carry out studies on international conventions relating to the environment and their impact at the national level.
The Superior Council for Territorial Planning	The CSAT is the high authority defining the main orientations of the national spatial planning and sustainable development policy and approving the general and sectoral documents relating to spatial planning, at the national and regional levels. It includes, among other things, the Permanent National Commission for Spatial Planning and Sustainable Development, which gives it decision-making power for the implementation of national land-use planning guidelines.

Table 5. Environmental advisory bodies.

Environmental advisory bodies	Role	
The Superior Council for the Safeguarding of Fisheries Heritage	Created in 2000, the CSSPH is set up under the government authority responsible for maritime fisheries. It is in particular responsible for proposing orientations and objectives allowing the rational exploitation of the halieutic heritage for the purposes of economic and social development, and for examining and giving opinions on all questions concerning the safeguarding and exploitation of halieutic resources. national. It includes representatives of the various ministerial departments, chambers of commerce and professional fishing and aquaculture associations, and is made up of sectoral committees and regional councils.	
ESEC The Economic, Social and Environmental Council	The Economic, Social and Environmental Council is an independent constitutional institution, set up by His Majesty King Mohammed VI on February 21, 2011. It carries out advisory missions on major development guidelines, economic and social public policies as well as those concerning sustainable development and advanced regionalization.	

Observatories Role National Environmental Sustainable to collect data and indicators relating to the environment and and Development Observatory Morocco sustainable development from national institutions and specialised of (ONEM)/Department of Sustainable organisations, process environmental data and information, **Development/Ministry of Energy Transition and** initiate and carry out studies and surveys, publish and disseminate Sustainable Development environmental information and promote data exchange and partnership programmes (national, regional and international). National Laboratory for Pollution Monitoring Undertakes studies on pollution at the national level in order to meet the country's needs in terms of analyses, measurements, Studies (LNESP)/Department of Sustainable controls and expertise relating to the environment. **Development/Ministry of Energy Transition** and Sustainable Development (http://www.environnement.gov.ma/fr/bd/bd-onem/9-noncategorise Directorate of Environmental Hygiene and monitoring of pollution of the environment. It has 23 regional **Environmental Protection (DHMPE)/ Ministry of** environmental hygiene laboratories that collect data on **Public Health** atmospheric pollution, noise pollution, chemical pollution, nonionizing waves, ionizing waves, solid waste and the quality of bathing water. It publishes the list of beaches prohibited for swimming due to alarming pollution rates **ODYSSEA AI Hoceima Marine Observatory/** platform for oceanographic information and forecasting over the **ODYSSEA Project** entire Mediterranean basin, from coastal areas to the open sea. ODYSSEA is a platform that will integrate all existing information systems (Copernicus, GEOSS, GOOS, EMODNet, ESFRI, Lifewatch, Med-OBIS, GBIF, AquaMaps, Marine IBA e-atlas, MAPAMED and others) as well as data from 9 observatories Marsad Observatory of the MarchichaNador is a research centre attached to the Pluridisciplinary Faculty of Lagoon Nador. The members of the OLM and the FPN have set as their main concern to study the state of the lagoon, through a multidisciplinary approach. The OLM team's project therefore aims to investigate modern environmental phenomena in order to reestablish and impose the relationship between the NadorMarchica lagoon and its surroundings.

Table 6. Observatories, National agencies involving in monitoring

Research institutions	Role
National Institute for Fisheries Research (Institut National de Recherche Halieutique, INRH)/ Ministry of Agriculture, Maritime Fisheries, Rural Development, Water and Forests	to study the functioning of marine and coastal ecosystems, to monitor the quality and health of the marine environment; to monitor the fishery resources and their exploitation; and contribute to the development of aquaculture. INRH includes 5 regional centres, including 2 on the Mediterranean coast (Tangier and Nador); 1 centre specialising in aquaculture in M; of a fish pathology laboratory in Tangier. This Institute also has the means of intervention at sea for sampling and monitoring the marine environment, including two research vessels.
The Rabat Faculty of Science / Mohammed V University - Centre de Biotechnologies, Biodiversité et Environnement,Laboratoire de Biodiversité, Ecologie et Génome Mohammed V University-Rabat/InstitutScientifique - Département de Zoologie et d'ecologieanimale	 Herbiers de Cymodocea nodosa dans la lagune de Marchica Herbiers de Cymodocea nodosa dans le Parc National d'AlHoceima Herbiers de Zostera marina dans le SIBE de Jbel Moussa Coralligène dans le Parc National d'AlHoceima et Jbel Moussa to study the functioning of marine and coastal ecosystems Biodiversity and habitats
- Département Physique du Globe	Hydrography, marine geophysic (side scan sonar, echosounder, very high resolution marine seismic) Cores, sedimentology, currents
Laboratory of Aquatic Ecology and the Environment University Aïn Chock, Casablanca	Founded in 2005, the Laboratory of Aquatic Ecology and the Environment (Laboratoired'EcologieAquatique et Environnement) of the Hassan II University Aïn Chock, Casablanca, conducts research in the field of ecology, biodiversity and environmental science. The "Biodiversity and Ecosystem Management" team carries out ecological diagnostics and zoning for the development of management plans for coastal wetlands and marine protected areas. -planktonic and nektonic compartments in marine ecosystems.

Table 7. Research institutions involving in monitoring

Research institutions	Role	
	-ecological assessment of the impacts of marine pollution and other disturbances on marine and coastal ecosystems.	
The Tetouan Faculty of Science/AbdelmalekEssaadi University.	The Tetouan Faculty of Science (http://www.fst.ac.ma/site/) was established in 1983. It forms part of the AbdelmalekEssaadi University. Several of its research laboratories, such as the "Ecology, Systematics, Biodiversity Conservation Research Team" (in biology); "Water, Environmental Studies and Analysis" and "Marine eco-toxicology" (in chemistry) lead scientific research in relation with coastal and marine environments. -research on interactions between marine turtles and fisheries	

6.5.2 Institutions at regional level

Regional Observatories for the Environment and Sustainable Development (OREDDs)

The Regional Directorate of the Environment (RDE) established Regional Observatories for the Environment and Sustainable Development (OREDDs) as operational entities within the institutional arrangements at the regional level, under the authority of the OREDD (Table 8). Its mission is to follow the state and evolution of the environment and sustainable development at the regional level, establish a permanent mechanism for the collection, production, analysis, management and dissemination of information on the state of the environment, in order to help decision makers. Of the twelve OREDDs, two are located along the Mediterranean coasts.

Regional agencies	Role
OREDD Oriental	Located in Oujda, the OREDD Oriental shares socio-economic and environmental data relating to sustainable development. Data is accessible through the SIREDD of the Eastern region, created by the Government Secretariat for Sustainable Development (SEDD) with the technical and financial support of Germany (GIZ). The website is accessible (https://siredd.environnement.gov.ma/oriental)

Table 8.	Regional	Agencies	involved	in	monitoring
10010-01	Regional	/ Scholes			

Regional agencies	Role
OREDD Tangier – Tetouan - Al Hoceïma	Established in 2016, its missions are to allow the establishment and management of pollution observation and measurement networks, the implementation and promotion of national, regional and international exchange and partnership programmes in the field of the environment and the establishment and promotion of systems and mechanisms for monitoring and evaluating the state of the environment (indicators, quality objectives, etc.). The website is accessible <u>https://siredd.environnement.gov.ma/Tanger-Tetouan-</u> <u>AlHoceima/Home</u>

6.6 Data availability and data sharing mechanisms

Adequate data availability

In order to be used for assessment of CIs, data should be:

- Available at an appropriate scale
- Comparable throughout the study area and at all times
- interoperable
- Checked, validated...
- Updated
- Available as a time series which often is not the case for tides, storms, sea level.

Results from interviews highlighted that data concerning C15 are not widely available. Only some institutions (HDOC, ANP, DPPMM, ANDA, INRH) are collecting C15-related parameters as current velocity, temperature, salinity, bathymetry, turbidity, waves.

Desk analysis and interviews highlighted that available data suffer from failures:

- Data is partial, punctual (depending on the projects), this is particularly relevant for ecological monitoring of benthic habitats which is performed on a project approach.
- Studies and projects remain fragmentary and do not always meet national needs.
- There is a need for funding regular monitoring of hydrographical changes

In fact, marine observations are costly because they require very important naval means. Moreover, it is often non-reproducible because the sea is a highly variable environment, with very short (waves, tides, etc.) to very long periods (climate change, evolution of species, geology of the soil and subsoil, etc.). The preservation of data from marine observation is an economic factor but also a scientific issue for the reconstruction of time series to illustrate this variability.

Although some information on hydrographical parameters is available through the scientific monitoring carried out either by the National Laboratory of the DDD or through associated research work, there is an increased lack of information and data on the impact of hydrographical disturbances on the environment, particularly on the habitat after the installation of artificial structures. The EIAs offer, in this case, the reference state before the installation of these structures but it is the post-functioning situation that remains devoid of data on the extent of habitats impacted by the installation of new artificial structures. In this context, and in accordance with Law 81-12 on the coastline, the promotion of scientific research is essential for the production of relevant data for the development of conservation and development strategies for the

coastline and its resources (extracted from a focal point IMAP-Hydrography questionnaire).

Data sharing

Data sharing is one of the cornerstones of modern science that enables large-scale analyses and reproducibility. Data sharing is a scientific norm and an important part of research ethics in all disciplines.

Potential barriers were identified and classified in categories: technical, economic, and political. Benefits of data sharing have been widely recognized – transparency and cooperation, reproducibility of research, cost-efficiency and preventing redundancies, acceleration of discovery and innovation.

- Data not Checked, validated
- Data sharing requires time and resources that are chronically lacking in Marine sciences
- Lack of reciprocity. Data sharing practices have not always been fair

Nevertheless, the Moroccan legislation establishes the right to obtain information in accordance with the conditions stipulated, and this has a positive impact on the relationship between citizens and administrations.Law No. 31 of 2013 Relating to the Right of Access to Information. Article 27 of the Moroccan Constitution of 2011 guarantees freedom of access to publicly-held information: "The citizens [...] have the right of access to information held by the public administration, the elected institutions and the organs invested with missions of public service."

Law 31-13 on the protection of the right of access to information was passed in January 2018. This Law contains articles dictating that all Moroccan citizens have the right to access information to ensure transparency, counter corruption, boost the administration's openness, and establish a culture of good governance and democracy. However, implementing texts are not yet in place.

It restricts the right to access publicly held information pertaining to "relations with a third State or international organisation [...] information that could prejudice the ability of the State to manage its monetary, economic and financial policy", or information related to "the deliberations of the Government". The draft also introduces jail penalties against officials who may disclose information that is deemed confidential.

Morocco and UNESCO signed an action plan on the right to access information.

The action plan strives to enable Moroccan citizens to access "detailed and transparent" information.

It also seeks to allow Moroccans to make their own decisions based on accurate data so that they can fully contribute to the democratic process in the country.

In April 2018 Morocco joined the Open Government Partnership (OGP) as part of 70 countries, 20 local governments, and thousands of civil society organisations. The aim of the OGP is to foster principles of transparency, accountability and improved civic participation in policy-making.

Results from interviews highlighted that data gathering from the competent institutions may be challenging. Sometimes in fact, scattered information must be sought in many departments. The problem becomes even more crucial when it comes to accessing certain non-public data, for example remote sensing data. The problem of non-availability of certain data strongly affects the knowledge of hydrographic conditions.

It is also worth noting that without permanent archiving according to established standards, it has been proven that 30% of the data acquired is lost after 10 years¹⁰. The very high cost of the resources at sea used for data acquisition is such that it is essential to implement the means necessary for a good data backup.

¹⁰<u>https://data.ifremer.fr/Tout-savoir-sur-les-donnees/Gestion-des-donnees</u>

Discussion of SPI

Despite a maritime vocation favoured by an exceptional geographical context allowing it to have 2 coastal façades (totalling a length of about 3500 km) on two types of marine domains (Mediterranean Sea, and Atlantic Ocean), insufficiency of an effective policy in the field of marine geosciences. In addition, there is a general lack of knowledge of circulation patterns, functioning and geological characteristics of the substratum.

Integrating a scientific and technical culture into decision-making processes and governance structures is not an easy process. In the case of Morocco, for example, the history of the expansion of a scientific and technical culture is very recent. This is strongly related to a program designed to promote scientific and technical culture introduced in late 2004 by the French Ministry of Foreign and European Affairs (Mikou and Bensalah 2012.The reception of the new hydrographic vessel BHO2M DAR AL BEIDA marks a major step in the development of the HDOC, and will enable it to operate both onshore and offshore.

Based on a five-year action plan developed in 2015, the DHOC continues its surveys and hydro-oceanographic campaigns with a view to not only updating the various nautical works dealing with the Moroccan coasts, but also to increase the rhythm of co-production of marine maps within the framework of the technical arrangement linking it to the Shom.

At the opening of the 2022 United Nations Oceans Conference, held from June 27 to July 1st in Lisbon, Minister of Agriculture, Fisheries, Rural Development and Water and Forests, said in his speech, Morocco has embarked on an ambitious program for the development of the blue economy, aimed at strengthening the integration of its maritime sector strategies around an inclusive, efficient and innovative ecosystem vision. To make these efforts more effective, additional actions have been implemented, such as the "Blue Belt" Initiative initiated by Morocco on the occasion of COP22 of the United Nations Framework Convention on Climate Change, the fight against marine and plastic pollution, the establishment of marine protected areas. Morocco has also enacted a law dedicated to the management of its coastline.

In this report, a first map of existing SPI frameworks and processes in Morocco is presented. Mapping of scientific centres/laboratories, institutions and partners (both on the scientific and policy side) refers to a methodological approach that attempts to conceptualise the institutions related to an issue in a particular place, at a particular time and with a particular objective (in our case for Cl 15 and Cl1). It aims, among other things, to produce an analysis of the functioning of institutions and to assess the interactions of the main actors involved in these institutions. One of its key points is that it identifies influential and important stakeholders in the institutions concerned who may become future partners to work with.

6.7 Scientific gaps and uncertainties for monitoring CI 15

Monitoring of hydrographical conditions is crucial to understand ecosystem status, functioning, and responses to management actions and changes in environmental drivers. The enormous demand for ocean data and information in all sectors (environmental, scientific, academic, private and public), requires a major commitment from all countries to generate and maintain research capacities and infrastructure at all levels, as well as from national institutions in charge of generating knowledge.

Future progress in this area depends heavily on adequate and effective capacity at national level for collecting, updating and publishing the necessary information, as well as systems that provide mapping of technical and human capacities in ocean science.

Monitoring for CI 15

Monitoring can be defined as the systematic, repeated measurement of biotic and abiotic parameters of the marine environment, with predefined spatial and temporal schedule, having the purpose to produce datasets that can be used for application of assessment methods and derive credible conclusions on whether the desired state or target is achieved or not and on the trend of changes for the marine area concerned (Zampoukas et. al, 2014).

The methodology to assess the CI 15 can be divided in three main steps: (i) Baseline hydrographical conditions characterisation (Monitoring and modelling of actual conditions without structure);

(ii) Assessment of hydrographical alterations induced by new structure (comparing baseline conditions and with structure conditions, using modelling tools); and

(iii) Assessment of habitats impacted directly by hydrographic alterations (by crossing hydrographical alterations and habitat maps).

Among hydrographical conditions, at least waves and currents changes should be assessed, with changes in sediment transport processes and turbidity in case of sandy sites, and salinity and/or temperature changes in case of structures that involve water discharge, water withdrawal or changes in freshwater movements.

The monitoring should focus on habitats of interest around new permanent constructions (lasting more than 10 years). At first, the geographical scale (in cross-shore and long-shore directions) to be used should be about 10 to 50 times the characteristic length of the structure, and should be enlarged depending on the first results obtained for this area.

To correctly assess changes in time on habitats induced by constructions, monitoring should be performed: (i) before construction (baseline conditions); (ii) during construction; (iii) and after construction - <u>short term</u> changes 0 to 5 years after (at least yearly up to 5 years), <u>midterm</u> changes 5 to 10 years after (at least biennium to 10 years), and <u>long-term</u> changes (10 to 15 years after construction). UNEP/MAP, 2019

Monitoring for CI 15 focuses on permanent alterations. Although there are discussions and proposed definitions (such as alterations lasting for more than ten years) a fully agreed definition of "permanency" is not available. Hydrographical monitoring should cover both the data to assess related indicators as well as basic hydrographical data reflecting long-term changes in ecosystems for interpreting indicators' results.

Permanent alteration of hydrographical condition can have large scale human activities implemented by infrastructures. they can be generally identified with coastal defence works, damming of large rivers and soil usage related to water abstraction, discharges of salts or warm/cool water by industrial plants, dredging and dumping of dredged materials, land reclamation projects and structures in coastal or open sea, such as wind farms, offshore airports, ocean energy device arrays, large scale aquaculture facilities, fishing and maritime transport (with effects on turbidity) and may permanently influence residual and tidal currents, waves, tides, sediment dynamics, turbidity, salinity, temperature and the seafloor integrity (sediment distribution, bathymetry/topography). That tells how many parameters should be followed to answer the various issues for CI 15 monitoring.

Key Uncertainties and Gaps

According to the report of the 7th meeting of the Coordination Group of the Ecosystem Approach held in Athens on September 9, 2019 "the current common indicator 15 is too complex and not mature enough to be implemented at the Mediterranean scale". The 2017 report of UNEP-MAP relates the great heterogeneity in the results of implementation of this indicator at the European level and the difficulty of homogenising the approaches of this implementation.

In Morocco, even when there is awareness that a project for a new structure is underway and that an impact study has to be carried out, information about whether these structures have (or have not) identified the parameters for monitoring the CI15 is not available. These parameters are numerous, quite expensive to assess and little or not known by the investor.

There are general difficulties linked to this indicator, valid for the Moroccan context and far beyond:

1. Lack of coherence in definitions, standard approaches in the development and application of indicators and in the assessment of impacts, together with lack of methodological standards.

2. Lack of knowledge and understanding on the link between physical pressures and biological impacts and on the cumulative impacts.

3. Another difficulty comes from the hydrographical alterations CI 15 indicator should assess. These alterations, around a particular coastal construction, often change in intensity, in area and indeed in time, depending on the off-shore hydrographical conditions (calm weather/extreme event; seasonality of waves height and directions; local wind conditions...) and on the morphologic history of the site (the present state is due to the succession of these different conditions).

So, an in-depth study to define which hydrographical conditions and temporal scale have to be undertaken to assess hydrographical alterations by numerical modelling have to be carried out.

4. Like everywhere, there is certainly a lack of physical characteristics data in the Mediterranean Sea (bathymetric data, seafloor topography, current velocity, wave exposure, turbidity, salinity, temperature, etc.), that will be the main issue to implement this indicator, in particular to define the baseline conditions. To identify these lacks, a global and clear inventory of existing and available data in the Mediterranean Sea should be done.

Nevertheless, data can be collected from regional models (bathymetry, hydrodynamics, salinity, temperature). These data with coarse resolution will need to be refined close to the location of the new structure.

Baseline characterisation importance

From the outset, it is important to recognise the linkage between the two phases of data collection and the importance of appropriate baseline characterisation. If the baseline provides insufficient coverage, the subsequent monitoring may have limited value. Similarly, the baseline surveys should be repeatable so that meaningful comparison with any subsequent surveys (i.e. during construction/ operation etc.) can be undertaken. (UNEP(DEPI)/MED WG.411/3)

Physical and biogeochemical processes

Gaps remain in predictive modelling of deep ocean temperature and salinity measurements for sea level and closure of the energy budget, and oxygen and carbon measurements dense enough to measure deoxygenation of the world ocean and track the mechanisms driving the ocean carbon cycle.

Numerical models

Other difficulties come from the use of numerical models to assess hydrographic alterations before the structure is built. These tools need substantial data (bathymetry, offshore hydrodynamics data, field data); which can be costly and time-consuming; and their use requires experience and knowledge about the processes and theories involved¹¹. In the context of numerical modelling, two main spatial scales are considered:

o Near-field, i.e. the area within the immediate vicinity of the development ;

o Far-field, e.g. the coastline, non-immediate areas of scientific and conservation interest.

Modelling may be a costly endeavour, requiring specific scientific expertise and computational capacities.

First improvements to address gaps

- In some cases, rapid progress can be made to address knowledge gaps. Efforts to coordinate future projects and data collection around CI 15 in a more sophisticated way will help to increase the possibilities of data use and intercompatibility.
- Communication between scientists through publications, modern social media, international projects and symposia is and will be important. Building integrated, interdisciplinary communities of modellers, field observers, and remote sensing research is a critical component of future efforts. Models can be used to inform observational strategies. The observations can then be used to improve parameterizations used in models. This approach is necessary in order to develop a new generation of creative marine scientists, developing projects to address crucial gaps of knowledge.
- ICZM in morocco is well developed and can provide a framework for the management of the coast.
 ICZM seeks to balance environmental, economic, social, cultural and recreational objectives over the long-term, all within the limits set by natural dynamics. The three main pillars of ICZM frameworks are defined as a) institutional, b) socio-economic and c) biophysical environment (World Bank Group 2012). The assessment of the biophysical environment takes into account the hydrographical conditions, as well as the ecosystem components. In this respect, a direct link to the scope of CI 15 in morocco can be made.

6.8 Barriers and opportunities of the science-policy interface for CI 15 in Morocco

BARRIERS

From the interviews the identification of the internal gaps at national level that act as barriers to SPI processes, in relation with Cl 15, and which impact decisions have been identified.

Barriers related to Communication

- 1. IMAP is not known outside the close circle of the national EcAp Focal Points (the institutions do not know IMAP). Apart from the Department of Sustainable development, all the other institutions have never heard of the IMAP project, despite it being already ten years since it started.
- 2. Inappropriate communication procedures (Lack of communication between institutions)
- 3. Each IMAP cluster (biodiversity, pollution, hydrography) has a focal point. However, due to the lack of communication between these focal points, it was decided to appoint a coordinator in the person

¹¹<u>https://www.medqsr.org/key-messages-ci15</u>

of the director of LNESP in 2021.

- 4. Dealing with wider audiences and divergent viewpoints: Improved outcomes come from engaging policy-makers who hold significantly divergent viewpoints on the importance of the environment, but whose decisions influence environmental outcomes, for example officials in economics ministries
- 5. Data providers disseminate research in the form of reports, through scientific papers, and through symposia and meetings. Raw data are seldom available,

Barriers related to Governance

- 1. Monitoring of the coastal area for the topics of coastal hydrography are under the responsibility of different ministries.
- 2. There is a lack of efficient communication between science and policy making
- 3. There is no national institution specifically dedicated to monitoring of the marine environment
- 4. Each institution deals exactly only with what is assigned to it per statute.
- 5. Duplication of effort is common

Barriers related to Legislation

- 1. Difficulty in operationalizing the existing legislative and regulatory framework.
- 2. Several laws suffer from the absence of implementing texts.
- 3. There is no national strategy for monitoring CI 15.

As part of a recommandation, legislation and all these decision-making bodies not need to be obviously a sum and juxtaposition of legislative, regulatory texts and Norms, but a global approach which invites reflection, particularly on the constitutional level and which opens the way to new fields for the strategic and forward-looking action, in an area as vital and, problematic as Marine Environment in Morocco.

Barriers related to Data acquisition

The lack of appropriate data for assessing Cl 15 can be linked to the following factors:

- 1. Lack of skills in hydrography. Data monitoring and data analysis is paramount in virtually every industry. Institutions need skilled employees, who can acquire, organize and analyze data to give them meaningful insight. The lack of local postgraduate programmes in marine sciences was a strong barrier for the creation and expansion of marine research in Morocco. Indeed, the community of marine geologists representing only 3.8% of the national scientific potential (Hamoumi, 2021)
- 2. Lack of capacity and facilities. In marine science, identified capacity building needs include development of skills, infrastructures, technology transfer, and access to data. A particular need exists in relation to the introduction of new principles for management, such as the precautionary approach and ecosystem-based management.
- 3. Gaps in data monitoring.
 - a. Duplication of effort is common: Data monitoring must be agreed between the partners
 - b. Heterogeneous methodologies, tools and protocols of monitoring (in terms of harmonization and standardization of risk-based and analytical monitoring protocols).

- c. Impact assessment studies due before future infrastructure implantation must be based on real investigations and not only on the bibliographic basis
- 4. Lack of funding or limited financial resources for data collection and monitoring programmes. Research in marine and coastal sciences (Integrated Coastal Zone Management (ICZM),) for long periods has been dependent on foreign funding (donors, ...). Foreign funding, while valuable, does not promote an overall national research portfolio geared towards addressing national research priorities. Accordingly, whilst providing critical support and often strong catalytic inputs, this funded research contributions often do not fill research gaps since they are driven by their own priorities rather than specific national goals and needs. Support through the European Commission funded projects e.g. IMAP-MPA and ECAP MED and from UNEP/MAP coordination of projects' activities have provided significant support to address in some aspects this gap.

Other different barriers can be identified as:

- The inclusion of non-scientific or unstructured 'informal' expertise and knowledge can account for a large part of the knowledge gap. It often offers a way to address an issue that would otherwise not be feasible within specific societal settings. Local knowledge is both complex and inherently contextual, and a rigorous and comprehensive investigation and interpretation of local knowledge is needed to fully understand it in its own right.
- Very long processes.... or the political context for science-policy activity has changed: decisions are urgent, uncertainty is high and political will can fluctuate rapidly.

Barriers related to Data sharing

- 1. Data providers disseminate research in form of reports, through scientific papers, and through symposia and meetings (fig. 13),
- 2. Institutions have all specified that the data can only be used after 1-2 years.... This is a very long time, especially in terms of impact
- 3. Difficult access to scientific knowledge



Figure 13. Data sharing process for CI15 in Morocco

OPPORTUNITIES

1- Opportunity to do so is to elaborate Strategic Action Programme for marine sciences in Morocco

2- Initiate a process of collaboration between and with national institutions: Motivation and commitment to collaboration

3- Develop opportunities to train national staff with the necessary skills to carry out monitoring under IMAP: Attracting Young People and Skilled Workers

4- Create a long-term national oceanographic programme to monitor Moroccan waters in order to complete the picture of the state of the Western Mediterranean

5- Using existing data as a start baseline

6- Successful awareness raising campaigns can open windows of opportunity for policy influence to be taken advantage of to effectively and efficiently transform science-policy interfaces.

7- Create a kind of scientific watch or alert to capture all scientific work on C15.

FINAL CONSIDERATIONS REGARDING STRENGTHENING OF GOVERNANCE

In some governmental institutions (INRH, ANDA, ANP...), and in particular kinds of research, there is a direct linkage between the production of knowledge and its application (fig.14).

Management authorities in the region often meet their knowledge needs by commissioning tailor-made studies.

However, there are also a number of institutions producing unsolicited research that could contribute to coastal and marine management but there are no formal mechanisms that could be used to channel them through (as universities...).



Figure 14. Solicited/Unsolicited Research.

The report of the 7th meeting of the Ecosystem Approach Coordination Group held in Athens on 9 September 2019 (UNEP-MAP, 2019) highlighted that "the current common indicator 15 is too complex and not mature enough to be implemented in a timely manner at the Mediterranean scale". The 2017 UNEP-MAP report shows the great heterogeneity in the results of the implementation of this indicator at European level and the difficulty of homogenising the approaches to this implementation. These difficulties are reflected in the Moroccan situation as well.

The link between the authorization procedures of new structures (EIA procedures) and monitoring of CI 15 is missing. Decision makers do not check such aspects and experts preparing EIA are most probably not aware of assessment requested under CI 15. The CI15 parameters are indeed numerous, quite expensive to carry

out and little or not known to the investor.

For the main structure set up in recent years and which is still under construction, in this case the port of Nador West med, those in charge have invested significant means to compile or produce the hydrodynamic and hydrological information necessary for a better visibility of the functioning of the ecosystem and the preparation of a monitoring programme. Nevertheless, those responsible for this and future projects may not be sufficiently informed about this indicator, but they often have a significant amount of information to be able to implement it, at least in part.

The integration of this indicator and its systematic application suggests a better appropriation and control of this indicator on a national scale, a better homogenisation of the approaches to its use and, perhaps better still, that it be integrated as an element of the EIA of marine and coastal development projects, knowing that between hydrographic, hydrological, sedimentological and biological parameters, it is difficult to choose between the nature, usefulness, relevance, frequency, etc. of the measures to be taken into account, depending on the nature of the project.

7 Preliminary ideas for strengthening SPI in Morocco

Based on the analysis of the interviews responses, a provisional list of gaps to be filled in order to strengthen the science-policy interface as a priority for a better implementation of the IMAP-CI 15 was drawn up. The existing literature highlights that the influence and impact of science is highly dependent on how scientific information is perceived, especially on whether the information presented is perceived to be credible, relevant and legitimate (Cash et al., 2003).

Strengthening communications issue

Having a regular communication plan and pattern is key for establishing trust and credibility. When issues come up, the need to communicate and reach out to the entire team becomes even more critical. All projects require sound communication plans, but not all projects will have the same types of communication or the same methods for distributing the information. The communication management plan documents how the communication needs of the stakeholders will be met, including the types of information that will be communicated, who will communicate them, and who will receive them; the methods used to communicate; the timing and frequency of communication; the method for updating the plan as the project progresses, including the escalation process; and a glossary of common terms.

Considering the Moroccan context and the discussions with experts and institutions, it's necessary to improve the communication by on CI 15:

- information needs to be packaged in an easily digestible form and presented to recipients in a way that makes them care about the issue and relate it to citizen lives (this would also help fostering ecosystem sustainability and community resilience)

- mechanisms to promote science-based management and decision-making should include working groups, forums and roundtables, where decision-makers and key stakeholders are engaged collectively. However, many of these mechanisms are short-lived if not supported by long-term commitment by stakeholders, or government institutions, and backed up by sufficient resources.

- Multi-stakeholder think tanks

Many researchers and scientists do not understand policy-making processes, which contribute to a disconnection between the scientific and policymaking communities. Scientists often conceive the link between science and policy as a one-way flow of information in which scientists convey scientific 'truth' to drive the development of policy. Similarly, the outputs provided by scientists are often in a form that is not readily assimilated by decision-makers. Conversely, policy-makers expect science to provide definite answers and a full cost analysis of the implications of decisions (Figure 15).



Figure 15. Link between science and policy. Source: Zhanyun Wang, 2019.

Strengthening Governance and Legislations issues

- Need to create an ocean Mediterranean governance framework and especially a CI15 governance.
- Need to have a single reference institution in marine science, responsible for CI 15
- Need to think about national strategy for monitoring the CI 15
- avoid laws that are highly sectoral in nature;
- combating the lack of a statutory authority to integrate and coordinate efforts;
- correct the fragmentation of statutory authority where it exists.

Strengthening data issue

- Data monitoring must be agreed between the partners
- Data should flow easily
- Need to manage the delay between the monitoring and the sharing of the data (1-2 years is too long)

8 Infographics

Infographic 1 - Barriers to SPI process in relation to CI 15 in Morocco



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Infographic 2 - Opportunities for SPI process, in relation with CI 15 in Morocco





Infographic 3 - Frame for action for SPI process in relation with CI 15 in Morocco

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Annex 1: Involved institutions

Institutions contacted for participating in interviews

Institution	Division/Coordination Unit			
La Marine Royale	Division Hydrographie, Océanographie Et Cartographie			
Ministère de l'Equipement et de l'Eau	Direction des Ports et du Domaine Public Maritime			
Département des Eaux et Forêts	Parc National d'AlHoceima / Partie Marine			
Institut National de Recherche Halieutique, INRH	L'Institut National de Recherche Halieutique, INRH-			
	-ObservatoireMarsad de la LaguneMarchicaNador			
Fondation Mohammed VI pour la protection de l'Environnement	Pole ocean			
Centre Royal de TélédétectionSpatiale (CRTS)	-			
AgenceNationale de Développement de l'Aquaculture (ANDA)	-			
AgenceNationale des Ports (ANP)	-			
Office National des Pêches (ONP)	-			
Observatoire Marin d'AlHoceima ODYSSEA	-			
1. Société Nationale des Etudes pour le Détroit	-			
2. Département des Eaux et Forêts	Division des Parcs et RéservesNaturelles			
3. Direction de la Marine Marchande	Division de la Sécurité de la Navigation et Prévention de la Pollution par les Navires			
Direction Régionale de l'Environnement de l'OrientalDépartement du Développement Durable, Ministère de la Transition Énergétique et du Développement Durable.	ObservatoireMarchicaNador			
Département du Développement Durable	Direction des Programmes et des Réalisations - Service du Littoral			
Département du Développement Durable	Direction des ChangementsClimatiques, de la Biodiversité et de l'ÉconomieVerte - Service de la Préservation de la biodiversité			
Département du Développement Durable	Laboratoire National des Etudes et de la Surveillance de la Pollution			
Département du Développement Durable	Service de la Planification de la Coordination Interministérielle			
Département du Développement Durable	Service de Bases des DonnéesEnvironnementales			
Département du Développement Durable	Service de l'Observation de l'Etat de l'Environnement			
Département du Développement Durable	ObservatoireRégional de l'Environnement et du Développement Durable de Marchica - Nador			

Annex 2: Template used for interviews

Interview about data collection and sharing relevant for IMAP Common Indicators CI 1 and CI 15

English version

Interview date

Interviewer name

Interviewee name

Institution

Email

Telephone

A. Data collection/production

• Are you/your institution involved in production of data relevant for Common Indicator 1 Habitat distributional range (Ecological Objective 1) to also consider habitat extent as a relevant attribute

Such data are:

- i) The use of condition indices and a representative sampling and assessment in a restricted number of areas with subsequent extrapolation into the larger area
- ii) Modelling habitats and mapping against impacts and spatial pressure intensity data.
- iii) Direct monitoring of habitats
- Are/is you/your institution involved in production of data relevant for Common Indicator 15 Location and extent of habitats potentially impacted by hydrographic alteration (Ecological Objective 7)

Such data are:

- i) Baseline hydrographical conditions characterisation (monitoring and modelling);
- ii) Assessment of hydrographical alterations induced by new; and
- iii) Assessment of habitats impacted directly by hydrographic alterations.
- If yes, what data do you provide/collect (parameter name, area, frequency)?
- What are the major scientific/technical challenges you encounter in collecting data and producing knowledge for CI1 and CI15 (e.g. lack of instruments/tools, unavailability of funds, lack of skills, etc)?
- Evaluation of hydrographic conditions and/or monitoring of benthic habitats and alterations requires long-term monitoring and study. What are the major problems affecting this long-term activity? How can they be solved?

B. Data sharing

- Do you/your institution make such data available?
- Raw data publicly available (how, where)
- Data publicly available as reports (how, where)
- Products other than reports (e.g. maps) based on collected data are publicly available (how, where)
- Raw data are provided to the institutions that make a request (how, where)
- We contribute to national reporting under IMAP by drafting reports (how)
- We have established agreement for data exchange with the national institution acting as IMAP focal point (how)
- If your institution **does not regularly share data** on Cl1 and Cl 15, what are the main reasons?
- If your institution regularly shares data on CI 1 and CI 15, what are the main drivers and benefits?
 - How long does collected data take to be made available?
 - Less than 6 months
 - From 6 months to one year
 - From 1 year to 2 years
 - More than 2 years
 - Are there any terms of use of such data? What are they?
 - No terms of use
 - Embargo (how long)
 - Other agreements

C. Policy / Governance / Legislation - related issues

• Are there any policy-related barriers affecting your activity? e.g. lack of a clear legislative framework, limited coordination with institutions and stakeholders in general, lack of a policy-oriented mandate (i.e. data are mainly collected for scientific purposes and not for operational scopes, including EIA)?

Entretien sur la collecte et le partage de données pertinentes pour les indicateurs communs IMAP CI 1 et CI 15

Version française

Information générale

Date de l'interview Nom de l'interviewer

Nom de la personne interviewée

Institution

Email

Téléphone

A. Collecte/production de données

• Êtes-vous/votre institution impliquée dans la production de données pertinentes pour le suivi de l'indicateur commun 1 - aire de répartition de l'habitat (objectif écologique 1) afin de considérer également l'étendue de l'habitat comme un attribut pertinent ?

CesDonnéesSont :

- i) L'utilisation d'indices d'état, d'un échantillonnage et d'une évaluation représentatifs dans un nombre restreint de zones, avec une extrapolation ultérieure dans une zone plus vaste.
- ii) Modélisation des habitats et cartographie fonction des impacts et des données sur l'intensité de la pression spatiale.
- iii) Suivi / surveillance direct des habitats
- Votre institution participe-t-elle à la production de données pertinentes pour l'indicateur commun 15 - Localisation et étendue des habitats potentiellement touchés par l'altération hydrographique (objectif écologique 7) ?

CesDonnéesSont :

- i) Caractérisation des conditions hydrographiques de base (surveillance et modélisation);
- ii) L'évaluation des altérations hydrographiques induites par les nouvelles ; et
- iii) Évaluation des habitats directement touchés par les modifications hydrographiques.
- Si oui, quelles sont les données que vous fournissez/collectez (nom du paramètre, zone, fréquence)
 ?
- Quels sont les principaux défis scientifiques/techniques que vous rencontrez dans la collecte de données et la production de connaissances pour l'IC1 et l'IC15 (par exemple, manque d'instruments/outils, indisponibilité de fonds, manque de compétences, etc.)
- L'évaluation des conditions hydrographiques et/ou la surveillance des habitats benthiques et des altérations nécessitent une surveillance et une étude à long terme. Quels sont les principaux problèmes affectant cette activité à long terme ? Comment peuvent-ils être résolus ?

B. Partage de données

- Est-ce que vous/votre institution rendez ces données disponibles ?
- Données brutes accessibles au public (comment, où)
- Données Accessibles au public sous forme de rapports (comment, où)
- Les produits autres que les rapports (par exemple les cartes) basés sur les données collectées sont disponibles publiquement (comment, où)
- Les données brutes sont fournies aux institutions qui en font la demande (comment, où).
- Contribution aux rapports nationaux dans le cadre de l'IMAP en rédigeant des rapports (comment)
- Etablissement d'un accord d'échange de données avec l'institution nationale faisant office de point focal IMAP (comment)
- Si votre institution **ne partage pas régulièrement les données** sur Cl1 et Cl 15, quellesensont les principales raisons ?
- Si votre institution **partage régulièrement des données** sur le Cl 1 et le Cl 15, quels sont les principaux moteurs et avantages ?
- Combien de temps faut-il pour que les données collectées soient disponibles ?
- Moins de 6 mois
- De 6 mois à un an
- De 1 an à 2 ans
- Plus de 2 ans
- Existe-t-il des conditions d'utilisation de ces données ? Quelles Sont-elles ?
- Pas de conditions d'utilisation
- Embargo (combien de temps)
- Autres accords

C. Politique / Gouvernance / Législation - questions connexes

Existe-t-il des obstacles liés aux politiques qui affectent votre activité ? Par exemple, l'absence d'un cadre législatif clair, une coordination limitée avec les institutions et les parties prenantes en général, l'absence d'un mandat orienté vers les politiques (c'est-à-dire que les données sont principalement collectées à des fins scientifiques et non pour des champs d'application opérationnels, notamment d'EIE) ?